WICHITA STATE UNIVERSITY

Program Review Self-Study

Academic unit: Aerospace Engineering

College: Engineering

Date of last review: Fall 2015

Date of last accreditation report (if relevant): Summer 2014

List all degrees described in this report (add lines as necessary)

Degree: BS Aerospace Engineering CIP* code: 14.0201

Degree: MS Aerospace Engineering CIP code: 14.0201

Degree: PhD Aerospace Engineering CIP code: 14.0201

*To look up, go to: Classification of Instructional Programs Website, http://nces.ed.gov/ipeds/cipcode/Default.aspx?y=55

Faculty of the academic unit (add lines as necessary)

Name	Signature
Brandon Buerge	
Animesh Chakravarthy	
Atri Dutta	
Klaus Hoffmann	
Nicholas Smith	
Suresh Keshavanarayana	
Linda K. Kliment	
Roy Myose	
Michael Papadakis	
Syed Raza	
Kamran Rokhsaz	
Elizabeth Rollins	
Bhisham Sharma	
James E. Steck	
Chidhar Yang	

Submitted by: _____ Date: April 2, 2018

(L. Scott Miller, Professor & Chair)

1. Departmental purpose and relationship to the University mission (refer to instructions in the WSU Program Review document for more information on completing this section).

a. University Mission:

The mission of Wichita State University is to be an essential educational, cultural, and economic driver for Kansas and the greater public good.

b. Program Mission (if more than one program, list each mission):

Undergraduate Program

The mission of the Aerospace Engineering undergraduate program is to:

- Prepare students for careers in aerospace engineering, related fields, and for continued study
- Engage in high-quality teaching, research, scholarship, and service to the benefit of students, faculty, industry, government, and society

Graduate Program

The mission of the Aerospace Engineering graduate (MS & PhD) program is to:

- Prepare students for careers in aerospace engineering and related fields, for further graduate studies, and to work in research organizations and universities

c. The role of the program (s) and relationship to the University mission: Explain in 1-2 concise paragraphs.

Undergraduate Program

The role of the Aerospace Engineering undergraduate program is:

- To provide an education that will, within a few years after graduation, assure program alumni are dependable, productive professionals using learned engineering principles to successfully satisfy employer needs in aerospace engineering or related fields in Wichita and the global community
- To provide an education that will, within a few years after graduation, assure program alumni successfully complete (if desired) advanced degrees in aerospace engineering or related fields

Graduate Program

The role of the Aerospace Engineering graduate program is:

- To provide comprehensive educational opportunities in an urban setting, through teaching and scholarship and to seek to provide its graduates with the educational and cultural tools they need to thrive in a complex world
- To advance the University's goals of providing high quality instruction, making original contributions to knowledge and human understanding through research and publications
- To be the provider of advanced education in aerospace engineering, contributing to the Kansas economy and the broader community

d. Has the mission of the Program (s) changed since last review? ☐ Yes ☒ No
   i. If yes, describe in 1-2 concise paragraphs. If no, is there a need to change?

At this time, undergraduate and graduate program reviews suggests there is no need to change the program mission.

e. Provide an overall description of your program (s) including a list of the measurable goals and objectives of the program (s) (programmatic). Have they changed since the last review?
☐ Yes ☒ No

If yes, describe the changes in a concise manner.

Undergraduate Program Description

The undergraduate Aerospace Engineering (AE) BS degree includes 135 credit hours of required course work. The program is designed such that students can complete a degree in 4-years.

The program has been developed and refined over time by department faculty, most of who have considerable academic and industrial experience. Input from constituents (i.e., students, employers, alumni, etc.) has also been used to further refine the curriculum content.

To ensure the program educational objectives are achieved, the department has structured its curriculum and other educational opportunities to lead students to the outcomes required for successful entry into engineering practice or further study at the graduate or professional level. These same outcomes provide the graduate with a sound foundation for subsequent career development and success in the engineering profession.

Specifically, mathematics, statistics, and science courses in chemistry and physics provide basic knowledge required for understanding and analyzing engineering systems. Subsequent studies in materials science, aerodynamics, structures, propulsion, and aircraft stability and control enable the graduate to apply engineering principles to create, analyze and improve aerospace processes, devices, and systems to meet customer needs.

Design and other open-ended problems assigned to students throughout the curriculum help students develop sound engineering judgment. The design experience is distributed throughout the curriculum and culminates in the senior year two-semester capstone design courses. The principal purpose is to integrate material, covered by earlier individual courses, into an aerospace vehicle design process.

Finally, the social science and humanities courses students select assist them in developing an understanding of the societal context in which they will practice engineering. This experience includes issues related to environmental, legal, aesthetic, and human aspects of an engineering project.

Furthermore, all students must take a general education Issues and Perspectives course in “Professional and Ethical Issues in Engineering.” This course was designed by the WSU Department of Philosophy. As a result, ethics, professionalism, life-long learning, and societal perspectives of engineering projects are complimented in the engineering curriculum.

A notable number of AE students participate in the cooperative education program, working locally or out of town. Not surprisingly, the NASA Research Center tours are the most popular. Additionally, many

students work with faculty on research projects or with the WSU National Institute for Aviation Research (NIAR) in their laboratories. Obviously, such experiences dramatically compliment the student's education.

The AE department meets standards established by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (simply called "ABET").

ABET requires accredited undergraduate programs to utilize a comprehensive process of continuous improvement. Programs must establish clear objectives, quantifiably measure progress, achieve minimum outcomes, and effectively identify changes as needed to improve the program. Constituent (i.e., students, alumni, industry, graduate programs, etc.) needs are paramount within the effort.

Accreditation reviews involve generation of a comprehensive self-study document and a campus visit by a qualified team of evaluators. At minimum, programs seeking accreditation are reviewed every 6-years. The WSU AE program completed an ABET visit in the fall of 2013. The EAC ABET reported on their review in the summer of 2014. The AE program received full accreditation.

Specific measureable objectives and outcomes directly related to the program are evaluated regularly and externally reviewed during the ABET accreditation cycle. The AE Program Educational Objectives (PEOs) are:

- Within a few years after graduation program alumni are dependable, productive professionals using learned engineering principles to successfully satisfy employer needs in aerospace engineering or related fields in Wichita and the global community.
- Within a few years after graduation program alumni successfully complete advanced degrees in aerospace engineering or related fields.

Interestingly, these objectives are not static. Department faculty utilizes program-related input, from students, employers, and graduates, to regularly review the Program Educational Objectives. Hence, a mechanism to change or update the PEOs exists. The current PEOs were updated in 2014.

The following AE undergraduate program outcomes are central to measuring success in meeting the PEOs. Graduating students are expected to clearly demonstrate:

a. An ability to apply knowledge of science, mathematics, and engineering;
b. An ability to design and conduct experiments, as well as to analyze and interpret data;
c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
d. An ability to function on multi-disciplinary teams;
e. An ability to identify, formulate, and solve engineering 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 engineering solutions in a global, economic, environmental, and societal context;
i. A 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 engineering tools necessary for engineering practice.

The above outcomes are evaluated utilizing a variety of methods related to the following:

- Department assessment exam
- Co-Op employer survey
- Course exams and rubrics

Additional and more detailed information on the assessment methods, results, and program changes will be provided in other sections of this self-study.

Undergraduate Program Goals and Objectives Changes
There have been no changes to the program's goals or objectives.

Graduate Programs Description
The Department of Aerospace Engineering offers Master of Science (MS) and Doctor of Philosophy (PhD) degrees in the following areas of specialization:

- Aerodynamics and Fluid Mechanics
- Structures and Solid Mechanics
- Flight Dynamics and Controls
- Multi-Disciplinary Design, Analysis, and Optimization

There are three MS degree program options available, with the following requirements:

- Thesis Option - A minimum of 24 credit hours of graduate course work plus 6 credit hours of thesis
- Directed Project - A minimum of 30 graduate credit hours of course work plus 3 credit hours of directed project
- Non-Thesis Option - A minimum of 33 credit hours of graduate course work plus an exit exam over the core courses in the major

A Direct to PhD option was developed in 2017. It was recently approved and started in Spring 2018. This degree path will allow qualified students to enter the PhD track without a MS degree. It is hoped that this option will assist the department in boosting PhD program enrollment.

The PhD degree program requires a proper breadth of course work. The Plan of Study includes at least 15 hours in the student's major field and 18 hours outside the major area. The 18 hours must include a minimum of six hours in a minor area (defined by the advisory committee) and a minimum of six hours of mathematics/statistics. The PhD Plan of Study normally contains about 60 hours of course work, including any courses from a master's degree, and should have a minimum of 60 percent of the hours (24 dissertation hours included) beyond any master's level work at the 800-900 level or equivalent.

The MS & PhD programs strive to achieve an acceptable placement rate within one year of graduation either in jobs or in graduate programs for further study.

Graduate Program Goal and Objectives Changes

There have been no changes to the program's goals or objectives.

Facilities, Equipment, Resources, and Services

The AE department (not counting the NIAR) is well equipped with a range of academic focused facilities and equipment, including:

- Three large wind tunnels, including a 3x4-foot low-speed, 4x4-inch supersonic, and a 9x9-inch supersonic
- A 2x3-foot water tunnel
- An aerospace structures lab, with three MTS machines (5, 20, and 55kip)
- A projects and prototyping lab
- A controls lab
- An astronautics lab
- A propulsion lab, with an instrumented jet engine
- A flight simulation lab
- A structural acoustics lab

The undergraduate and graduate programs include academic content that exploit opportunities afforded by these labs. Clearly, the best way to learn and to grow as a student is by actually doing engineering.

Until the spring of 2017 the department provided fundamental engineering mechanics courses for other College of Engineering programs. Previously all undergraduate engineering students, except for Computer Science and Engineering Technology, took AE 223 Statics. Mechanical Engineering (ME) and Industrial and Manufacturing Engineering (IME) students also took AE 333 Mechanics of Materials and all ME students took AE 373 Dynamics.

Starting in Spring 2017, only AE, Biomedical, and ME students will continue taking AE 223. Only AE and ME students will continue taking AE 333 and only AE students will continue taking AE 373. These changes might affect course Rubric/Exam based assessment results, especially in AE 373.

2. Describe the quality of the program/certificate as assessed by the strengths, productivity, and qualifications of the faculty in terms of SCH, majors, graduates, and scholarly/creative activity (refer to instructions in the WSU Program Review document for more information on completing this section).

Scholarly Productivity	Number Journal Articles		Number Presentations		Number Conference Proceedings		Performances			Number of Exhibits		Creative Work		No. Books	No. Book Chaps.	No. Grants Awarded	$ Grant Value
	Ref	Non-Ref	Ref	Non-Ref	Ref	Non-Ref	*	**	***	Juried	****	Juried	Non-Juried				
2015	13		36	22	23										2	21	$1.66M
2016	7		27	25	15										3	9	$1.29M
2017	12		37	33	24										2	7	$1.36M

* Winning by competitive audition. **Professional attainment (e.g., commercial recording). ***Principal role in a performance. ****Commissioned or included in a collection.

- Provide a brief assessment of the quality of the faculty/staff using the data from the table above and tables 1-7 from the Office of Planning Analysis as well as any additional relevant data. Programs should comment on details in regard to productivity of the faculty (i.e., some departments may have a few faculty producing the majority of the scholarship), efforts to recruit/retain faculty, departmental succession plans, course evaluation data, etc.

  Provide assessment here:

  Scholarly Productivity
  Overall, department faculty remain very productive, generating a wide range of publications and in securing external funds via grants. Obviously, some faculty are more prolific or play stronger roles in certain areas. Indeed, it's significant to note that one senior faculty member's research efforts have continued to drop in anticipation of a change in status and eventual retirement. This adjustment is significant, since the individual faculty member previously accounted for $2-4M in external funding each year.

  The table above omits a significant item. Specifically, many of the department's grants require extensive amounts of reporting. This is especially the case for industry and government lab related work. Progress and final report preparation represents a notable faculty responsibility and effort. Sadly, compared to journal articles, contract reports are often times significantly larger, more detailed, and very time-consuming to prepare. Faculty submitted thirty-eight contract reports during the three years noted in the table above.

  It's important to note that three senior faculty are within fives years of retirement.

  Student Credit Hour (SCH) Production
  The following table outlines fiscal year totals and course-level distributions of Student Credit Hour (SCH) production. The data shows a slight decline in 2016, but the rate of decline decreased on 2016-2017.

Course Level	2015	2016	2017
Total	6,951	6,089	5,928
100-299	1,280	1,452	1,470
300-499	2,159	1,636	1,623
500-699	1,831	1,493	1,508
700-799	1,398	1,131	924
800-899	206	322	257
900-999	97	55	146

  The following table outlines total and course-level distributions of Student Credit Hour (SCH) production at fall census day. Again, a decline in 2016 was observed, but the rate of decline decreased from 2015 to 2016. Data for 2017 was not available at this writing.

Course Level	2014	2015	2016
Total	3,479	2,860	2,717
100-299	663	711	638
300-499	1,105	683	711
500-699	860	690	725
700-799	729	582	432
800-899	83	170	158
900-999	39	24	55

Additionally, the above tables show that our doctoral program, characterized by 800+ level classes, is on the path to recovery after steadily declining for a few years.

The following table outlines Student Credit Hour (SCH) production among department instructional faculty on November employee census day. Data for 2017 was not available at this writing.

Employee Type	2014	2015	2016
Program Total	2,200	2,856	2,601
Tenure Eligible	2,200	1,923	1,848
Non-tenure eligible	0	933	729
Lecturers	0	0	24
GTA	0	0	0
Unclassified Professionals	0	0	0
Classified Staff	0	0	0
GSA, GRA, UG students	0	0	0

The following table outlines instructional FTE employed on November 1st census day. Data for 2017 was not available at this writing.

Employee Type	2014	2015	2016
Program Total	10.7	12.7	14.8
Tenure Eligible	10.7	9.7	11.5
Non-tenure eligible	0	3.0	3.0
Lecturers	0	0	0.2
GTA	0	0	0
Unclassified Professionals	0	0	0
Classified Staff	0	0	0
GSA, GRA, UG students	0	0	0

The above two tables show that:

- Tenure eligible faculty carried the bulk of the teaching load over this period
- The increase in the number of tenure-eligible positions was due to filling some vacant slots
- The department added three non-tenure-track engineering educators in 2015

The following table outlines Student Credit Hour (SCH) by FTE for university instructional faculty on November 1st census day. Data for 2017 was not available at this writing.

Employee Type	2014	2015	2016
University Level Total	222	213	216
Tenure Eligible	195	183	194
Non-tenure eligible	304	296	295
Lecturers	292	264	254
GTA	183	192	184
Unclassified Professionals	101	94	114
Classified Staff	114	61	0
GSA, GRA, UG students	0	0	0

The following table outlines Student Credit Hour (SCH) by FTE for college division instructional faculty on November 1st census day. Data for 2017 was not available at this writing.

Employee Type	2014	2015	2016
College Level Total	331	332	346
Tenure Eligible	221	221	248
Non-tenure eligible	595	590	627
Lecturers	451	497	407
GTA	n/a	n/a	n/a
Unclassified Professionals	225	229	208
Classified Staff	105	110	0
GSA, GRA, UG students	0	0	0

The following table outlines Student Credit Hour (SCH) by FTE for program instructional faculty on November 1st census day. Data for 2017 was not available at this writing.

Employee Type	2014	2015	2016
Program Level Total	205	225	176
Tenure Eligible	205	198	160
Non-tenure eligible	n/a	311	243
Lecturers	n/a	n/a	96
GTA	n/a	n/a	n/a
Unclassified Professionals	0	n/a	0
Classified Staff	0	0	0
GSA, GRA, UG students	0	0	0

The following table outlines program majors (including double majors) on fall census day. Data for 2017 was not available at this writing.

Student Class	2014	2015	2016
Total	527	476	488
Freshmen	105	103	106
Sophomore	68	65	72
Junior	66	56	70
Senior	153	126	119
Masters	120	112	106
Doctoral	15	14	15

The following table outlines program degree production by fiscal year

Degree Level	2015	2016	2017
Total	90	66	74
Doctoral	5	3	1
Masters	22	7	29
Bachelor	63	56	44

Data in these two tables (above) show that:

- The decrease in masters degrees in 2016 was an anomaly
- The doctoral program is declining in size by graduating more students than it recruits
- The total number of degrees awarded is increasing, owing to the masters program

3. **Academic Program/Certificate: Analyze the quality of the program as assessed by its curriculum and impact on students for each program (if more than one). Attach updated program assessment plan (s) as an appendix (refer to instructions in the WSU Program Review document for more information).**

a. For undergraduate programs, compare ACT scores of the majors with the University as a whole.

Mean ACT Scores	2014	2015	2016
University level	23.1	23.0	23.1
Program majors	26.1	26.2	26.2
Program majors count	219	182	189
Reporting ACT	113	92	84
Percent reporting	51.6%	50.5%	44.4%

Based on WSU Office of Planning and Analysis data, admitted aerospace engineering undergraduate students have ACT scores that are higher than those of the university. Data for 2017 was not available at this writing.

b. For graduate programs, compare graduate GPAs of the majors with University graduate GPAs.

Mean GPA	2015	2016	2017
University level	3.5	3.5	3.5
Program majors	3.3	3.3	3.5
Program majors count	106	84	81
Reporting GR gpa	39	35	28
Percent reporting	36.8%	41.7%	34.6%

Based on WSU Office of Planning and Analysis data, admitted aerospace engineering graduate students now have the same GPA (3.5) as that of the university.

c. Identify the principal learning outcomes (i.e., what skills does your Program expect students to graduate with). Provide aggregate data on how students are meeting those outcomes in the table below. Data

should relate to the goals and objectives of the program as listed in 1e. Provide an analysis and evaluation of the data by learner outcome with proposed actions based on the results.

In the following table provide program level information. You may add an appendix to provide more explanation/details. Definitions:
Learning Outcomes: Learning outcomes are statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire in their matriculation through the program (e.g., graduates will demonstrate advanced writing ability).
Assessment Tool: One or more tools to identify, collect, and prepare data to evaluate the achievement of learning outcomes (e.g., a writing project evaluated by a rubric).
Criterion/Target: Percentage of program students expected to achieve the desired outcome for demonstrating program effectiveness (e.g., 90% of the students will demonstrate satisfactory performance on a writing project).
Result: Actual achievement on each learning outcome measurement (e.g., 95%).
Analysis: Determines the extent to which learning outcomes are being achieved and leads to decisions and actions to improve the program. The analysis and evaluation should align with specific learning outcome and consider whether the measurement and/or criteria/target remain a valid indicator of the learning outcome as well as whether the learning outcomes need to be revised.

Learning Outcomes (most programs will have multiple outcomes)	Assessment Tool (e.g., portfolios, rubrics, exams)	Target/Criteria (desired program level achievement)	Results	Analysis
Undergraduate Program Outcome a: An ability to apply knowledge of science, mathematics, and engineering;	- Department Assessment Exam - Co-Op Employer Survey - Course Rubrics/Exams	- An average score of 3.0, out of 5.0, is set as the target for all assessment tools.	- The average assessment exam score is 3.1, above the target outcome. - The Co-Op Employer Survey average score (3.6) exceeds the target value. - The average course Rubric/Exam score is 3.5 All courses except for AE 373 exceed the target level.	- Course changes, placing a stronger emphasis on learning fundamental engineering mechanics concepts, in AE 223 Statics, AE 333 Mechanics of Materials, and AE 373 Dynamics were implemented. - As of Spring 2017, AE 373 is now only taken by AE students. This has resulted in a dramatic change (improvement) in the number of D/W/F grades. We anticipate a Rubric/Exam score that will exceed the target within a year.
Undergraduate Program Outcome b: An ability to design and conduct experiments, as well as to analyze and interpret data	- Co-Op Employer Survey - Course Rubrics/Exams	- An average score of 3.0, out of 5.0, is set as the target for all assessment tools.	- The Co-Op Employer Survey average score (3.4) exceeds the target value. - The average course Rubric/Exam score is 3.0 The AE 628 value (2.5) is below the target value.	- No program changes are needed. - Refresher exercises on data reduction and analysis have been added to the content of AE 628.
Undergraduate Program Outcome c: An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	- Co-Op Employer Survey - Course Rubrics/Exams	- An average score of 3.0, out of 5.0, is set as the target for all assessment tools.	- The Co-Op Employer Survey average score (3.1) exceeds the target value. - The average course Rubric/Exam score is 3.7 All courses exceed the target level.	- More experiences related to directly applying program course content have been added.
Undergraduate Program Outcome d: An ability to function on multi-disciplinary teams	- Co-Op Employer Survey - Course Rubrics/Exams	- An average score of 3.0, out of 5.0, is set as the target for all assessment tools.	- The Co-Op Employer Survey average score (3.5) exceeds the target value. - Course Rubric/Exam scores meet or exceed the target value.	- No program changes are needed.

Undergraduate Program Outcome e: An ability to identify, formulate, and solve engineering problems	- Department Assessment Exam - Co-Op Employer Survey - Course Rubrics/Exams	- An average score of 3.0, out of 5.0, is set as the target for all assessment tools.	- The average assessment exam score is 0.2 below the target outcome. - The Co-Op Employer Survey average score (3.5) exceeds the target value. - The average course Rubric/Exam score is 2.9. Values for AE 223, AE 373, AE 502, and AE 528/628 were below the target.	- Course changes, placing a stronger emphasis on learning fundamental concepts, in AE 223 Statics, AE 333 Mechanics of Materials, and AE 373 Dynamics were implemented and will continue. - A series of separate studies are continuing to identify student and instructional issues in AE 223. - As of Spring 2017, AE 373 is now only taken by AE students. This has resulted in a dramatic change (improvement) in the number of D/W/F grades. We anticipate a Rubric/Exam score that will exceed the target within a year. - Multiple functional area (e.g., aerodynamics, structures, S&C, propulsion, & data reduction/analysis) assignments have been added to AE 528/628 to refresh student skills.
Undergraduate Program Outcome f: An understanding of professional and ethical responsibility	- Co-Op Employer Survey - Course Rubrics/Exams	- An average score of 3.0, out of 5.0, is set as the target for all assessment tools.	- The Co-Op Employer Survey average score (3.6) exceeds the target value. - Course Rubric/Exam scores meet or exceed the target value.	- No program changes are needed.
Undergraduate Program Outcome g: An ability to communicate effectively	- Co-Op Employer Survey - Course Rubrics/Exams	- An average score of 3.0, out of 5.0, is set as the target for all assessment tools.	- The Co-Op Employer Survey average score (3.6) exceeds the target value. - The average course Rubric/Exam score is 2.7 All classes but AE	- No program changes are needed. - Increased attention will be placed on improving code documentation skills within AE 227.

			227, with a score of 2.3, exceeded the target value.	
Undergraduate Program Outcome h: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	- Co-Op Employer Survey - Course Rubrics/Exams	- An average score of 3.0, out of 5.0, is set as the target for all assessment tools.	- The Co-Op Employer Survey average score (3.0) exceeds the target value. - Course Rubric/Exam scores meet or exceed the target value.	- No program changes are needed.
Undergraduate Program Outcome i: A recognition of the need for, and an ability to engage in life-long learning	- Co-Op Employer Survey - Course Rubrics/Exams	- An average score of 3.0, out of 5.0, is set as the target for all assessment tools.	- The Co-Op Employer Survey average score (3.2) exceeds the target value. - Course Rubric/Exam scores meet or exceed the target value.	- No program changes are needed.
Undergraduate Program Ou**tcome j**: A knowledge of contemporary issues	Co-Op Employer Survey - Course Rubrics/Exams	- An average score of 3.0, out of 5.0, is set as the target for all assessment tools.	- The Co-Op Employer Survey average score (3.2) exceeds the target value. - Course Rubric/Exam scores meet or exceed the target value.	- No program changes are needed.
Undergraduate Program Outcome k: An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	- Co-Op Employer Survey - Course Rubrics/Exams	- An average score of 3.0, out of 5.0, is set as the target for all assessment tools.	- The Co-Op Employer Survey average score (3.4) exceeds the target value. - The average course Rubric/Exam score is 3.5 All classes but AE 227 and AE 528/628, exceeded the target level.	- No program changes are needed. - AE 528/628 students are now <u>required</u> to utilize higher-order analysis tools (e.g., VSPAero, Empirical Drag Prediction methods, CATIA, etc.) for preliminary design. - An increased emphasis is now placed on results validation in AE 528/628, utilizing experimental data and fundamental methods.
Graduate Program Competency in the area of specialty	- Passing core classes in areas of specialty	- 100% must comply.	- 100% complied.	- No program changes are needed.
Graduate Program Competency in graduate level mathematics	- Passing one graduate level class per degree in mathematics/statistics	- 100% must comply.	- 100% complied.	- No program changes are needed.
Graduate Program Ability to perform independent research	- Successful preparation of theses, dissertations, or directed project reports	- More than 90% must comply.	- 100% complied.	- No program changes are needed.

d. Provide aggregate data on student majors satisfaction (e.g., exit surveys), capstone results, licensing or certification examination results (if applicable), employer surveys or other such data that indicate student satisfaction with the program and whether students are learning the curriculum (for learner outcomes, data should relate to the outcomes of the program as listed in 3c).

Student Satisfaction

The following data, from the WSU Office of Planning and Analysis, outlines undergraduate and graduate student satisfaction, as measured at the end of program exit. This table shows that both undergraduate and graduate aerospace student satisfaction levels are higher than those of the college of engineering and the university.

Group	2015	2016	2017
University Undergraduate	80.9%	80.7%	82.3%
College of Engineering Undergraduate	73.5%	68.1%	70.4%
Aerospace Engineering Undergraduate	89.2%	80.0%	83.9%
University Graduate	84.9%	85.4%	82.9%
College of Engineering Graduate	91.3%	87.0%	84.6%
Aerospace Engineering Graduate	96.9%	88.0%	86.7%

Learner Outcomes (e.g., capstone, licensing/certification exam pass-rates) by year, for the last three years				
Year	N	Name of Exam	Program Result	National Comparison±
1		Not applicable to aerospace engineering		
2				
3				

Learning the Curriculum

Assessment efforts, outlined above in section 3c, include results for the capstone two-semester design class and Co-Op employer surveys. Although the assessments and evaluations focus most on changes needed to improve the program, it is important to recognize how well the undergraduate students are learning the curriculum.

Undergraduate students did very well in nine of the eleven desired program outcomes. As noted, only two outcomes spurred program changes. Specifically, faculty efforts to help students learn fundamental engineering mechanics concepts better and to provide more high-level experiences directly applying program content have been emphasized and continued.

e. Provide aggregate data on how the goals of the WSU General Education Program and KBOR 2020 Foundation Skills are assessed in undergraduate programs (optional for graduate programs).

Outcomes: ○ Have acquired knowledge in the arts, humanities, and natural and social sciences ○ Think critically and independently ○ Write and speak effectively ○ Employ analytical reasoning and problem solving techniques	Results	
	Majors	Non-Majors
These goals/skills are assessed directly or indirectly within the department's established AE undergraduate program assessment activities (see section 3c above)	See section 3c above for AE results	

Note: Not all programs evaluate every goal/skill. Programs may choose to use assessment rubrics for this purpose. Sample forms available at: http://www.aacu.org/value/rubrics/

f. For programs/departments with concurrent enrollment courses (per KBOR policy), provide the assessment of such courses over the last three years (disaggregated by each year) that assures grading standards (e.g., papers, portfolios, quizzes, labs, etc.) course management, instructional delivery, and content meet or exceed those in regular on-campus sections.

Provide information here:

Not applicable

g. Indicate whether the program is accredited by a specialty accrediting body including the next review date and concerns from the last review.

Provide information here:

Undergraduate Program

The undergraduate program meets standards established by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET), simply called "ABET."

ABET requires accredited undergraduate programs to utilize a comprehensive process of continuous improvement. Programs must establish clear objectives, quantifiably measure progress, achieve minimum outcomes, and effectively identify changes as needed to improve the program. Constituent (i.e., students, alumni, industry, graduate programs, etc.) needs are paramount within the effort.

Accreditation reviews involve generation of a comprehensive self-study document and a campus visit by a qualified team of evaluators. At minimum, programs seeking accreditation are reviewed every 6-years. The WSU AE program completed an ABET visit in the fall of 2013. The EAC ABET reported on their review in the summer of 2014.

The undergraduate program received full accreditation, with no weaknesses or concerns. ABET identified the following as program strengths:

- "*Faculty members are especially responsive to the continuous improvement process, conducting specially designed quantitative and qualitative assessments designed to improve as well as to develop the program in new directions*."

- "*Numerous laboratories provide student with opportunities to experience hands-on learning and to develop skills for engaging in innovative approaches to problem solving. Among the laboratories are low velocity and supersonic wind tunnels, water tunnels, a structural testing laboratory, a flight simulation laboratory and several research laboratories including the nationally-recognized NAIR 7x10-foot low-speed wind tunnel*."

The next ABET visit is scheduled for fall of 2019.

Graduate Program
The Higher Learning Commission (HLC) accredits the graduate program.

h. Provide the process the department uses to assure assignment of credit hours (per WSU policy 2.18) to all courses has been reviewed over the last three years.

Provide information here:

Undergraduate & Graduate Programs
In the process of developing a new course, faculty proposes assignment of credit hours on the Curriculum Change Form, which is submitted to the Department Chair and a Department Curriculum Committee. These participants verify the credit hour assignment using criteria outlined in WSU policy.

Existing courses are regularly evaluated within the ABET assessment and evaluation process. Indeed, each course has a designated Coordinator who is responsible for making sure all aspects of the established course are consistently delivered and assessed.

Courses and/or academic work are scheduled in a way that conforms to the credit hour definitions. Faculty also provides sufficient information and detail in syllabi to establish the minimum amount of work expected of students.

i. Provide a brief assessment of the overall quality of the academic program using the data from 3a – 3e and other information you may collect, including outstanding student work (e.g., outstanding scholarship, inductions into honor organizations, publications, special awards, academic scholarships, student recruitment and retention).

Provide assessment here:

Undergraduate Program
The overall AE undergraduate program quality is high. However, there is always room and a desire to improve. A number of positive undergraduate program changes have been implemented over the last three years, directly as a result of assessment activities. The following summarizes changes, items of concern, and related observations:

- A strong emphasis on fundamental engineering mechanics concepts continues in AE 223 Statics, AE 333 Mechanics of Materials, and AE 373 Dynamics
- Improvements in AE 223 and AE 333 student performance has been elusive, despite course, instructional, and content changes

- Interestingly, a separate study of 160 AE 223 students and 250 AE 333 students provides insight into other factors that might be in play. Specifically, the typical AE 223 and AE 333 student is:
    - Enrolled in 14 credit hours/semester (equivalent to about 35 hours/week of time)
    - Working part-time job for 14 hours/week
    - Spending 15 hours/week on other activities (e.g., 5.3 hours/week of extracurricular activity, 4.1 hours/week of driving, and 5.5 hours/week on household chores/childcare)
- This situation translates to the equivalent of 64 hours/week, assuming the student attends class
- For the surveyed average course load (14 credit hours) students should be spending another 28 to 42 hours/week studying
- As a result of these observations, it is probable that the average AE 223 and AE 333 student is simply overloaded with outside of class commitments and is not studying enough
- There have been notable improvements in AE 373 (the course is no longer one of the university's highest D/W/F courses)
- The flight structures course sequence's (AE 525/625) weekly recitation sessions and Wingbox competition allow students to practice more real-life course content application
- The capstone design course sequence (AE 528/628) students continue to improve in overall quality, given the sustained use of hands-on activities (e.g., Bronze Propeller competition)
- Interestingly, the program's use of hands-on activities facilitate identification of undergraduate program issues
- Weaknesses recognized in assessments center most around the high-level application of science/math/engineering principles (Outcome a) and an ability to identify/formulate/solve engineering problems (Outcome e)
- It's critical to note that these outcome concerns center most on the application of concepts at a higher-level, beyond the basics
- Undergraduate students are meeting all basic outcome expectations
- Functional area assignments were added to the AE 528/628 courses to help students practice the application or extension of basic skills to higher-level problems
- Improvements in demonstrated high-level skills will make good students even better
- A new Projects and Prototyping Lab was established in the Experiential Engineering Building, expanding opportunities for further student hands-on activities
- Additional equipment (e.g., a numerically controlled foam cutter and a battery analyzer) and more aircraft components (TX/RX, servos, motors, batteries, etc.) were added to streamline student vehicle and wind tunnel model construction
- A dedicated department structures lab, containing three MTS testing machines, a small whiffletree-testing fixture, and related instrumentation was established
- Other student project work areas have been significantly expanded and improved (e.g., WH 221; WH 07; SSWT; 3x4 wind tunnel lab; & flight simulation)
- The new controls lab, in the Experiential Engineering Building, is being used to reinforce academic content and experiences in AE 607 Flight Control Systems. Students are now implementing autopilot systems, with actual flight demonstrations.
- Department support for extracurricular experiential learning opportunities continue (e.g., the Bronze Propeller competition, Wingbox Competition, AIAA Design/Build/Fly team, the Rocket Club, and the Near-Space Launch Program). Airbus and Boeing, respectively, now sponsor the Wingbox and Bronze Propeller competitions.

- In response to high student interest, the department hired an astronautics focused faculty member who is expanding course, hands-on, and research opportunities for students
- Also in response to student and industry interest (specifically from GE Aviation), the department is considering expanding course, hands-on, and research opportunities for students in the applied propulsion area
- Some minor changes were made in course prerequisites to minimize bottlenecks to degree completion
- The department has devised a plan to offer a critical structures course twice a year, versus the current fall only offering – this could noticeable assist students with graduating sooner
- The department chair continues to meet with more than seventy Campus Visitors a year in an ongoing effort to sustain and improve recruiting (visitor surveys indicate the visits are extremely effective)
- The WSU NASA Jump Start Fellowship Program continues to create opportunities for new freshmen or transfer students to get valuable experience working with faculty or in campus labs (e.g., 7x10-ft wind tunnel)

Graduate Program

The overall quality of the graduate (MS & PhD) program is high. Specifically:

- 100% of the students passed the core courses in their areas of specialty
- 100% of the students showed competency in at least one graduate level class per degree in mathematics/statistics
- 100% of the graduates showed the ability to perform independent research by preparing, theses, dissertations, or final project reports.
- All graduates, who could be tracked, were employed by the local and national industry or continued with their studies for a higher graduate degree.
- A new direct to PhD option has been developed and approved, to start in Fall 2018. It's hoped that this opportunity will increase the number of graduate students pursuing a PhD

4. Analyze the student need and employer demand for the program/certificate. Complete for each program if appropriate (refer to instructions in the WSU Program Review document for more information on completing this section).

a. The following table summarizes program undergraduate and graduate application, admittance, and enrollment data for three years. This table shows that greater than 97% of undergraduate students applying are admitted and that approximately 38% of admitted students enroll in the program. Approximately 57% of the students who apply to the graduate program are admitted and around 48% enroll in the program.

Group	2015	2016	2017
Undergraduate Applicants	294	350	382
Undergraduate Admitted	290	338	370
Undergraduate Enrolled	142	133	141
Graduate Applicants	186	172	147
Graduate Admitted	111	88	84
Graduate Enrolled	70	44	40

The following table summarizes percent Under-represented Minority (URM) enrollment data for both the undergraduate and graduate programs over the last three years. This table shows that the percentage of minorities at the junior and senior levels, as well as among masters students, is on a slow rise. Data from 2017 was not available at this writing.

Group	2014	2015	2016
Freshman & Sophomores	13.9%	15.5%	10.1%
Juniors & Seniors	9.1%	8.2%	10.6%
Masters	5.0%	7.1%	8.5%
Doctoral	0.0%	7.1%	6.7%

The following table summarizes the percent of program degrees conferred for Under-represented Minority (URM) students over the last three years. This table shows approximately 9% of the degrees conferred were for Under-represented Minority (URM) students. Sadly, no URM MS or PhD students graduated in the same time period.

Group	2015	2016	2017
Bachelor	11.1%	5.4%	6.8%
Masters	9.1%	0.0%	3.4%
Doctoral	0.0%	0.0%	0.0%

b. Utilize the table below to provide data that demonstrates student need and demand for the program.

Employment of Majors*							
	Average Salary	Employ-ment % In state	Employment % in the field	Employment: % related to the field	Employment: % outside the field	No. pursuing graduate or profes-sional educa-tion	Projected growth from BLS** Current year only.
Year 1	~$112K	~25%	~70%	~10%	~5%	~15%	
Year 2	~$112K	~25%	~70%	~10%	~5%	~15%	
Year 3	~$112K	~25%	~70%	~10%	~5%	~15%	-2%

* May not be collected every year

** Go to the U.S. Bureau of Labor Statistics Website: http://www.bls.gov/oco/ and view job outlook data and salary information (if the Program has information available from professional associations or alumni surveys, enter that data)

- Provide a brief assessment of student need and demand using the data from tables 11-15 from the Office of Planning and Analysis and from the table above. Include the most common types of positions, in terms of employment graduates can expect to find.

  Provide assessment here:

  Undergraduate Program
  AE undergraduate enrollments and the industry demand for quality graduates appear steady. The US labor data suggests a negative 2% rate of employment growth for AE's.

  Most AE students take traditional engineering positions, especially in structures and testing areas. Interestingly, students are often hired at higher levels because of WSU's Cooperative Education program, on-campus research activities, and AE's hands-on learning focus. Their prior work and project experience proves very valuable.

  Graduate Program
  The need for engineering students with graduate degrees is strong. Industry interest in employee development is a major driver. Additionally, many of our graduate students are working to better position themselves, through graduate education, to work in a competitive environment.

  Most of the MS and PhD students take on more advanced engineering positions or advance in-grade, especially in structures and testing areas. Employment data for Program Graduate Degree Recipients from 2015 through 2017 are summarized below.

Graduate's Location	Number
Wichita Aerospace Industry	
Airbus	0
Textron Aviation	4
Spirit AeroSystems	3
NIAR	3
Consulting Companies	3
Other Aerospace Industry	8
Air Force/Navy/Army	2
Non-Aerospace Industry	2
Academia – Faculty Positions	1
Doctoral Programs	4

  This table shows that not only the local aerospace industry hires out graduate degree recipients, but they are also employed nationally. Most graduates work for the aerospace industry or pursue graduate studies, consistent with the program mission. Of those with unknown whereabouts, almost all are international students who left the Wichita area after the completion of their degrees.

5. **Analyze the service the Program/certificate provides to the discipline, other programs at the University, and beyond. Complete for each program if appropriate (refer to instructions in the WSU Program Review document for more information on completing this section).**

a. Provide a brief assessment of the service the Program provides. Comment on percentage of SCH taken by majors and non-majors, nature of Program in terms of the service it provides to other University programs, faculty service to the institution, and beyond.

Provide assessment here:

The following table outlines data on Student Credit Hour (SCH) production. Total and program graduate values have slowly decreased for the past three years. Undergraduate levels have been essentially level. Non-program majors account for most of the decrease. Data from 2017 was not available at this writing.

Major & Student Level SCH	2014	2015	2016
Total	3,479	2,860	2,717
Program Undergraduate Majors	1,815	1,555	1,649
Program Graduate Majors	626	543	483
Non-program Majors	1,038	762	585

This data suggest a few trends. Specifically, it appears the undergraduate program SCH growth rate observed years ago has moderated. Perhaps as a result of an improved economy, the graduate program SCH production is dropping. It may be that fewer students are attending graduate school since the job market has improved and jobs are easier to find with a BS degree.

6. Report on the Program's/certificate's goal (s) from the last review. List the goal (s), data that may have been collected to support the goal, and the outcome. Complete for each program if appropriate (refer to instructions in the WSU Program Review document for more information on completing this section).

(For Last 3 FYs)	Goal (s)	Assessment Data Analyzed	Outcome
	Attract, retain, and graduate more top-quality undergraduate students	ACT scores for entering students	Even with a slow program enrollment growth, the average ACT scores and GPA have remained nearly constant.
	Improve the quality of graduating undergraduate students	The outcomes assessment tools and data noted in the above section are utilized	We continue to make improvements in a few areas, including especially in upper-level courses, in the application of math/science and in identifying/formulating/solving engineering problems.
	Attract and retain more full-time graduate students	Graduate student enrollments	We are not meeting our goals, for a few potential reasons. First the economy has improved the job market. Many BS graduates simply elect not to attend graduate school. Competition with other programs is also keen; many offer students substantially larger assistantships.

7. Summary and Recommendations

a. Set forth a summary of the report including an overview evaluating the strengths and concerns. List recommendations for improvement of each Program (for departments with multiple programs) that have resulted from this report (relate recommendations back to information provided in any of the categories and to the goals and objectives of the program as listed in 1e). Identify three-year goal (s) for the Program to be accomplished in time for the next review.

Provide assessment here:

The Aerospace Engineering undergraduate and graduate programs fulfill the mission and goals of the university, college, and department. The following outlines program strengths; weaknesses; opportunities; threats; resource needs; and recommendations:

- The undergraduate and graduate programs are of high quality, enrollment is steady, and we are meeting department/college/university goals
- A direct to PhD option was recently added (starting in Spring 2018), with hopes to boost PhD enrollment

- Incoming undergraduate student GPA and ACT scores are as good or better than the university average
- Program SCH production is steady
- The undergraduate and graduate programs enjoy good reputations
- Students, alumni, and employers rate the programs and students highly
- The addition of six new labs in the Experiential Engineering Building (EEB) has had a dramatic impact on the program, the increased space for hands-on activities and resources are most appreciated
- Undergraduate engineering core course changes and the expansion of experiential learning opportunities continue to favorably impact the undergraduate and graduate programs
- Our ability to connect with, properly prepare, and advise incoming freshmen students has been dramatically diminished (this could have retention effects)
- Attempts to engage new freshmen have been disappointing, they wont attend well-advertised social or advising related events hosted by the department
- We are considering the addition of a zero-credit hour freshmen colloquium course, with the intent to increase contact and to assure students are starting the program properly
- Unfortunately, staffing and supporting a new zero-credit hour colloquium course will be extremely difficult
- Sophomore and higher-level class sizes have improved notably (down from about 75, to 50). The impact on student participation is notable
- Undergraduate and graduate student satisfaction is high, above both the college and university averages
- The average undergraduate student, enrolled in AE 223 and AE 333, is likely overloaded with outside of class commitments that limit study (and sleep) time
- The department has worked towards increasing program visibility and pride (e.g., adding a Facebook page with notable news, student/alumni successes, and job opportunities)
- Salaries for aerospace engineers is up significantly from three years ago
- The graduate program is the primary provider of advanced degrees in aerospace engineering in the state of Kansas
- The graduate program offers local engineers the opportunity to further their technical skills while employed
- Employers from outside of Kansas dramatically increased their efforts to recruit students in 2017 (e.g., Boom, Scaled Composites, Lockheed Martin, Boeing, and Gulfstream)
- Significant undergraduate enrollment growth will likely be hampered by a lower than national average job growth projection (US Department of Labor)
- There are now just enough faculty to offer critical junior and senior level courses each semester
- There are currently three faculty members who are potentially with four years of retiring
- Current faculty, staff, and space resources are now reasonably adequate to support the current programs
- Current faculty/staff teaching and service workloads limit program abilities to grow or respond to new academic and research opportunities
- Current faculty scholarship productivity is very good, with a notable number of conference and contract reports

- Research and external funding is reasonable, but is now focused with a smaller number of faculty
- The department has made some progress engaging Spirit Aerosystems in funded research (two $100K/year grants each, over the last three-years)
- The department is now applying essentially the same approach, used with Spirit, to seek support from other companies
- Unfortunately, competition for external funding is high since many aerospace organizations are already at their budget limit supporting the WSU NIAR
- Applied and fundamental research collaboration and coordination opportunities with the NIAR should be better defined, optimized, established, and sustained to the benefit of both units
- Currently available department funding and resources to attract and support graduate students are not competitive

The following, identified via the department's strategic planning and program assessment activities, out line goals for the next three-years:

- Continue to improve the academic program's visibility and reputation
    - Advertise the program better
    - Attract, retain, and graduate more top-quality undergraduate students
    - Strengthen the astronautics and propulsion curriculum and related experiences
- Grow the department's research capabilities and reputation
    - Attract more full-time graduate students
    - Improve faculty external funding levels
    - Continue to broaden industry/government connections, collaborations, exchanges, and training
    - Improve the impact and visibility of research work