WICHITA STATE UNIVERSITY

Program Review Self-Study

Academic unit: Aerospace Engineering

College: Engineering

Date of last review: Fall 2012

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	
Walter J. Horn	
Suresh Keshavanarayana	
Linda K. Kliment	
Roy Myose	
Michael Papadakis	
Syed Raza	
Kamran Rokhsaz	
James E. Steck	
Chidhar Yang	
Elizabeth Rollins	

Submitted by: _____ Date: March 30, 2015

(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:

- 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) B.S. 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 Johnson Space and Armstrong Flight Research Centers 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. Indeed, the current PEOs were updated in 2013.

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 Changes

Based on recent outcome results evaluations, the faculty identified the areas of greatest potential program improvement in:

- Outcome a - an ability to apply knowledge of mathematics, science, and engineering
- Outcome e - an ability to identify, formulate, and solve engineering problems

The department faculty has implemented changes with an expectation that at least two things will have a favorable impact on program quality and the noted outcomes (i.e., a and e). Specifically:

- A stronger emphasis on students learning fundamental engineering mechanics concepts (i.e., material contained in three fundamental engineering mechanics courses - AE 223 Statics, AE 333 Mechanics of Materials, and AE 373 Dynamics)
- Providing students with more experiences related to directly applying program course content

It is assumed that strengthening a student's understanding of engineering mechanics enhances learning and performance at all program levels. Additionally, faculty recognizes the importance and the value of "learning by doing." The anticipated consequences are an improvement in both the program quality and student outcome scores (i.e., outcomes a and e).

Graduate Programs Description

The Department of Aerospace Engineering offers Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) 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 M.S. 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

The Ph.D. 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 Ph.D. Plan of Study normally contains about 60 hours of course work, including courses from the master's degree, and should have a minimum of 60 percent of the hours (24 dissertation hours included) beyond the master's 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 Changes
There have been not significant changes in the graduate programs.

Facilities, Equipment, Resources, and Services
The AE department is well equipped with a range of facilities and equipment: including wind tunnels; a water tunnel; a structures lab; and project prototyping labs. 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.

The department provides fundamental engineering mechanics courses for other College of Engineering programs. Indeed, all undergraduate engineering students, except for Computer Science and Engineering Technology, take AE 223 Statics. Mechanical Engineering (ME) and Industrial and Manufacturing Engineering (IME) students take AE 333 Mechanics of Materials. All ME students take AE 373 Dynamics.

2. Describe the quality of the program 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				
Year 1	6		12	35	12										2	13	$2.66M
Year 2	7		16	12	16										1	10	$2.09M
Year 3	7		12	24	17										0	8	$1.56M

* 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 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 dropped 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.

Interestingly, 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 burden. Sadly, the reports are often times significantly larger, detailed, and more time-consuming to prepare than journal articles. Faculty submitted thirty-six contract reports during the same three years noted above.

The department is currently working to fill one tenure-track faculty position. Interestingly, within the process, it is appears other universities are offering significantly higher pay and larger start-up packages.

Approximately 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 slow to steady overall growth.

Course Level	2011	2012	2013
Total	6,275	6,549	6,598
100-299	1,374	1,443	1,125
300-499	2,027	2,112	2,354
500-699	1338	1424	1634
700-799	963	1008	1035
800-899	424	418	305
900-999	149	140	145

The following table outlines total and course-level distributions of Student Credit Hour (SCH) production at fall census day. Again, a slow yet steady growth is observed.

Course Level	2011	2012	2013
Total	3,076	3,083	3,226
100-299	669	600	615
300-499	961	1,088	1,130
500-699	644	686	799
700-799	489	492	477
800-899	246	153	158
900-999	67	64	47

Additionally, the above tables show that our doctoral program, characterized by 800+ level classes, has been steadily declining in favor of increased productivity in the undergraduate program. The M.S. program has shown no significant variation.

The following table outlines Student Credit Hour (SCH) production among department instructional faculty on November employee census day.

Employee Type	2011	2012	2013
Program Total	2,857	2,949	2,061
Tenure Eligible	1,812	1,999	2,061
Non-tenure eligible	0	0	0
Lecturers	45	186	0
GTA	687	522	0
Unclassified Professionals	313	242	0
Classified Staff	0	0	0
GSA, GRA, UG students	n/a	n/a	n/a

The following table outlines instructional FTE employed on November 1st census day.

Employee Type	2011	2012	2013
Program Total	9.9	10.5	9.5
Tenure Eligible	8.3	8.5	9.5
Non-tenure eligible	0	0	0
Lecturers	0.2	0.2	0
GTA	0.6	1.0	0
Unclassified Professionals	0.7	0.7	0
Classified Staff	0	0	0
GSA, GRA, UG students	n/a	n/a	n/a

The above two tables show that:

- Tenure eligible faculty carried the bulk of the teaching load over this period
- The percent increase in SCH production is exactly the same as that for tenure-eligible faculty

The following table outlines Student Credit Hour (SCH) by FTE for university instructional faculty on November 1st census day

Employee Type	2011	2012	2013
University Level Total	230	222	225
Tenure Eligible	216	194	194
Non-tenure eligible	284	289	306
Lecturers	269	295	302
GTA	210	203	206
Unclassified Professionals	149	122	102
Classified Staff	0	14	0
GSA, GRA, UG students	n/a	n/a	n/a

The following table outlines Student Credit Hour (SCH) by FTE for college division instructional faculty on November 1st census day.

Employee Type	2011	2012	2013
College Level Total	231	231	222
Tenure Eligible	203	191	202
Non-tenure eligible	223	406	12
Lecturers	270	436	501
GTA	356	256	351
Unclassified Professionals	282	136	90
Classified Staff	n/a	n/a	n/a
GSA, GRA, UG students	n/a	n/a	n/a

The following table outlines Student Credit Hour (SCH) by FTE for program instructional faculty on November 1st census day.

Employee Type	2011	2012	2013
Program Level Total	288	282	217
Tenure Eligible	218	236	217
Non-tenure eligible	n/a	n/a	n/a
Lecturers	180	745	n/a
GTA	1099	522	n/a
Unclassified Professionals	427	327	n/a
Classified Staff	n/a	n/a	n/a
GSA, GRA, UG students	n/a	n/a	n/a

These three tables (above) show that the tenure-eligible faculty consistently generated more SCH per FTE than the college or the university.

The following table outlines program majors (including double majors) on fall census day.

Student Class	2011	2012	2013
Total	490	469	528
Freshmen	87	84	80
Sophomore	70	57	83
Junior	78	82	80
Senior	129	137	159
Masters	103	93	111
Doctoral	23	16	15

The following table outlines program degree production by fiscal year

Degree Level	2011	2012	2013
Total	53	78	72
Doctoral	1	2	4
Masters	19	25	21
Bachelor	33	51	47

Data in these two tables (above) show that:

- The undergraduate program has steadily grown

- The masters program size remains steady
- The doctoral program is declining in size by graduating more students than it recruits

3. **Academic Program: 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.

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. Specifically, for the 2011-2013 period, aerospace engineering student scores range from 26.2 to 26.5. University scores, for the same time frame, range from 22.8 to 23.0.

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

Based on WSU Office of Planning and Analysis data, for the 2011-2013 period, admitted aerospace engineering graduate students 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 0.3 below the target outcome. - The Co-Op Employer Survey average score (3.5) exceeds the target value. - Course Rubric/Exam scores are 2.4 in AE 223 Statics and AE 373 Dynamics.	- 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. - More experiences related to directly applying program course content have been added. - The Physics I requirement for AE 223 Statics was changed from a co-requisite to a prerequisite. - Increase the number of faculty to reduce class sizes.
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 (3.1) exceeds the target value. - Course Rubric/Exam scores meet or exceed the target value.	- No program changes are needed.
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 (2.7) is below the target value. - Course Rubric/Exam scores meet or exceed the target value.	- 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 (3.3) 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 0.25 below the target outcome. - The Co-Op Employer Survey average score (3.4) exceeds the target value. - Course Rubric/Exam scores in AE 502 Propulsion I, AE 525 Flight Structures I, AE 628 Aerospace Design II, and for the Open House Project reviews range from 2.5 to 2.9. - Course Rubric/Exam scores meet or exceed the target value.	- 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. - More experiences related to directly applying program course content have been added. - The Physics I requirement for AE 223 Statics was changed from a co-requisite to a prerequisite. - Increase the number of faculty to reduce class sizes.
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 (3.5) 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 (3.5) exceeds the target value. - Course Rubric/Exam scores meet or exceed the target value.	- No program changes are needed.
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 (3.1) 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 (3.3) exceeds the target value. - Course Rubric/Exam scores meet or exceed	- No program changes are needed.

			the target value.	
Undergraduate Program Outcome 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 (3.5) exceeds the target value. - Course Rubric/Exam scores meet or exceed the target value.	- No program changes are needed.
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 undergraduate student satisfaction levels are lower than those of the university, but higher than the college of engineering. Students at the graduate level are more satisfied, compared to the university level.

Group	2011	2012	2013
University Undergraduate	n/a	79.5%	82.9%
College of Engineering Undergraduate	n/a	63.4%	70.1%
Aerospace Engineering Undergraduate	n/a	75.0%	73.2%
University Graduate	n/a	80.0%	82.5%
College of Engineering Graduate	n/a	84.5%	84.3%
Aerospace Engineering Graduate	n/a	84.2%	85.3%

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 notable program changes. Specifically, modifications to help students learn fundamental engineering mechanics concepts better and to provide more experiences directly applying program content have been incorporated.

d. 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/

e. 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

f. 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.

g. 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 2.18.

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.

h. 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 desire to further improve. Particular attention is being focused on better understanding weaknesses and in identifying logical program improvements.

A number of positive undergraduate program changes have been implemented over the last three years, directly as a result of continuous assessment activities. The following summarizes the changes:

- A stronger emphasis on students learning fundamental engineering mechanics concepts (i.e., the material contained in AE 223 Statics, AE 333 Mechanics of Materials, and AE 373 Dynamics). Enhanced teaching and improved assessment tools are being explored, with the intent of improving student learning.
- The flight structures course sequence (AE 525 and AE 625) now includes weekly recitation sessions, designed to illustrate and practice more real-life course content application.
- The capstone design course sequence (AE 528 and AE 628) was significantly changed to include vehicle construction, validation, and flight demonstration elements.
- A new controls lab has been jointly developed, with the Electrical Engineering & Computer Science department, to reinforce academic content and experiences in AE 607 Flight Control Systems.
- In-class and extracurricular experiential learning opportunities, supported by the department, have increased notably (e.g., the Bronze Propeller competition, AIAA Design/Build/Fly team, the Rocket Club, and the Near-Space Launch Program).
- There is a greater effort, during initial orientation and advising, to encourage freshmen involvement in department sponsored extracurricular activities.
- The NASA Jump Start Fellowship Program has been continued 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).
- The Bronze Propeller competition was established in 2009 to broaden underclassmen, graduate student, and even local high school student involvement in hands-on activities.
- The Small Aircraft Prototype Lab was moved to a larger room, creating opportunities for further 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 aircraft 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 208; WH 221; WH 07; SSWT; 3x4 wind tunnel lab; & flight simulation).
- The Physics I requirement for AE 223 Statics was changed from a co-requisite to a prerequisite.

- A new aircraft design class, AE 460H Selected Topics in Aircraft Design, specifically aimed at freshmen and sophomore students, has been developed and successfully trialed. There are plans to offer this course on a regular basis starting in 2014.
- Elective credit options for honors and cooperative education students have been established.
- A need to increase program experimental structures related content has been identified. Starting in 2014, AE 512 includes an additional credit hour of structures material. The course name was changed to AE 512 Experimental Methods in Aerospace.
- To improve the program's aerodynamics course sequence, ME 521 Fluid Dynamics was dropped from the curriculum in 2014. This change eliminates significant redundancies with AE 424. AE 424 was slightly reorganized, renamed (Aerodynamics I) and a new course was added (AE 524 Aerodynamics II). The new sequence significantly strengthens program compressible, viscous, and heat transfer content. Additionally, both aerodynamics courses include expanded applied experiences (e.g., aircraft drag prediction, use of advanced computer codes, etc.).
- The development of a new or enhanced computing course is also being studied (based on senior exit survey comments).

Graduate Program

The overall quality of the graduate (M.S. & Ph.D.) 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 were employed by the local and national aerospace industry or continued with their studies for a higher graduate degree.

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

a. Evaluate tables 11-15 from the Office of Planning Analysis for number of applicants, admits, and enrollments and percent URM students by student level and degrees conferred.

The following table summarizes program undergraduate and graduate application, admittance, and enrollment data for three years. This table shows that greater than 96% of undergraduate students applying are admitted and that approximately 53% of admitted students enroll in the program. Approximately 73% of the students who apply to the graduate program are admitted and around 56% enroll in the program.

Group	2011	2012	2013
Undergraduate Applicants	208	201	218
Undergraduate Admitted	205	196	213
Undergraduate Enrolled	113	98	115
Graduate Applicants	82	87	121
Graduate Admitted	65	64	89
Graduate Enrolled	33	42	48

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, for all but one case, that less than 10% of the student population is composed under-represented minorities.

Group	2011	2012	2013
Freshman & Sophomores	6.4%	6.4%	7.4%
Juniors & Seniors	9.7%	10.5%	9.6%
Masters	1.9%	5.4%	3.6%
Doctoral	0.0%	0.0%	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 M.S. or Ph.D. students graduated in the same time period.

Group	2011	2012	2013
Bachelor	9.8%	6.4%	10.9%
Masters	0.0%	0.0%	0.0%
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	$71,000	~60%	~70%	~10%	~5%	~15%	
Year 2	$71,000	~60%	~70%	~10%	~5%	~15%	
Year 3	$71,000	~60%	~70%	~10%	~5%	~15%	7%

* 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

The need for engineering students is strong, even in the face of hard economic times. AE undergraduate enrollments are stable (yet too high) and the industry demand for quality graduates appears to be growing. Furthermore, political and state government commitments to increasing graduation rates in response to industry interests are well know (e.g., Senate Bill 127). The US labor data suggests a 7% rate of growth.

Most AE students take on traditional engineering positions, especially in structures and testing areas. Interestingly, students are often hired at higher levels because of WSU's strong Cooperative Education program, on-campus research activities, and experiential learning opportunities. Their prior work 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 more 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 (2011-2014, 76 total) are summarized as follows.

Graduate's Location	Number
Wichita Aerospace Industry	
Airbus	1
Cessna	7
Beechcraft	3
Spirit AeroSystems	13
NIAR	10
Consulting Companies	1
Other Aerospace Industry	6
Non-Aerospace Industry	4
Academia – Faculty Positions	2
Graduate Programs	3
Unknown	24

This table shows the local aerospace industry to be the major employer of the graduate degree recipients (35/76). 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 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).**

Evaluate table 16 from the Office of Planning Analysis for SCH by student department affiliation on fall census day.

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 Student Credit Hour (SCH). Total and program undergraduate values have slowly increased for the past three years at about 4%. Program graduate levels have decreased by about 3%. Non-program majors account for an approximate 15% increase in SCH.

Major & Student Level SCH	2011	2012	2013
Total	3,076	3,083	3,226
Program Undergraduate Majors	1,811	1,892	1,928
Program Graduate Majors	557	483	471
Non-program Majors	708	708	827

This data suggest a few trends. Specifically, it appears the undergraduate programs SCH growth rate is moderating. Undergraduate program review data presented in 2012 showed a greater than 50% increase in SCH. The current rate is around 4%.

Program graduate SCH values, as noted, appear to be dropping. This change may be due to the larger number of students who elected to enter our graduate program in the 2008-2011 time frames when the overall job market was weak. Many students simply elected to attend graduate school since they had difficulty finding a desirable job with a B.S. degree.

The 15% increase in non-program major SCH highlights the importance of core aerospace engineering courses to other college programs.

Department faculty remains active in areas other than academics. Research, publications, and service contributions assist industry, professional activities, and other units on campus (most notably the NIAR).

6. Report on the Program'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 4% program enrollment growth, the average ACT scores and GPA have remained constant. Informal data suggests that more students with higher ACT scores are entering the program. Clearly, additional and more accurate data is needed to confirm this change.

	Improve the quality of graduating undergraduate students	Additional and improved outcomes assessment tools data	Results have been excellent, with only two specific areas for program improvement highlighted. Quantifiable measurements of improvements should be available shortly.
	Attract and retain more full-time graduate students	Graduate student enrollments	There has been a slow growth in graduate students. Unfortunately, additional graduate assistantship funding resources are needed to secure additional and significant growth.

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 (AE) 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:

- Undergraduate core course changes and the expansion of experiential learning opportunities have impacted the undergraduate program favorably
- The undergraduate and graduate programs enjoy good reputations
- Students, alumni, and employers rate the programs and students highly
- Sophomore and higher-level class sizes are too large (>75)
- There are not enough faculty to offer critical junior and senior level courses each semester
- Significant undergraduate enrollment growth will likely be hampered by a lower than national average job growth projection (US Department of Labor)
- 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
- Faculty, staff, and space resources are inadequate to support the current programs (the new building will not address faculty and staff availability and office issues)
- Current faculty/staff workloads limit program abilities to grow or respond to new academic and research opportunities
- Research and external funding is strong, but is focused with a smaller number of faculty
- Funding and resources to attract, support, and office graduate students is non-competitive

The department has made notable progress addressing the previous Program Review (2012) recommendations. Specifically, the following:

- New and improved assessment tools have provided better and more quantifiable measures of outcomes that facilitate identification of appropriate undergraduate program changes
- Notable improvements in the undergraduate program, especially related to core courses and experiential learning, have been implemented

Some department unique advantages and research opportunities naturally exist as a result of the growth of the National Institute for Aviation Research (NIAR). Unfortunately, these opportunities have not been fully considered or exploited by either unit. The following recommendation is offered:

- 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

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

- Improve the academic program's visibility and reputation
    - Advertise the program better
    - Attract, retain, and graduate more top-quality undergraduate students
    - Strengthen the astronautics curriculum and related experiences
- Grow the department's research capabilities and reputation
    - Attract more full-time graduate students
    - Improve faculty external funding levels
    - Broaden industry/government connections, collaborations, exchanges, and training
    - Improve impact and visibility of research work
- Establish the necessary staffing and infrastructure
    - Size the faculty and infrastructure to meet critical curriculum requirements and to allow creative tactical growth
    - Employ an appropriate number of technicians and teaching assistants