BSAE PROGRAM ASSESSMENT

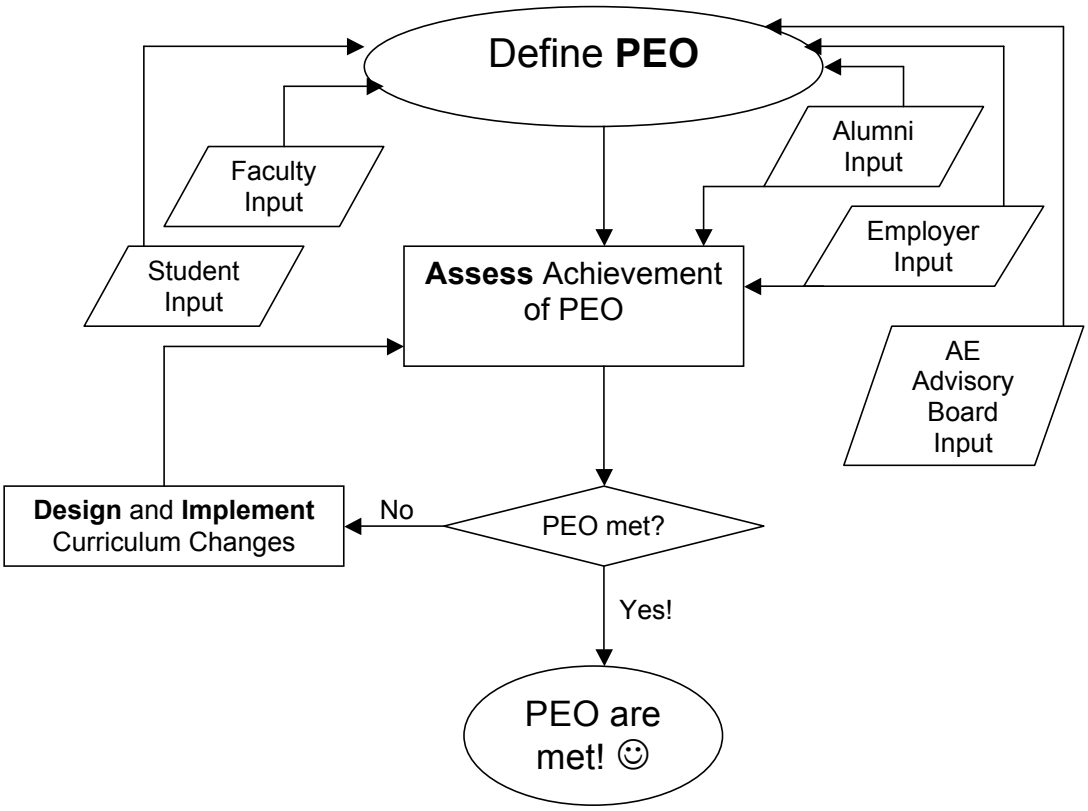
The ***Program Educational Objectives*** (PEOs) of the BSAE Program reflect our constituents' expectations that our graduates:

1. *Hold positions of technical responsibility, as members or leaders of multi-disciplinary teams engaged in aerospace engineering problem solving, modeling, systems analysis, design, development, testing or research.*

2. *Have enhanced and continue to enhance their professional skills by pursuing / completing a graduate degree or other post-graduate training.*

3. *Are well rounded in their understanding of multicultural and global perspectives and work effectively with engineers and customers from around the world, while providing for issues such as public safety, honest product marketing, and respect for intellectual property.*

The process for defining and assessing the PEOs is shown below.



In our most recent assessment (AY 2010-2011) all our constituents agreed that the PEOs defined are appropriate for our BSAE Program. Moreover, alumni input confirmed that the BSAE Program is currently achieving these objectives.

The ***Student Outcomes*** and ***Performance Criteria*** for the BSAE Program are:

Outcome 3A: Ability to use mathematics, science, and engineering principles to identify, formulate and solve aerospace engineering problems.

Outcome Elements

3A-1: Ability to apply mathematics.
3A-2: Ability to apply physics.
3A-3: Ability to apply engineering principles.
3A-4: Ability to identify, formulate and solve AE problems.

3A-1: Ability to apply mathematics

Outcome Performance Criteria:

3A-1.1: Apply calculus in the process of solving AE problems.
3A-1.2: Use differential equations in the process of solving AE problems.
3A-1.3: Use linear algebra in the process of solving AE problems.

3A-2: Ability to apply physics

Outcome Performance Criteria:

3A-2.1: Draw free–body diagrams in the process of solving AE problems.
3A-2.2: Apply Newton's laws in the process of solving AE problems.
3A-2.3: Apply physics concepts (ex. angular momentum, friction, thermal / fluid concepts etc.) in the process of solving AE problems.

3A-3: Ability to apply engineering principles

Outcome Performance Criteria:

3A-3.1: Apply structures principles in the process of solving AE problems.
3A-3.2: Apply rigid body dynamics principles in the process of solving AE problems.
3A-3.3: Apply aerodynamics principles in the process of solving AE problems.
3A-3.4: Apply flight mechanics principles in the process of solving AE problems.
3A-3.5: Apply propulsion principles in the process of solving AE problems.

3A-4: Ability to identify, formulate and solve AE problems

Outcome Performance Criteria:

3A-4.1: Engage in the solution of problems (spend adequate time on task, ask questions, etc.).
3A-4.2: Define (open-ended) problems in appropriate engineering terms.
3A-4.3: Explore problems (i.e., examine various issues, make appropriate assumptions, etc.).
3A-4.4: Develop a plan for the solution (i.e., select appropriate theories, principles,

approaches).
3A-4.5: Implement their solution plan and check the accuracy of their calculations.
3A-4-6: Evaluate their results and reflect on their strengths and weaknesses in the process.

Outcome 3B: Ability to design and conduct water tunnel and wind tunnel experiments, as well as to analyze and interpret data from such experiments.

Outcome Elements

3B-1: Ability to design water tunnel and wind tunnel experiments.
3B-2: Ability to conduct water tunnel and wind tunnel experiments.
3B-3: Ability to analyze data from water tunnel and wind tunnel experiments.
3B-4: Ability to interpret data from water tunnel and wind tunnel experiments.

3B-1: Ability to design experiments

Outcome Performance Criteria:

3B-1.1: Define goals and objectives for the experiment.
3B-1.2: Research relevant theory and published data from similar experiments.
3B-1.3: Select the dependent and independent variables to be measured.
3B-1.4: Select appropriate methods for measuring/controlling each variable.
3B-1.5: Select a proper range for the independent variables.
3B-1.6: Determine an appropriate number of data points for each type of measurement.

3B-2: Ability to conduct experiments.

Outcome Performance Criterion:

Given an experimental setup, become familiar with the equipment, calibrate the instruments to be used, and follow the proper procedure to collect the data.

3B-3: Ability to analyze data from experiments.

Outcome Performance Criterion:

Given a set of experimental data, carry out the necessary calculations and tabulate / plot the results using appropriate choice of variables and software.

3B-4: Ability to interpret data from experiments.

Outcome Performance Criteria:

3B-4.1: Given a set of results in tabular or graphical form, make observations and draw conclusions regarding the variation of the parameters involved.
3B-4.2: Given a set of results in tabular or graphical form, compare with theoretical predictions and/or other published data and explain any discrepancies.

Outcome 3C: Ability to perform conceptual and preliminary design of aircraft or spacecraft to meet a set of mission requirements within realistic constraints such as

economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

Outcome Performance Criteria:

3C-1: Research, evaluate, and compare vehicles designed for similar missions.
3C-2: Follow a prescribed process to develop the conceptual/preliminary design of an aerospace vehicle.
3C-3: Develop economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints and design a vehicle that meets these constraints.
3C-4: Select an appropriate configuration for an aerospace vehicle with a specified mission.
3C-5: Apply AE principles (ex. aerodynamics, structures, flight mechanics, propulsion, stability and control) to design various vehicle subsystems.
3C-6: Develop and compare alternative configurations for an aerospace vehicle, considering trade-offs and appropriate figures of merit.
3C-7: Develop final specifications for an aerospace vehicle.

Outcome 3D: Ability to collaborate with people from different cultures, abilities, backgrounds, and disciplines to complete aerospace engineering projects.

Outcome Performance Criteria:

3D-1: Participate in making decisions, negotiate with partners, and resolve conflicts arising during teamwork.
3D-2: Set goals related to team projects, generate timelines, organize and delegate work among team members, and coach each other as needed to ensure that all tasks are completed.
3D-3: Demonstrate leadership by taking responsibility for various tasks, motivating and disciplining others as needed.
3D-4: Demonstrate adequate understanding of other fields (ex. different branches of engineering / physical sciences, economics, management, etc.) to participate effectively on multidisciplinary projects.
3D-5: Communicate ideas relating to AE in terms that others outside the discipline can understand.

Outcome 3E: Ability to communicate effectively through technical reports, memos, and oral presentations as well as in small group settings.

Outcome Elements

3E-1: Ability to communicate in writing
3E-2: Ability to communicate orally

3E-1: Ability to communicate in writing

Outcome Performance Criteria:

3E-1.1: Produce well-organized reports, following guidelines.
3E-1.2: Use clear, correct language and terminology while describing experiments, projects or solutions to engineering problems.
3E-1.3: Describe accurately in a few paragraphs a project / experiment performed, the procedure used, and the most important results (abstracts, summaries).
3E-1.4: Use appropriate graphs and tables following published engineering standards to present results.

3E-2: Ability to communicate orally

Outcome Performance Criteria:

3E-2.1: Give well-organized presentations, following guidelines.
3E-2.2: Make effective use of visuals.
3E-2.3: Present the most important information about a project / experiment, while staying within allotted time.
3E-2.4: In small group settings, listen carefully, ask clarifying questions when others speak, and respect the opinion of others when disagreeing.

Outcome 3F: Understanding of professional and ethical responsibility.

Outcome Elements

3F-1: Understanding of professional responsibility.
3F-2: Understanding of ethical responsibility.

3F-1: Understanding of professional responsibility.

Outcome Performance Criterion:

Demonstrate professional excellence in performance, punctuality, collegiality, and service to the AE profession.

3F-2: Understanding of ethical responsibility.

Outcome Performance Criteria:

3F-2.1: Are aware of the various professional codes of ethics (ex. NSPE, ASME).
3F-2.2: Properly acknowledge the work of others by citing all their sources when writing reports.
3F-2.3: Given a job-related scenario that requires a decision with ethical implications they can identify possible courses of action, discuss the pros and cons of each one, decide on the best course of action, and justify their decision.

Outcome 3G: Broad education to understand current events, how they relate to aerospace engineering, as well as the impact of engineering solutions in a global and societal context.

Outcome Performance Criteria:

3G-1: Identify regional, national, or global contemporary problems that involve AE.
3G-2: Discuss possible ways AE could contribute to the solution of these problems.
3G-3: Describe accurately the environmental impact of aerospace vehicles, including those they have designed in course projects.
3G-4: Describe accurately the health / safety impact of aerospace vehicles, including those they have designed in course projects.

Outcome 3H: Recognition of the need for, and ability to engage in life-long learning.

Outcome Elements

3H-1: Recognition of the need for lifelong learning.
3H-2: Ability to engage in lifelong learning.

3H-1: Recognition of the need for lifelong learning

Outcome Performance Criteria:

3H-1.1: Are willing to learn new material on their own.
3H-1.2: Participate in professional societies.
3H-1.3: Read non-course related AE related articles / books, attend short courses, workshops, seminars, conferences and plan to attend graduate school.

3H-2: Ability to engage in lifelong learning.

Outcome Performance Criteria:

3H-2.1: Develop a systematic approach to studying a new topic, reflect regularly on their learning process and make any necessary adjustments to improve the efficiency of this process.
3H-2.2: Can access information effectively and efficiently from a variety of sources.
3H-2.3: Read critically and assess the quality of information available (ex. question the validity of information, including that from textbooks or teachers).
3H-2.4: Can research and learn new material on their own by reading articles, books, contacting experts, etc.)

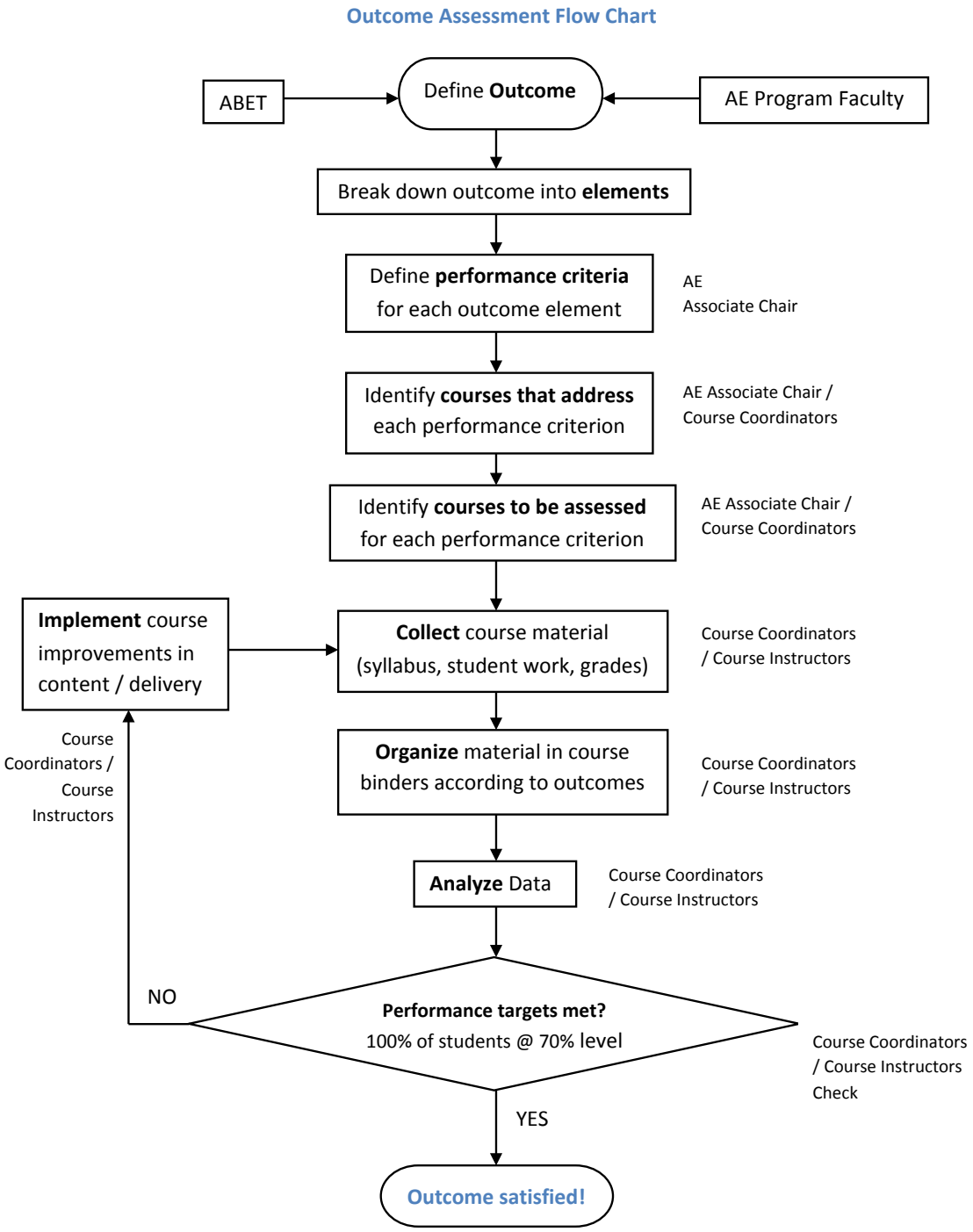
Outcome 3I: Ability to use the techniques, skills, and modern engineering tools (analytical, experimental, and computational) necessary for aerospace engineering practice.

Outcome Performance Criteria:

3I-1: Can access information effectively and efficiently from the internet.
3I-2: Use state-of-the-art software to write technical reports and give oral presentations.
3I-3: Use computer simulations to conduct parametric studies and ‘what if’ explorations.
3I-4: Use modern software to analyze aerospace systems.
3I-5: Use modern equipment and instrumentation in AE laboratories.

3I-6: Are aware of state-of-the-art tools and practices used in the aerospace industry through plant visits and presentations by practicing engineers.

The process of assessing BSAE Student Outcomes is shown below.



The table below shows the required BSAE courses in which Student Outcomes are assessed and the expected level of proficiency for each outcome.

	Student Outcomes								
BSAE	A	B	C	D	E	F	G	H	I
Original ABET Outcomes	(a), (e)	(b)	(c)	(d)	(g)	(f)	(h), (j)	(i)	(k)
Required Courses									
Engr. 100W					+++				
AE 114	++	✈		✈	✈			✈	
AE 140	++			✈				✈	
AE 160	++	++	✈	✈	+++			✈	+++
AE 162	++	++	✈	✈	+++		✈	++	+++
AE 164	++	✈	✈	✈	✈		✈	✈	
AE 165	++		✈	✈	✈		✈	✈	
AE 167	++		✈	✈	✈		✈	✈	
AE 168	✈			✈				✈	
AE 169	++			✈				✈	+++
AE 171 A, B AE 172 A, B	✈	✈	+++	+++	+++	+++	++	+++	+++
Extra Curriculum Activities		✈	✈	✈	✈	✈			

+: Skill level 1 or 2 in Bloom's Taxonomy
++: Skill level 3 or 4 in Bloom's Taxonomy
+++: Skill level 5 or 6 in Bloom's Taxonomy
✈ Skill addressed but not assessed

To satisfy Criterion 3, we have defined our ***performance target*** as follows:

The scores earned by <u>all</u> students, in the assignments and test questions, which pertain to a particular performance criterion, in each course where this performance criterion is assessed, must be at least 70%.

Gateway Assignments

To ensure that all students meet the minimum performance requirement and thus achieve the performance target of 100% in each outcome, gateway assignments are being implemented in key required courses. Students must receive a minimum score of 70% in these assignments to pass the course, regardless of their performance in other course assignments or exams. The gateway assignments implemented in AY 2010-2011 are shown in the table below:

Gateway assignments

Outcome 3B	AE 160 AE 162	4 – Lab Reports 4 – Lab Reports
Outcome 3C	AE 171A&B, AE 172A&B	12 Design Reports 03 Design Briefings
Outcome 3E	Engr. 100W	Exit Exam
	AE 171A&B, AE 172A&B	03 Design Briefings
Outcome 3F	AE 171A&B, AE 172A&B	4 – Case Studies with related assignments
Outcome 3G	AE 171A&B, AE 172A&B	2 – Research Papers / Presentations

The intended timeline for BSAE Student Outcome Assessment is shown in the table below:

	Outcomes								
	3A	3B	3C	3D	3E	3F	3G	3H	3I
AY 11-12	X					X			
AY 12-13		X					X		
AY 13-14			X					X	
AY 14-15				X					X
AY 15-16					X				
AY 16-17						X			
AY 17-18							X		

Using the WASC Rubric to Assess the Quality of the BSAE Program Student Outcomes – Timeline for Improvements

Criterion	***Level***	***Improvements needed to reach next level***
Comprehensive List	***Highly Developed*** *Standard:* The list is reasonable, appropriate, and comprehensive, with clear distinctions between BSAE and MSAE expectations. National disciplinary standards (AIAA) have been considered. Faculty have agreed on explicit performance criteria for assessing student level of mastery of each outcome. *Rationale:* The list was developed by ABET and adapted by the AE faculty to reflect the specific strengths of the SJSU BSAE Program.	None
Assessable Outcomes	***Developed (C, D, F, G, H, I) / Highly Developed (A, B, E)*** *Standard:* Outcomes describe how students can demonstrate their learning. Faculty have agreed on explicit criteria statements, such as rubrics, and have identified examples of student performance at varying levels for each outcome. *Rationale:* AE faculty developed the performance criteria presented above precisely for the purpose of describing in more specific terms how students must demonstrate their achievement of each outcome. However, AE faculty have not yet developed rubrics with specific examples of student performance at varying levels for each and every outcome.	Rubrics will be developed for the performance criteria of outcomes C, D, F, G, H, and I *Spring 2012*

Alignment	***Highly Developed*** *Standard:* Pedagogy, grading, the curriculum, relevant student support services, and co-curriculum are explicitly and intentionally aligned with each outcome. Curriculum map indicates increasing levels of proficiency. *Rationale:* Pedagogy, grading, and the curriculum, are explicitly and intentionally aligned with each outcome and expected levels of proficiency for each outcome are currently shown on a curriculum table (see above).	None
Assessment Planning	***Highly Developed*** *Standard:* The program has a fully-articulated, sustainable, multi-year assessment plan that describes when and how each outcome will be assessed and how improvements based on findings are implemented. The plan is routinely examined and revised, as needed. *Rationale:* The program does indeed have a fully-articulated, sustainable, multi-year assessment plan as described above, however, program faculty do not currently meet on a regular basis to coordinate the implementation of this plan and the continuous improvement process.	Need program faculty meetings every semester for (a) assessment planning and (b) discussing the effectiveness of the continuous improvement process. *Established in Fall 2011*
The Student Experience	***Emerging / Developed*** *Standard:* Students have some knowledge of program outcomes. Communication is occasional and informal, left to individual faculty or advisors. Outcomes are included in most syllabi and are readily available in the catalog, on the web page, and elsewhere. *Rationale:* CLOs are linked to student outcomes on course syllabi but students are not always aware of this relationship and they do not necessarily understand how course requirements and pedagogy link to these outcomes. Students currently do not use program outcomes to guide their learning and they are not involved in the creation or use of the rubrics available.	Coach students to: 1. Acquire a good grasp of outcomes. 2. Use outcomes to guide their learning. 2. Participate in the creation of rubrics. 3 Use rubrics to self-assess their performance in relation to each outcome. *Spring 2012 – Fall 2012*

MSAE PROGRAM ASSESSMENT

The ***Program Educational Objectives*** (PEOs) of the MSAE Program reflect our constituents' expectations that our graduates have:

1. A strong foundation beyond the undergraduate level in their chosen focus area as well as in mathematics, basic science and engineering fundamentals, to successfully compete for technical engineering positions in the local, national and global engineering market, advance in their current position or pursue doctoral studies.

2. Contemporary professional and lifelong learning skills to be able to apply theory to solve practical aerospace engineering problems.

3. Provide students with the expertise necessary to work in the analysis and design of aerospace engineering systems with possible specialization in Aircraft Design or Space Transportation & Exploration.

4. Strong verbal and written communication skills, including the ability to write engineering reports.

5. The ability to perform research and work independently to solve open-ended problems in aerospace engineering.

The process for defining and assessing the MSAE PEOs is the same as the corresponding process for the BSAE PEOs illustrated in the flow chart on page 1 of this report.

The ***Student Outcomes*** for the MSAE Program are:

Ability to:

1. Apply advanced mathematics as appropriate for the solution of AE problems.
2. Apply AE science (aerodynamics, propulsion, flight mechanics, stability & control, aerospace structures & materials, etc.) and/or aerospace vehicle design, appropriate for graduate level.
3. Use modern tools (computational or experimental) to solve AE problems.
4. Perform a literature search for a topic of interest and properly cite all references.
5. Demonstrate an understanding of the cited literature by summarizing previous work.
6. Perform an in-depth analysis and / or design of an AE system.
7. Use correct language and terminology in technical reports.
8. Draw appropriate conclusions and write an abstract for work performed.
9. Use graphs and tables appropriately while presenting results in technical reports.
10. Define clear project objectives.
11. Model a technical problem properly using physics, mathematics, and AE principles.

MSAE Student Outcomes are assessed in each and every MSAE project / thesis report using the following instrument:

MSAE Thesis / Project Evaluation Form

Title							
Name					Semester – Fall 2011		
Advisor	Dr.						
Scale: 1/5 = Lacking 2/5 = Weak 3/5 = Acceptable 4/5 = Good 5/5 = Excellent							
Max Possible Score = 100		Max Possible	*Weight*	***Ave score***	PPP	NJM	Faculty 3
1	Application of mathematics appropriate for graduate level and the problem	5	***1***				
2	Application of AE science (aerodynamics, propulsion, flight mechanics, stability & control, aerospace structures & materials, etc.) and/or aerospace vehicle design, appropriate for graduate level	20	***4***				
3	Use of modern tools (computational or experimental)	10	***2***				
4	Appropriate literature search (# and appropriateness of references cited)	10	***2***				
5	Understanding of the cited literature (summary of previous work)	10	***2***				
6	In-depth analysis and / or design of an AE system	20	***4***				
7	Correct language and terminology	5	***1***				
8	Ability to summarize (abstract) / draw conclusions	5	***1***				
9	Appropriate use of graphs and tables	5	***1***				
10	Clear project objectives	5	***1***				
11	Appropriate modeling	5	***1***				
	Total Score	100					

Overall Score: 90 – 100 = Excellent, 80 – 89 = Good, 60 – 79 = Acceptable, 40 – 59 = Weak, 00 – 58 = Lacking

Comments:

The intended timeline for MSAE Student Outcome Assessment is shown in the table below:

	Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	1
AY 11-12	X					X						
AY 12-13		X					X					
AY 13-14			X					X				
AY 14-15				X					X			
AY 15-16					X					X		
AY 16-17						X					X	
AY 17-18							X					X

Using the WASC Rubric to Assess the Quality of the MSAE Program Student Outcomes

Criterion	***Level***	***Improvements needed to reach next level***
Comprehensive List	***Highly Developed*** *Standard:* The list is reasonable, appropriate, and comprehensive, with clear distinctions between BSAE and MSAE expectations. Faculty have agreed on explicit performance criteria for assessing student level of mastery of each outcome. *Rationale:* The list was developed by AE faculty to reflect the expectations of our constituents and the specific strengths of the SJSU MSAE Program.	
Assessable Outcomes	***Developed*** *Standard:* Outcomes describe how students can demonstrate their learning. Faculty have agreed on explicit criteria statements, such as rubrics, and have identified examples of student performance at varying levels for each outcome. *Rationale:* AE faculty have not yet developed rubrics with specific examples of student performance at varying levels for all outcomes.	Rubrics will be developed for each outcome. *Fall 2012*
Alignment	***Developed*** *Standard:* The curriculum is designed to provide opportunities for students to learn and to develop increasing sophistication with respect to each outcome. This design may be summarized in a curriculum map.	An MSAE curriculum map or table needs to be developed, similar to the one developed for the BSAE

	Rationale: The MSAE curriculum is indeed designed to provide opportunities for students to learn each outcome, however, no curriculum map exists at this point.	Program *Spring 2012*
Assessment Planning	***Emerging*** *Standard:* The program relies on short-term planning, such as selecting which outcome(s) to assess in the current year. *Rationale:* There are only two full-time AE faculty and due to workload issues the emphasis has been on the BSAE Program ; there has been no systematic assessment of the MSAE Outcomes. However, in Spring 2011 the AE faculty began a schedule to assess one outcome every semester and to follow up with implementation of whatever improvements are necessary.	Need program faculty meetings every semester for (a) assessment planning and (b) discussing the effectiveness of the continuous improvement process. *Established in Fall 2011*
The Student Experience	***Emerging / Developed*** *Standard:* Students have some knowledge of program outcomes. Communication is occasional and informal, left to individual faculty or advisors. Outcomes are included in most syllabi and are readily available in the catalog, on the web page, and elsewhere. *Rationale:* CLOs are not linked to student outcomes on all of the MSAE course syllabi. Students are not always aware of the relationship between the two. Students are introduced systematically to MSAE Program Outcomes in AE295A,B/AE299, where the outcomes are also assessed. It is not clear whether students currently use program outcomes to guide their learning and they have not been involved in the creation or use of rubrics.	Coach students to: 1. Acquire a good grasp of program outcomes. 2. Use outcomes to guide their learning. 2. Participate in the creation of rubrics. 3 Use rubrics to self-assess their performance in relation to each outcome. *Spring 2012 – Fall 2012*