CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA

ACADEMIC SENATE

ACADEMIC PROGRAMS COMMITTEE

REPORT TO

THE ACADEMIC SENATE

AP-010-189

Systems Engineering, M.S. - Converting Pilot Program to Regular Program
Status

Academic Programs Committee	Date:	03/13/2019
Executive Committee Received and Forwarded	Date:	03/20/2019
Academic Senate	Date:	03/27/2019 First Reading

BACKGROUND:

The Industrial and Manufacturing Engineering Department is proposing to convert the pilot program for an MS in Systems Engineering to a regular program. The pilot program started the first cohort in Winter 2016 and operated on a self-supported model through the College of Extended University. An external review team, consisting of Dr. James Moore from the University of Southern California and Mr. David Mason from Project Performance International, visited the IME Department during March 21-22, 2018. After their visit, a report was prepared and submitted by the external reviewers, then both the department and Dean prepared responses. A self-study was also developed by the department of Industrial and Manufacturing Engineering Department in preparation for creating an MS in Systems Engineering program. The AP Committee reviewed these documents, which refers to Academic Senate referral AP-006-189 "Program Review for MS Systems Engineering" (currently being discussed in Academic Senate).

RESOURCES CONSULTED:
Associate Deans, all colleges
Department Chairs, all colleges

DISCUSSION and RECOMMENDATION:

The IME department proposes to convert the MS Systems Engineering program into a regular self-support program. A comprehensive program review (AP-006-189 "Program Review for MS Systems Engineering") has been performed. The program review of MS Systems Engineering is overall positive, based on the external reviewers and the self-study report. The program strengths such as engaged and qualified faculty, contemporary curriculum content, well-designed program structure, and the focus on continuous program improvement etc. were recognized. Some areas for improvement, such as aligned marketing efforts and ways to reducing semester conversion impact etc. were mentioned. The department and Dean's office were in broad agreement with the reviewers' comments and suggestions.

Based on the feedback gathered, the IME department has developed a plan of improvement in the following areas, 1. Revision of program mission and vision and alignment with CPP and College of Engineering strategic guidelines; 2. Collecting data from students/alumni/employers for continuous improvement; 3. Aligning marketing efforts; 4. Developed detailed five-year assessment plan for SLO's.

The pilot MS in Systems Engineering program has experienced significant growth during the last three years (2016 enrollment - 4, 2017 enrollment - 9, 2018 enrollment - 14) with a diverse student body (45% international, 30% female, 25% Hispanic). The program shows its strength in faculty qualification, solid curriculum design, and good job placement rate etc. With the self-study and program review performed, IME department improved the assessment and program offering from

various perspectives. There were no additional comments received after the university consultation (all college Associate Deans and Department Chairs).

The Academic Programs Committee recommends approval of the MS in Systems Engineering.

==Curriculog™ information as of March 18, 2019. For most recent information please refer to Curriculog™ database (https://cpp.curriculog.com)==

**Converting Pilot Programs to Regular Program Status Template
Bachelor's and Master's Levels
Offered through State-Support and Self-Support Modes**

This document provides the format to be used when submitting a request to convert a pilot program to regular program status.

1. **Program Type (Please specify any from the list below that apply—delete the others)**

   Self-Support

2. **Program Identification**

   a. Campus

      Pomona

   b. Full and exact degree designation and title (e.g. Master of Science in Genetic Counseling, Bachelor of Arts with a Major in History).

      Master of Science in Systems Engineering (MSSE)

   c. Date the Board of Trustees approved adding this program projection to the campus Academic Plan.

      Spring 2013

   d. Term and academic year of intended implementation (e.g. Fall 2013).

      Fall 2018

   e. Total number of units required for graduation. This will include all requirements, not just major requirements.

      30 semester units

   f. Name of the department(s), division, or other unit of the campus that would offer the proposed degree major program. Please identify the unit that will have primary responsibility.

      Department of Industrial and Manufacturing Engineering (Main Responsible)

College of Engineering
College of the Extended University

g. Name, title, and rank of the individual(s) primarily responsible for drafting the pilot conversion document.

Salomón Oldak
Professor, Electrical and Computer Engineering
Director of Graduate Studies, Academic Programs

h. Any other campus approval documents that may apply (e.g. curriculum committee approvals).

CPP Academic Senate Approval will be added here

i. Please specify whether this program was subject to WASC Substantive Change review. The campus is required to either attach a copy of the WASC Sub-Change proposal.

This program is not subject to a WASC Substantive Change review as per WSCUC, see below.

Salomon Oldak

From:	Larisa Preiser Houy
Sent:	Tuesday, May 8, 2018 11:42 AM
To:	Salomon Oldak
Subject:	FW: Substantive Change Screening Determination: No further review of program needed

Follow Up Flag:	Follow Up
Flag Status:	Flagged

FYI

From: John Hausaman <jhausaman@wscuc.org>
Sent: Wednesday, March 07, 2018 11:39 AM
To: Larisa Preiser-Houy <lpreiser@cpp.edu>
Subject: Substantive Change Screening Determination: No further review of program needed

WASC

WASC Senior College and University Commission

Dear ALO:

Thank you for submitting the Substantive Change Screening form. Following a review of the information submitted, it has been determined that no substantive change review will be necessary for the proposed program. Please submit the new degree program implementation form to WSCUC within 30 days of the Master of Science in Systems Engineering implementation.

3. Program Description

a. Please provide the catalog description of the program.

The Master of Science in Systems Engineering is a unique program developed to meet the need of the industry for highly qualified and well-trained systems engineers. The program gives engineers from different disciplines the advanced training to understand the role of systems engineering in process and product development for large complex systems, develop advanced skills in applying the systems engineering processes used during product development, describe the constraints imposed by society on systems engineering, develop mastery in team interaction and communication skills, develop management skills for Systems Engineering Projects.

b. Please prepare a chart listing all curricular requirements.

Quarter (until Summer 18):

Course No	Course Title	Units
Required Courses		
IME 510	Introduction to Systems Science	3
IME 511	Advanced Engineering Economics	4
IME 512	Systems Engineering Management	3
IME 513	Systems Engineering Life Cycle Design	3
IME 515	System Sustainability	4
IME 519	Operations Research in System Analysis	4
IME 520	Systems Simulation for Managers	4
IME 692	Systems Engineering Project	4
IME 523	Systems Architecture	4
Elective Courses		
IME 516	Facility Planning System	4
IME 517	Healthcare Systems Engineering	4
IME 518	Human Systems Interactions	4
IME 514	Emergency System	4
IME 522	Supply Chain Management in Production Systems	4

Semester (Fall 18 and henceforth):

Course No	Course Title	Units
Required Courses		
SE 5100	Introduction to Systems Science	3
SE 5110	Advanced Engineering Economics	3
SE 5130	System Engineering Life Cycle Design and Management	3
SE 5150	System Sustainability	3
SE 5190	Operations Research in System analysis	3
SE 5200	System Simulation for Managers	3
SE 5230	System Architecture	3
SE 6950	System Engineering Project	3
	Total	24
Elective Courses (Select 6 units from the following list)		
SE 5160	Facility Planning System	3
SE 5170	Healthcare Systems Engineering	3
SE 5180	Human Systems Interaction	3
SE 5140	Emergency System and Cyber Security	3
SE 5220	Supply Chain Management in Production Systems	3

4. **Program Evaluation**

   a. Please provide evidence of a thorough program evaluation, including an on-site review by one or more experts in the field.

   Attached are:
   Appendix A – MSSE Self Study Report
   Appendix B – MSSE Executive Summary
   Appendix C – MSEE External Review Summary

5. **Comprehensive Assessment Plan**

   a. Please include a comprehensive program/student learning outcome assessment plan. (See attached for sample assessment plan matrix).

   As part of their continuous improvement, since the last program review the Department reconvened and decided to revamp the program's Assessment Plan going into the Semester system. This included changing the PLOs and SLOs. Alignment of the PLOs and SLOs to the Graduate Institutional Learning Outcomes (GILOs) and the Strategic Vision is shown in Table 1. The GILOs (currently under Academic Senate review) are listed in Table 2. Table 3 details the overall assessment plan and Table 4 shows the projected data collection timeline.

Program Learning Outcomes	PLO/SLO Alignment	Student Learning Outcomes	Graduate Institutional Learning Outcomes (GILO)				Strategic Vision		
			1	2	3	4	Innovation and Creativity	Civic Engagement	Problem Solving
1. Recognize and understand behavior of processes in complex systems	PLO 1 to SLO a and d	a. Diagnose and identify causes of system failure			X	X			X
2. Skillful in systematic evaluation of complex organizational issues and in synthesizing interdisciplinary solutions to such problems	PLO 2 to SLO b, d, and e	b. Develop proposals to prescribe solutions to system failure		X	X	X	X		X
3. Evaluate the impact of these solutions in the broader context of the organization and society	PLO 3 to SLO d and c	c. Demonstrate effective communication skills in interdisciplinary teams	X				X		
4. Effectively perform and communicate in organizational interdisciplinary teams	PLO 4 to SLO c	d. Critically evaluate the global, societal, and ethical impacts of system behavior				X			X
		e. Assess impact of new elements on existing systems		X	X	X	X		X

Table 1. PLO/SLO Alignment.

1. **Communications**: Excel in written and oral communication, with the ability to convey complex ideas clearly, consistently, and logically.
2. **Information Literacy**: Evaluate the validity and comparative worth of diverse information sources related to the relevant discipline.
3. **Evaluation of Theories**: Evaluate the major theories and approaches to inquiry specific to the discipline.
4. **Scholarship and Creative Activities**: Utilize research and/or scholarship to achieve a relevant product consistent with disciplinary ethics and standards.

Table 2. Graduate Institutional Learning Outcomes (GILOs)
(Under Academic Senate Review)

Courses where each SLO is addressed.	Assessment activity (signiture assignment) used to measure each SLO.	Assessment tool used to measure outcome success	How assessment data will be reported as evidence SLO performance criteria have been met	Designated personnel to collect, analyze, and interpret student learning outcome data for the program	Student learning outcome data dissemination schedule	Closing the loop strategies
SE6950: System Engineering Project, SE5130: System Engineering Life Cycle Design and Management	SE6950: Thesis project, SE5130: Course project	Rubric designed around criteria for each SLO	Report on percentage of students that meet or exceed a minimum level for SLO	SE6950: The thesis chair will grade the master project/thesis using the rubric developed for this assignment. An assessment committee will analyze the rubric data. SE5130: Course instructor will grade the course project using the rubric designed for this assignment. An assessment committee will analyze the rubric data. Systems Engineering Graduate coordinator will compile all results, analyze, and work with instructors on strategies to improve student learning.	The data will be discussed by the systems engineering committee and disseminated to the department annually.	The systems engineering committee will identify where improvement is needed.
SE6950: Systems Engineering Project	SE6950: Thesis project					
SE5130: System Engineering Life Cycle Design and Management	SE5130: Course project					
SE6950: System Engineering Project, SE5130: System Engineering Life Cycle Design and Management	SE6950: Thesis project, SE5130: Course project					
SE6950: System Engineering Project, SE5130: System Engineering Life Cycle Design and Management	SE6950: Thesis project, SE5130: Course project					

Table 3. Overall Assessment Plan

Student Learning Outcome	Academic Year					
	AY 18-19	AY 19-20	AY 20-21	AY 21-22	AY 22-23	AY 23-24
a. Diagnose and identify causes of system failure	SE5130: Course-embedded project	SE6950: Written master thesis and thesis presentation	SE5130: Course-embedded project	SE6950: Written master thesis and thesis presentation	SE5130: Course-embedded project	SE6950: Written master thesis and thesis presentation
b. Develop proposals to prescribe solutions to system failure		SE6950: Written master thesis and thesis presentation		SE6950: Written master thesis and thesis presentation		SE6950: Written master thesis and thesis presentation
c. Demonstrate effective communication skills in interdisciplinary teams	SE5130: Course-embedded		SE5130: Course-embedded		SE5130: Course-embedded	
d. Critically evaluate the global, societal, and ethical impacts of system behavior	SE5130: Course-embedded project	SE6950: Written master thesis and thesis presentation	SE5130: Course-embedded project	SE6950: Written master thesis and thesis presentation	SE5130: Course-embedded project	SE6950: Written master thesis and thesis presentation
e. Assess impact of new elements on existing systems	SE5130: Course-embedded project	SE6950: Written master thesis and thesis presentation	SE5130: Course-embedded project	SE6950: Written master thesis and thesis presentation	SE5130: Course-embedded project	SE6950: Written master thesis and thesis presentation

Table 4. Data Collection Timeline

6. Faculty Resources

The faculty teaching in this program are:

Name	Rank	Department
Dr. Kamran Abedini	Professor	Industrial and Manufacturing Engineering
Dr. Saeideh Fallah-Fini	Assistant Professor	Industrial and Manufacturing Engineering
Dr. Greg Placencia	Assistant Professor	Industrial and Manufacturing Engineering
Dr. Shokoufeh Mirzaei	Associate Professor	Industrial and Manufacturing Engineering
Dr. Biman Ghosh	Professor	Industrial and Manufacturing Engineering

7. Facility Resources

The Master of Science in Systems Engineering shares facilities with the other three programs in the Department of Industrial and Manufacturing Engineering: B.S. in Industrial Engineering, B.S. Manufacturing Engineering and the M.S. in Industrial Engineering, which combined serve more than 500 students. The Department of Industrial and Manufacturing Engineering is part of the College of Engineering, which has grown to become the largest college on campus, with seven departments offering 11 B.S. and 7 M.S. degree programs. The college currently has more than 5,000 undergraduate and 300 graduate students.

All classes in the program are delivered at the main campus in Pomona. Some of the classes are taught in a hybrid mode to accommodate the schedules of working students. The IME department office is in (Building 17-Room 2643), faculty offices, are in Buildings 9, 13 and 17. The classes and most laboratories are located at the Extended University building.

All students have access to Cal Poly Pomona's central library, the University Library. There are no separate engineering collections elsewhere on campus. The University Library is a six-story building located in the center of with a collection that totals over 750,000 volumes including electronic databases with relevant professional journals.

8. Enrollment Statistics

a. Please provide enrollment statistics over the prior five years.

The following table shows the enrollment in the program. Since the program was launched on Winter 16, all numbers are referred to Winter quarter.

Quarter	Enrollment
Winter 16 (launch)	4
Winter 17	9
Winter 18	14

About 45% of the enrolled students are international, about 30% female, and about 25% of them Hispanic.

9. **Program Quality**

    a. Please provide evidence of program quality.

    Student Success:

    Monitoring and Advising

    Faculty members are responsible for academic advising. Therefore, every student has an academic advisor who is one of the full-time faculty members who are teaching in the MSSE program. The faculty advisors are assigned by the IME department.

    All full-time engineering faculty have at least four office hours per week, and most are available for more than these minimum required hours. Students may meet with their advisor during regular office hours, or by appointment. Students and faculty use the curriculum provided in the MSSE webpage (link provided above) to track the student's progress through the curriculum.

    Students who have questions regarding the content of a particular course that they are taking generally see the course instructor, all of whom maintain regular posted office hours.
    The department administrative support coordinator assists students with procedural matters and answers questions on certain policy issues, but does not provide academic advising. Librarians, career center personnel, and many others outside the Department also provide supplementary advising to students.

    Satisfaction of Program Requirements:

    To successfully complete the program, a student must receive a passing grade in each of the required courses. The vast majority of students complete the degree requirements   exactly   as   stated   on   the   MSSE   program   website (https://www.cpp.edu/~ceu/degree-programs/systems-engineering/curriculum.shtml), either by completing coursework at Cal Poly Pomona or by transferring courses for degree credit. In limited circumstances, course prerequisites may be waived. Such requests are granted only when there is clear evidence the student has a background or academic preparation comparable to the prerequisite course, and must be approved by the department chair. These requests are extremely rare.
    Students cannot receive academic credit solely by virtue of work experience, and we generally do not permit "challenging" a course (i.e., receiving course credit by taking an exam in lieu of completing the course).

    In addition, all students must satisfy the GPA requirements of "overall GPA ≥ 3.0". Students whose GPA falls below 2.0 are placed on academic probation and are notified of the academic requirements to complete their degree. Those whose GPA falls sufficiently far below 2.0 (based on a certain formula) are disqualified and

thus are no longer students at this university. In some cases, disqualified students who meet certain criteria (such as improving their academic standing by taking courses through the College of the Extended University) might later be reinstated.

The College of Engineering also has published policies on academic integrity. Violations are processed using the procedures described in this policy.

10. **Evidence of Societal Need**

   a. Provide evidence of applicable workforce demand projections and other relevant data that indicate labor-market demand.

   Note: Data Sources for Demonstrating Evidence of Need

   APP Resources Web http://www.calstate.edu/app/resources.shtml

   US Department of Labor, Bureau of Labor Statistics

   California Labor Market Information

   Although there is no specific data for the System's Engineer job outlook, graduates in this field are closely linked to Industrial Engineering. For Industrial Engineering, the Occupational Outlook Handbook projects a national job increase of 10% between 2016-2026, with more than 25000 jobs being generated annually in 2016. (https://www.bls.gov/ooh/architecture-and-engineering/industrial-engineers.htm#tab-6). California's EDD projects a job increase of 10.% between 2014-2024 in the state (adding 2500 jobs/year), but a 15.8% in the Inland Empire area (adding 120 jobs/year), (http://www.labormarketinfo.edd.ca.gov/OccGuides/Detail.aspx?Soccode=172112&geography=0604000071).

   It should be emphasized however that most students in this program are already employed.

11. **Student Demand**

   a. Provide compelling evidence of continued student interest in enrolling in the program. Types of evidence vary and may include national, statewide, and professional employment forecasts and surveys; petitions; survey results from potential students; lists of related associate degree programs at feeder community colleges; reports from community college transfer centers; and enrollments from feeder baccalaureate programs, for example.

   Our enrollment numbers have been going up as evidenced by the data in the Enrollment Statistics part of this proposal, where it is also mentioned that jobs are increasing at a pace of 10% in the Industrial Engineering profession.

   In 2010 CNET names Systems Engineering as the "Best Job in America" (https://www.cnet.com/news/systems-engineer-deemed-best-job-in-america/).

   Additionally nationally there is a need for Systems Engineers as is evidenced for example in Mishory,Jordana; "Welby: Systems Engineering Workforce Faces Shrinking Pool Of Talent", Inside the Pentagon, Arlington, Vol. 30, Iss. 15, 2014 where it is stated: "a large number of experienced systems engineers and analysts

are slated to retire within the next five to 10 years, leaving a "projected shortfall of qualified senior-level systems engineering leaders."

All areas of Engineering can potentially feed this program. Our B.S. in Industrial Engineering has had a steady enrollment during the last 5 years of about 300 students; during the same period, Engineering in general has had a steady enrollment of about 5300 students. However, as already mentioned this program caters to the working professional.

12. Appropriateness to Institutional Mission

a. Please provide a brief narrative describing how the program supports the institutional mission of the campus.

Institutional Mission Statement
Cal Poly Pomona's mission is to cultivate success through a diverse culture of experiential learning, discovery, and innovation.

College of Engineering Mission Statement
Prepare students for a wide range of careers by implementing a polytechnic philosophy that emphasizes application-oriented problem solving, collaborative teamwork, effective communication, creativity, and lifelong learning.

The Mission of the IME Department
1. To serve the university, the community, and our alumni by offering ABET accredited degree programs and courses that prepare students for study at both the undergraduate and graduate level.

2. To teach sound engineering principles, ethics and theory supported with significant classroom, laboratory and industrial experiences to a diverse student population. Our goal is to prepare students for immediate and productive entry into today's workplace or the best graduate schools.

3. To continuously improve the curriculum, faculty, scheduling, advising, teaching methods, facilities, and student services while maintaining safety of students, faculty, and staff as a top priority.

4. To educate the general public about the exciting fields of industrial and manufacturing engineering and the opportunities available at Cal Poly Pomona.

MSSE Program Mission Statement
The Master of Science in Systems Engineering (MSSE) will meet the need of the industry for highly qualified and well-trained systems engineers.
The program gives engineers from different disciplines the advanced training to understand the role of systems engineering in process and product development for large complex systems, develop advanced skills in applying the systems engineering processes used during product development, describe the constraints imposed by society on systems engineering, develop mastery in

team interaction and communication skills, develop management skills for Systems Engineering Projects.

MSSE Program Learning Outcomes
The goal of the MSSE is to prepare well rounded, technically savvy students who can work in modern private and public sectors, as well as, government agencies where they must:
1. Recognize and understand behavior of processes in complex systems
2. Be skillful in the systematic evaluation of complex organizational issues and in synthesizing interdisciplinary solutions to such problems
3. Be able to evaluate the impact of these solutions in the broader context of the organization and society
4. Effectively perform and communicate in organizational interdisciplinary teams
The degree will prepare students to work in the new market that requires people with solid engineering knowledge that is enhanced by other skills such as entrepreneurship and management. The systems engineering program will provide a broader perspective to working in an engineering context.

Consistency of the Program Learning Objectives with the Mission of the College of Engineering and the Institution
The MSSE Program Educational Objectives align well with the University mission statement:
"We cultivate success through a diverse culture of experiential learning, discovery, and innovation."
"...cultivate success..." is aligned with objectives 1, 2 and 3.
"...experiential learning, discovery, and innovation..." are firmly embedded in objectives 1, 2, 3 and 4.
"...diverse culture" is the essence of objective 4.
The MSSE mission statement is periodically reviewed by the faculty to see if it continues to reflect the mission of the IME department, COE, and the university in the greater scope of the institution. The last review by faculty was at the Faculty meeting in March 2018.

13. **Preparation for Employment and/or Graduate Education**

   a. Please write a brief narrative on how the program prepares graduates for employment and/or graduate education.

   Launched in Winter 2016, the MSSE was designed primarily for career enrichment of middle level professionals. The curriculum was developed in response to the industry needs with input from private industry, governmental agencies, and academia. The MSSE provides a broad education and opportunities for students to design engineering systems, solve operational problems, and shape organizational structures. It includes courses in engineering management, the science and business of system thinking, management of innovation, leadership management, business risk analysis and assessment and analytical tools and techniques to lead, redesign, anticipate, and manage organizational change in an interdisciplinary environment. After finishing this program, our graduates are prepared to apply systems thinking

and systems approaches to successfully architect, design and manage complex technical systems and processes throughout their life cycles, and to address systems integration and life cycle issues of any enterprise in today's market that is driven by quality, complexity, productivity, and globalization.

14. Self-Support Programs (in conformance with EO 1099 and EO 1102))

a. For self-support programs, please provide the following information including costs:
   - specification of how all required EO 1099 self-support criteria are met
   - the proposed program does not replace existing state-support courses or programs
   - academic standards associated with all aspects of such offerings are identical to those of comparable state-supported CSU instructional programs
   - explanation of why state funds are either inappropriate or unavailable
   - a cost-recovery program budget is included*
   - student per-unit cost is specified
   - total cost for students to complete the program is specified

* Basic Cost Recovery Budget Elements
(Three to five year budget projection)

   Student per-unit cost
   Number of units producing revenue each academic year
   Total cost a student will pay to complete the program

   Revenue - (yearly projection over three years for a two-year program; five years for a four-year program)
       Student fees
       Include projected attrition numbers each year
       Any additional revenue sources (e.g., grants)

   Direct Expenses
       Instructional costs – faculty salaries and benefits
       Operational costs – (e.g., facility rental)
       Extended Education costs – staff, recruitment, marketing, etc.
       Technology development and ongoing support (online programs)

   Indirect Expenses
       Campus partners
       Campus reimbursement general fund
       Extended Education overhead
       Chancellor's Office overhead

   *Additional line items may need to be added based on program needs

COLLEGE OF THE EXTENDED UNIVERSITY
PROGRAM:MSSE
EST. COMPLETION: 1.5 years full-time (9 units per semester) 2 years part-time (6 units per semester)
TOTAL PROGRAM UNITS: 30

TYPE: CREDIT

	Year One	Year Two	Year3	Notes
Units	18	18	18	
Tuition per unit	$892.50	$892.50	$892.50	
Head count	16	18	20	
Attrition: Attrition 2 students per year with no net loss				
Revenue:				
Tuition	257,040.00	289,170.00	321,300.00	
Less Discount	-	-	-	
Total Revenue	**257,040.00**	**289,170.00**	**321,300.00**	
Expenses:				
Direct Expenses:				
Director Salaries	5,500.00	5,500.00	5,500.00	
Faculty Salaries	69,692.00	69,692.00	69,692.00	
Benefit - Medicare	1,090.28	1,090.28	1,090.28	
ADA				
Classroom Rental				
Credit Card Processing Fee (2.99%)	7,685.50	8,646.18	9,606.87	
Equipment Rental				
Marketing Fee	25,704.00	28,917.00	32,130.00	
Supplies & Services				
Travel				
Other Expenses	3,000.00	3,000.00	3,000.00	
Total Direct Expenses:	112,671.78	116,845.47	121,019.15	

Indirect Expenses:

Campus Charge 6% (Estimated)	15,422.40	17,350.20	19,278.00
CEU Overhead -25%	64,260.00	72,292.50	80,325.00
CO Offc, State Prorata 2.11%	5,423.54	6,101.49	6,779.43
College Partner Admin (5%)	12,852.00	14,458.50	16,065.00
Risk Mngmt 3.04%	2,285.84	2,285.84	2,285.84
Total Indirect Expenses:	100,243.78	112,488.52	124,733.27
Total Expenses	**212,915.56**	**229,333.99**	**245,752.42**
Income (Loss) before Reserved	44,124.44	59,836.01	75,547.58
Reserved (5%)	2,206.22	2,991.80	3,777.38
Net Income (Loss)	**41,918.22**	**56,844.21**	**71,770.20**

Net Split - Distribution:

College Partner 50%	20,959.11	28,422.10	35,885.10
CEU 50%	20,959.11	28,422.10	35,885.10
TOTAL	41,918.22	56,844.21	71,770.20

Questions?

Contact Academic Program Planning

Dr. Christine Mallon
Assistant Vice Chancellor
Academic Programs and Faculty Development
Phone   (562) 951-4672
Fax (562) 951-4982
cmallon@calstate.edu

Academic Program Planning is on the Web http://www.calstate.edu/APP/

Contact Extended Education
Dr. Sheila Thomas
State University Dean, Extended Education

Phone   (562) 951-4795
Fax   (562) 951-4982
sthomas@calstate.edu

APP 10-8-14

Revised 11/18/15

Appendix A – MSSE Self Study Report

Self-Study Report

Master of Science in Systems Engineering (MSSE) Program

California State Polytechnic University Pomona, CA

March 2018

Table of Contents

Section 1 - Introduction

(a) Describe the program, including in which department and college it resides, the degree granted, and any emphases or options within the program.

Master of Science in Systems Engineering (MSSE) is offered by the Industrial and Manufacturing Engineering Department at College of Engineering at Cal Poly Pomona. This program is operating entirely on a self-supported model through the College of Extended University.

Launched in Winter 2016, the MSSE was designed primarily for career enrichment of middle level professionals. The curriculum was developed in response to the industry needs with input from private industry, governmental agencies, and academia. The MSSE provides a broad education and opportunities for students to design engineering systems, solve operational problems, and shape organizational structures. It includes courses in engineering management, the science and business of system thinking, management of innovation, leadership management, business risk analysis and assessment and analytical tools and techniques to lead, redesign, anticipate, and manage organizational change in an interdisciplinary environment. After finishing this program, our graduates are prepared to apply systems thinking and systems approaches to successfully architect, design and manage complex technical systems and processes throughout their life cycles, and to address systems integration and life cycle issues of any enterprise in today's market that is driven by quality, complexity, productivity, and globalization.

MSSE Program Contact Information

Kamran Abedini, PhD, Chair
Department of Industrial & Manufacturing Engineering
California State Polytechnic University, Pomona
3801 W. Temple Avenue
Pomona, CA 91768
Telephone: 909-869-2555
Email: kabedini@cpp.edu

Saeideh Fallah-Fini, PhD, Assistant Professor
Department of Industrial & Manufacturing Engineering
California State Polytechnic University, Pomona
3801 W. Temple Avenue
Pomona, CA 91768
Telephone: 909-869-4087
Email: sfallahfini@cpp.edu

Options

There is no specific emphasis or option in this master program.

Program Delivery Modes

The MSSE program is delivered using evening classes consisting of traditional lecture/laboratory classes. Blackboard 9.1 is used as a course management system at the discretion of each instructor. A few classes are taught as hybrid classes. This makes the program more accessible to professionals working in industry.

Program Locations

All classes in the program are delivered from the main campus in Pomona. The IME department office (Building 17-Room 2643), faculty offices, are located in Buildings 9, 13, 17. The classes and most laboratories are located at the Extended University building.

Public Disclosure

California State Polytechnic University, Pomona College of Engineering Official
Website http://www.cpp.edu/~engineering/

California State Polytechnic University, Pomona Master in Systems Engineering Official
Website
https://www.cpp.edu/~ceu/degree-programs/systems-engineering/index.shtml

California State Polytechnic University, Pomona Facts and Figures.
https://www.cpp.edu/~aboutcpp/calpolypomona-overview/facts-and-figures.shtml

(b) List the mission and goals and discuss their relationship to those of the college and University.

Institutional Mission Statement

Cal Poly Pomona's mission is to cultivate success through a diverse culture of experiential learning, discovery, and innovation.

College of Engineering Mission Statement

Prepare students for a wide range of careers by implementing a polytechnic philosophy that emphasizes application-oriented problem solving, collaborative teamwork, effective communication, creativity, and lifelong learning.

The Mission of the IME Department

1.	To serve the university, the community, and our alumni by offering ABET accredited degree programs and courses that prepare students for study at both the undergraduate and graduate level.
2.	To teach sound engineering principles, ethics and theory supported with significant classroom, laboratory and industrial experiences to a diverse student population. Our goal is to prepare students for immediate and productive entry into today's workplace or the best graduate schools.
3.	To continuously improve the curriculum, faculty, scheduling, advising, teaching methods, facilities, and student services while maintaining safety of students, faculty, and staff as a top priority.
4.	To educate the general public about the exciting fields of industrial and manufacturing engineering and the opportunities available at Cal Poly Pomona.

MSSE Program Mission Statement

The Master of Science in Systems Engineering (MSSE) will meet the need of the industry for highly qualified and well trained systems engineers.

The program gives engineers from different disciplines the advanced training to understand the role of systems engineering in process and product development for large complex systems, develop advanced skills in applying the systems engineering processes used during product development, describe the constraints imposed by society on systems engineering, develop mastery in team interaction and communication skills, develop management skills for Systems Engineering Projects.

MSSE Program Objectives

The goal of the MSSE is to prepare well rounded, technically savvy students who can work in modern private and public sectors, as well as, government agencies where they must understand:
1.	The technical aspect of process and product development
2.	The financial implication of technology investment

3.   Market forces and their implication on enterprise direction
4.   The capabilities and constraints of engineering disciplines
5.   Management of personnel, resources and projects

The degree will prepare students to work in the new market that requires people with solid engineering knowledge that is enhanced by other skills such as entrepreneurship and management. The system engineering program will provide a broader perspective to working in an engineering context.

Consistency of the Program Educational Objectives with the Mission of the College of Engineering and the Institution

The MSSE Program Educational Objectives align well with the university mission statement:

"We cultivate success through a diverse culture of experiential learning, discovery, and innovation."

"…cultivate success…" is aligned with objectives 3, 4 and 5.

"…experiential learning, discovery, and innovation…" are firmly embedded in objectives 1, 2, 3 and 4.

"…diverse culture" is the essence of objective 5.

The MSSE mission statement is periodically reviewed by the faculty to see if it continues to reflect the mission of the IME department, COE, and the university in the greater scope of the institution. The last review by faculty was at the Faculty meeting in March 2018.

(c) Review of previous self-study, its recommendations, and resulting changes.

There is no previous self-study report as this is currently a pilot program.

Section 2 - The Program Description

This section should fully describe the program and its role in helping the University achieve its overall mission.

(a)   Review the units to degree. If the degree program being reviewed is deemed to require more than 45-quarter units and or 30-semester units, academic reasons for continuing such practice should be presented.

The MSSE program consists of 45 quarter units (Minimum of 41 units plus 4 units of culminating experience), and takes approximately two years to complete.

Graduation Writing Test (GWT) Information:

All persons who receive undergraduate, graduate, or external degrees from Cal Poly Pomona must pass the Graduation Writing Test (GWT). If students are unable to pass the test after two attempts, they may apply to enroll in CPU401, a class in which your writing is assessed on a portfolio basis. Students enrolling in CPU401 will be charged the state graduate level tuition fees for this course.

(b)   List the curriculum (core, directed electives, emphasis areas, minors, etc.). Updated expanded course outlines (no more than five years old) for all courses must be on file in the department office and available to reviewers.

Course No	Course Title	Units
Required Courses		
IME 510	Introduction to Systems Science	3
IME 511	Advanced Engineering Economics	4
IME 512	Systems Engineering Management	3
IME 513	Systems Engineering Life Cycle Design	3
IME 515	System Sustainability	4
IME 519	Operations Research in System Analysis	4
IME 520	Systems Simulation for Managers	4
IME 692	Systems Engineering Project	4
IME 523	Systems Architecture	4
Elective Courses		
IME 516	Facility Planning System	4
IME 517	Healthcare Systems Engineering	4
IME 518	Human Systems Interactions	4
IME 514	Emergency System	4
IME 522	Supply Chain Management in Production Systems	4

(f)   Discuss any major curricular changes made in the past five years and notable changes being made during conversion.

In the semester system, the MSSE program will consist of 30 semester units. The following table shows the labels and the names of the courses that will be used in the semester system. Major changes are as below:

1.   Systems Engineering Life Cycle Design (IME513) and Systems Engineering Management (IME512) were combined into one class in semester system called System Engineering Life Cycle Design and Management (SE 5130).

2.   Course labels were changed from IME to SE

Course No	Course Title	Units
Required Courses		
SE 5100	Introduction to Systems Science	3
SE 5110	Advanced Engineering Economics	3
SE 5130	System Engineering Life Cycle Design and Management	3
SE 5150	System Sustainability	3
SE 5190	Operations Research in System analysis	3
SE 5200	System Simulation for Managers	3
SE 5230	System Architecture	3
SE 6950	System Engineering Project	3
	Total	24
Elective Courses (Select 6 units from the following list)		
SE 5160	Facility Planning System	3
SE 5170	Healthcare Systems Engineering	3
SE 5180	Human Systems Interaction	3
SE 5140	Emergency System and Cyber Security	3
SE 5220	Supply Chain Management in Production Systems	3

(g)   Discuss the anticipated evolution of the curriculum. Describe the external needs/demands for the program. Describe how new ideas, directions, and technical advances have been incorporated into the curriculum. Discussion should include comparisons, as relevant, to college, university, CSU, and national trends and needs.

Currently the program is being evaluated to change from Pilot to Permanent. The demand for the program has increased from the inception to threefold. The program started with a cohort of 4 students registered for this self-support program offered through our College of Extended University. Due to much research on the pricing, the unit cost was chosen to be competitive with similar programs at local universities. With the cost and profit sharing structure, the program showed to be profitable even with four students. The cost per unit currently is higher than that of the state side and we did have one international student dropping out to enter the MS in Engineering Management at Cal Poly Pomona due to its cost. However, others have remained.

Currently there are 15 students in the MSSE program. One will finish this quarter and about four more are expected to finish in the Spring quarter. Because we have been also offering classes in Summer, students are able to finish the program in 1.5 years. Further increase in demand is expected once the College of Extended University finds more enhanced marketing to national and international students in addition to our faculty trying to design more of the classes to be hybrid.

CSU does not have another MS program in Systems Engineering and the national trend indicates a much higher demand for MSSE. There are currently two professional societies in the area of Systems Engineering. One is INCOSE (International Council on Systems Engineering) and the other IISE (Institute of Industrial and Systems Engineering). We currently have student chapters of both of the said organizations active at our campus who will surely attract more students in the field and thus more interest in our graduate program.

(h)   Discuss any curricular bottlenecks and efforts to alleviate such problems. (Note: This is most-likely a non-issue and it can be stated as such.)

Currently, we are not facing any curricular bottleneck.

(i)   Include a table indicating often required and elective courses have been offered in the four years preceding the program review. Explain the reason for any courses that have not been offered at least every two years.

Required and elective courses offered in the past two years are as below:

Course No	Course Title	Status
Required Courses		
IME 510	Introduction to Systems Science	offered
IME 511	Advanced Engineering Economics	offered
IME 512	Systems Engineering Management	offered
IME 513	Systems Engineering Life Cycle Design	offered
IME 515	System Sustainability	offered
IME 519	Operations Research in System Analysis	offered
IME 520	Systems Simulation for Managers	offered
IME 692	Systems Engineering Project	offered
IME 523	Systems Architecture	offered
Elective Courses		

IME 516	Facility Planning System	offered
IME 517	Healthcare Systems Engineering	offered
IME 518	Human Systems Interactions	offered
IME 514	Emergency System	offered
IME 522	Supply Chain Management in Production Systems	offered

Section 3 - Program Assessment

(a) Summarize the accreditation status or other external assessment of the program.

External assessment or accreditation status review of the MSSE program was not performed previously.

(b) List the programs' student learning outcomes

Originally the committee designing the program decided on the following Student Learning Outcomes (SLO), focusing on the skills and abilities students are expected to demonstrate at graduation) for the MSSE program are to:

1.   Demonstrate knowledge of designing complex engineering systems.
2.   Identify and critically analyze operations of organizations and real-world problems
3.   Demonstrate skills in conducting research, analysis and interpretation of engineering data
4.   Demonstrate excellence in oral and written communication skills

Upon further evaluations by the MS in Systems Engineering Committee, the SLOs were enhanced to the following set for the semester system:

1.   Diagnose and identify causes of system failure (apply knowledge and effectively apply engineering skills and tools)
2.   Develop proposals to prescribe solutions to system failure (design experiments, design systems and solve advanced problems)
3.   Engage with interdisciplinary teams to design systems (work with interdisciplinary teams, show effective communication skills and apply business skills)
4.   Fluently express understanding of global, ethical and societal impact of system behavior (professionalism & ethics, expresses global & social impacts)

5.   Engage in lifelong learning by assessing impacts of incorporating new elements in existing systems (Lifelong learning, incorporates Contemporary Issues and Employability)

(c) Include a matrix showing how courses in the program meet the student learning outcomes.

Students Outcomes Assessment – Core Course (I= Introduction; P= Practice; M=Master)

Course No	Course Title	SO-1	SO-2	SO-3	SO-4
IME 510	Introduction to Systems Science	I		I	I
IME 511	Advanced Engineering Economics			P	P
IME 512	Systems Engineering Management	I			I
IME 513	Systems Engineering Life Cycle Design	P	I	I	P
IME 514	Emergency Systems			I	P
IME 515	System Sustainability	I		I	P
IME 516	Facility Planning Systems		I	P	P
IME 517	Healthcare Systems	I	P	P	P
IME 518	Human Systems Interaction			I	P
IME 519	Operations Research in System Analysis			P	P
IME 520	Systems Simulation for Managers			P	P
IME 692/IME 521	Systems Engineering Project	M	M	M	M
IME 522	Supply Chain Management in Production Systems		P	P	P
IME 523	Systems Architecture	I	I		P

(d) Describe the process used for assessing the learning outcomes, courses and curricular structures.

Integrity:

The MSSE is a pilot program and uses appropriate processes for assessing and evaluating the extent to which the **student outcomes** are being attained.

Our department utilizes direct assessment instruments of the student outcomes including the faculty's evaluation of the student's masters research project final report and oral presentation.

Indirect measurements include the masters alumni survey. These evaluations are used to update or add curriculum and introduce new teaching methodologies. This activity has not been officially performed since we do not have enough graduates yet.

Assessment Plan:

In addition to collecting and discussing data from all those who are taking EGR 692, at the onset of their culminating experience activity when the take IME 510, the following schedule is set to receive information from courses taught: (**C**: Collection of Assessment Data and Analysis, **D**: Discussion of Assessment Results)

	W-16	SP-16	SU-16	F-16	W-17	SP-17	SU-17	F-17	W-18	SP-18
SLO-1	C IME-510	D IME 510			C IME692	D IME692		C IME 510	D IME 510	C IME692
SLO-2					C IME692	D IME692				C IME692
SLO-3	C IME510	D IME 510			C IME692	D IME692		C IME 510	D IME 510	C IME692
SLO-4	C IME510	D IME 510			C IME692	D IME692		C IME 510	D IME 510	C IME692

Collection of Assessment Data and Analysis

Direct Data:

The following measurements will be used to assess each learning outcomes:
- Evaluation of student master's project report or master's thesis as well as the final student oral presentation.
- Embedded questions in final exam, embedded assessment of selected questions in written examinations measured against a Likert scale (1 through 4 on selected criteria)
- Faculty assessment of student oral presentation and/or written report of contemporary issues.

Indirect Data

- Three-year assessment of program objectives by master alumni surveys is planned to be performed in future. Master alumni surveys will be analyzed for potential improvements for faculty review.

Discussion of Assessment Results

The graduate committee reviewed the assessment result as provided by the feedback received from both IME 510 and IME 521/EGR 692. IME 510 was designed to be the introductory level course to get the students motivated to obtain the adequate level of the SLOs. The master's project was used to evaluate the SLOs where students have received their education and are at the mastery stage of applying their knowledge.

The first time that IME 510 was offered, the responses to the SLOs as assessed by the instructor was low (low, medium, high). Student feedback indicated much information and not adequate time for learning. The instructor realigned the course to be more acceptable for the time limitations. The second time the course was offered (Fall 2017) the instructor assessment of the four SLOs showed drastic improvement in the outcomes.

All four SLOs were evaluated by the master's project instructor through reviewing student's proposals, periodical reports, final written project report and final oral presentations. Since there was only one set of students going through this course no comparison can be made. However, it could be mentioned that the high assessment of all SLOs could be attributed to the fact that there were only four students in that class and through periodical feedback they were led to perform at the highest level, exceeding the expectations.

These high-quality finished projects are going to be used to share with other students for an indication of a high-quality expectation set as the standard for MSSE theses/projects.

(e)   Evaluate the procedures for collecting and analyzing evidence that program goals and objectives are being achieved.

Our MSSE program committee is planning to collect data from our students two years after graduation, once adequate number of them have graduated.

(f)   Summarize the assessment performed in the last five years, conclusions from that assessment, and any changes to the program based on that assessment.
 No data available

Section 4 - Program Quality

Section 4.1 - Faculty
This section should include both description and self-appraisal of the following:

(b) Summarize faculty research and scholarly activity associated with the Systems Engineering Program.

The following scholarly activities are associated with full time CPP faculties. For part time instructors, please refer to their CVs.

Dr. Kamran Abedini

Dr. Abedini is a professor and chair in Industrial and Manufacturing Engineering department at Cal Poly Pomona. Dr. Abedini's research has mainly focused on ergonomics and biomechanical analysis, application of lean manufacturing in services and processes, and supply chain. In that capacity, Dr. Abedini has extensively applied ergonomics and human engineering, production and supply chain planning, as well as lean manufacturing on various industry and government projects, in energy and gas industry, manufacturing industry, and service industry.

Dr. Saeideh Fallah-Fini

Dr. Fallah-Fini is an assistant professor in Industrial and Manufacturing Engineering department at Cal Poly Pomona. She is also an adjunct assistant professor in the Bloomberg School of Public Health at Johns Hopkins University. She is system dynamics modeler by training and have extensive experience in (1) development, calibration, and validation of system dynamics models of complex socio-technical systems, with applications in civil infrastructure management, public health, and manufacturing systems; (2) productivity and performance measurements. As a PhD student, she worked for four years on a project funded by NSF and Virginia Department of Transportation (VDOT) in which she worked extensively on using system dynamics modeling to capture dynamics of road deterioration and renewal processes and consequently evaluating and optimizing the highway maintenance policies used by VDOT to allocate the limited budget among road sections in need of maintenance operations. She also worked extensively on using analytical methods to evaluate the efficiency and effectiveness of two highway maintenance contracting strategies (i.e., traditional versus performance-based methods) used to outsource highway maintenance operations at the state of Virginia. This experience has given Dr. FallahFini a great understanding of the physics of road deterioration and renewal processes, road condition data (how they are collected and measured), as well as highway maintenance policies and decision making processes. Dr. Fallah-Fini is also a member of the Systems Science Core of the Johns Hopkins Global Obesity Prevention Center, where she has worked extensively on applying systems thinking

and systems engineering techniques for addressing various problems in obesity, both childhood and adulthood, and for analyzing various policies.

Dr. Greg Placencia

Dr. Placencia is an assistant professor in Industrial and Manufacturing Engineering department at Cal Poly Pomona. His work focuses on applying systems engineering techniques to address various problems focusing on:

1.   Human Trafficking Study: Dr. Placencia is working with Drs. Sampath Jayarathna (Computer Science) and Shokoufeh Mirzaei (Industrial and Manufacturing) on a human trafficking study with the LA City Attorney's Office, Coalition to Abolish Slavery and Human Trafficking (CAST LA), and Los Angeles Sheriff's Department. The work involves using system engineering / systems dynamics to examine the current processes used by police, legal, and survivor network systems to develop ways to improve their abilities to disrupt tracking activities in Los Angeles County. This is through a Strategic Interdisciplinary Research Grant (2017 – 2018).

2.   Addressing food insecurity with IE students and Engineers Without Borders This activity looks at the problems of food insecurity at Cal Poly Pomona to develop improved food distribution systems at CPP. He is currently using systems engineering and work analysis and design to improve the Mobile Food Pantry event by examining the systems dynamics of matching food and related services (e.g. CalFresh and Career Center) with students, staff, and faculty. This will include working with Sowing Seeds for Life (the food provider) to improve data analysis to establish the flow of food and improving delivery systems to CPP and other local universities.

3.   Addressing prisoner rehabilitation and violence using smart cell design and environmental ergonomics. This research and activity uses systems engineering to examine the issues of incoming inmates with rehabilitation. As reported by new agencies, the California Department of Corrections and Rehabilitation (CDCR) has had huge problems with recidivism. His work focuses on developing improved methods of rehabilitation starting with the design of the prison cell and its effects on prisoners. This will be incorporated with further research on how the legal system, policing, social services, etc. affect the problem of incarceration.

Dr. Shokoufeh Mirzaei

Dr. Mirzaei is an associate professor in Industrial and Manufacturing Engineering department at Cal Poly Pomona. In a collaboration with faculties from California State University, Northridge a research was conducted to utilize the Bow-tie as a barrierbased risk assessment methodology to study major power blackouts in the US and Canada. They proposed a system-oriented framework to holistically analyze technological- as well as human and organizational factors (HOFs)-related risks of power blackouts and promote resiliency. This framework was developed by incorporating preventive as well as mitigation controls into one integrated model through connecting hazards to their possible causes and consequences.
The Bow-tie methodology has been applied to different context such as oil and gas drilling and transportation. However, it had not been implemented for power blackouts risk assessment through the analysis of both technical components and HOFs.

During the academic year 2016-207, Dr. Mirzaei received the SIRG award in the area of trafficking prevention. In this research, she serves as a Co-PI with Dr. Greg Placencia during the academic year 2017-2018. Specifically, her task has been advising graduate students to develop a system framework of the law enforcement and legislatives in trafficking preventions using systems engineering methods e.g. ACCIMAP.

Dr. Biman Ghosh

Dr. Ghosh is a professor in Industrial and Manufacturing Engineering department at Cal Poly Pomona. His work mainly focuses on applying simulations and systems engineering techniques for improving productivity in various manufacturing settings.

Section 4.2 - Student Success
a) Describe the departmental advisement program and evidence of quality

Monitoring and Advising

Faculty members are responsible for academic advising. Therefore, every student has an academic advisor who is one of the full-time faculty members who are teaching in the MSSE program. The faculty advisors are assigned by the IME department.

All full-time engineering faculty have at least four office hours per week, and most are available for more than these minimum required hours. Students may meet with their advisor during regular office hours, or by appointment. Students and faculty use the curriculum provided in the MSSE webpage (link provided above) to track the student's progress through the curriculum.

Students who have questions regarding the content of a particular course that they are taking generally see the course instructor, all of whom maintain regular posted office hours.

The department administrative support coordinator assists students with procedural matters and answers questions on certain policy issues, but does not provide academic advising. Librarians, career center personnel, and many others outside the Department also provide supplementary advising to students.

Satisfaction of Program Requirements

To successfully complete the program, a student must receive a passing grade in each of the required courses. The vast majority of students complete the degree requirements exactly as stated on the MSSE program website (https://www.cpp.edu/~ceu/degree-programs/systems-engineering/curriculum.shtml), either by completing coursework at Cal Poly Pomona or by transferring courses for degree credit. In limited circumstances, course prerequisites may be waived. Such requests are granted only when there is clear evidence the student has a background or academic preparation comparable to the prerequisite course, and must be approved by the department chair. These requests are extremely rare.

Students cannot receive academic credit solely by virtue of work experience, and we generally do not permit "challenging" a course (i.e., receiving course credit by taking an exam in lieu of completing the course).

In addition, all students must satisfy the GPA requirements of "overall GPA ≥ 3.0".

Students whose GPA falls below 2.0 are placed on academic probation and are notified of the academic requirements to complete their degree. Those whose GPA falls sufficiently far below 2.0 (based on a certain formula) are disqualified and thus are no longer students at this university. In some cases, disqualified students who meet certain criteria (such as improving their academic standing by taking courses through the College of the Extended University) might later be reinstated.

The College of Engineering also has published policies on academic integrity. Violations are processed using the procedures described in this policy.

Change of Majors

Cal Poly Pomona students currently enrolled in another master program may submit a request to change to our MSSE program. For non-impacted programs, such requests are normally granted so long as the student is in good academic standing.

For impacted programs, such requests are evaluated using the same criteria as for the most recent incoming transfer applicants.

e)   Discuss co-curricular learning experiences that are relevant to the program goals (such as internships, research experiences, study abroad).

Many of our students are currently working and as such are required to perform their Master's Project in the industry. They are encouraged to perform in teams, especially if it is acceptable by their organizations to allow classmates to be a team member of the project. Students are also encouraged to work with faculty on performing research projects and publish.

f)   A summary of the following data should also be included:
   (a) Number of graduates employed in a field or job requiring the degree(s)

Most of our graduate students are already working. The first cohort of four students all have full time jobs. One of the students after receiving his degree was able to obtain a better position at a different organization. Another graduate was able to find a part-time teaching position at the IME department here at CPP, in addition to teaching short courses at a UC campus.

   (b) Other accomplishments by current and former students that reflect on program quality

See item "f" above.

Section 5 - Resources

(a) Enrollment. Discuss five-year data supplied by the Office of Institutional Research, Assessment and Planning. The discussion should include trends in numbers and retention of students by gender and ethnicity, and should include comparisons, as relevant, to college, university, CSU, and national trends and needs.

Our first cohort of 5 students graduated last year and one this winter. Our new cohort has about 15 students. This rate of growth shows significant opportunities for further growth of this program. Moreover, about 45% of our students are international, about 30% of them are female, and about 25% of them are Hispanic, which shows the strength of attracting international and minority students.

Section 6 - Suggestions for Action

We strongly suggest changing the Pilot program to Permanent. This is due to increasing demand and enrollment and also seeing the success of our first cohort of students.

Section 7 - External Review

Below is the information of our external reviewers:

Reviewer 1:

James Elliott Moore, II, PhD

Former Associate Dean; Former Chair; Past President of the Inst. Of Industrial and Systems Engineers; Professor, Epstein Department of Industrial and
Systems Engineering
University of Southern California

Mailing Address:
Epstein Department of Industrial and Systems Engineering
Louise Kerckhoff Hall (KER), Suite 204, MC-7725
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Los Angeles, California 90089

Email: jmoore@usc.edu
Contact Number: (213) 740-0595 (direct), (213) 663-8146 (cell), (213) 740-5297 (fax)

Reviewer 2:

David Mason, ESEP, MSBA, LSBB

Consultant, Project Performance International

Mailing Address:
10576 Gabacho Dr.,
San Diego, California, 92124-1403

Email: david.mason.se@gmail.com
Contact Number: (650) 999-1030

Our reviewer 1 (Dr. James Elliott Moore) is coming from USC which has a similar competing program. We used that program as a benchmark when we were developing our own master in systems engineering program. Both reviewers are active members of the systems engineering community. The reviewers can provide

us with valuable insights on how to enhance our program from both academic and industry aspects.

Section 8 - Summary

In summary, the MSSE program at Cal Poly Pomona has shown a significant growth in terms of number of students enrolled over the last two years since the start of this program. Our efforts for benchmarking similar successful programs as well as implementing continuous improvement practices for evaluating our courses and taking corrective actions based on the obtained results have led to increase in satisfaction of our students, making it a viable successful program to be offered permanently.

Section 9 - Faculty Participation

All full-time faculties responsible for the MSSE program have been involved in the review process and have reviewed the full academic program review report.

Faculty Name	Signature
Dr. Kamran Abedini	
Dr. Saeideh Fallah-Fini	
Dr. Shokoufeh Mirzaei	
Dr. Greg Placencia	
Dr. Biman Ghosh	

Appendix B – MSSE Executive Summary

Executive Summary for Master of Science in Systems Engineering (MSSE)
Industrial and Systems Engineering
Cal Poly Pomona
March 2018

1) **Names and affiliations of the reviewers (accreditation commission for externally accredited programs):**

Reviewer 1:
James Elliott Moore, II, PhD
Former Associate Dean; Former Chair; Past President of the Inst. Of Industrial and
Systems Engineers; Professor, Epstein Department of Industrial and Systems Engineering University of Southern California

Mailing Address:
Epstein Department of Industrial and Systems Engineering
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Los Angeles, California 90089

Email: jmoore@usc.edu
Contact Number: (213) 740-0595 (direct), (213) 663-8146 (cell), (213) 740-5297 (fax)

Reviewer 2:
David Mason, ESEP, MSBA, LSBB
Consultant, Project Performance International

Mailing Address:
10576 Gabacho Dr.,
San Diego, California, 92124-1403

Email: david.mason.se@gmail.com
Contact Number: (650) 999-1030

CV of both reviewers are available in the Appendix.

2) **Program names and description:**

Master of Science in Systems Engineering (MSSE)

According to the International Council on Systems Engineering (INCOSE):
"A **system** is a construct or collection of different elements that together produce results not obtainable by the elements alone. The elements, or parts, can include people, hardware, software, facilities, policies, and documents; that is, all things required to produce systems-level results".

"**Systems Engineering** is an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem. Systems Engineering integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation. Systems Engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs."

As one of the main providers of master-level education in systems engineering in southern California, our program at Cal Poly Pomona provides students with the right combination of engineering, management, and technology training. After finishing this program, our graduates are prepared to apply systems thinking and systems approaches to successfully architect, design and manage complex technical systems and processes throughout their life cycles, and to address systems integration and life cycle issues of any enterprise in today's market that is driven by quality, complexity, productivity, and globalization.

This program is operating entirely on a self-supported model through the College of Extended University. This new program is designed primarily for career enrichment of middle level professionals. The curriculum was developed in response to the industry needs with input from private industry, governmental agencies, and academia.

Program Learning Outcomes (PLO)
Program learning outcomes for the MSSE program are to:
1.	Provide understating of the technical and managerial aspects of product/service development processes.
2.	Provide understating of the financial implications of technology investments.
3.	Provide understating of market forces and their implication on enterprise lifecycle and directions.
4.	Provide understating of the capabilities and constraints of engineering disciplines.
5.	Prepare the graduate for managing personnel and resources for successful accomplishment of projects through their life cycle.

6.   Prepare the graduates by fostering teamwork, communication skills, and individual professionalism.

Student Learning Outcomes (SLO)
Student learning outcomes (the skills and abilities students are expected to demonstrate at graduation) for the MSSE program are to:
1.   Demonstrate knowledge of designing complex engineering systems.
2.   Identify and critically analyze operations of organizations and real-world problems
3.   Demonstrate skills in conducting research, analysis and interpretation of engineering data
4.   Demonstrate excellence in oral and written communication skills

To achieve the PLOs and SLOs stated above, the following courses (see Table 1) are offered in our master in systems engineering program.

Table 1: Curriculum for Master of Science in Systems Engineering

Course No	Course Title
IME 510	Introduction to Systems Science
IME 511	Advanced Engineering Economics
IME 512	Systems Engineering Management
IME 513	Systems Engineering Life Cycle Design
IME 514	Emergency Systems
IME 515	System Sustainability
IME 516	Facility Planning Systems
IME 517	Healthcare Systems
IME 518	Human Systems Interaction
IME 519	Operations Research in System Analysis
IME 520	Systems Simulation for Managers
IME 692	Systems Engineering Project
IME 522	Supply Chain Management in Production Systems
IME 523	Systems Architecture

3)   **Information of the faculty name who wrote the self-study:**

Dr. Kamran Abedini

Professor and Chair, Industrial and Manufacturing Engineering Department, Cal Poly
Pomona

Dr. Saeideh Fallah-Fini
Assistant Professor, Industrial and Manufacturing Engineering Department, Cal Poly Pomona

4)   Strengths of the Master in Systems Engineering Program:

The following is a list of strengths of our master in systems engineering program:
- Experienced/approachable/high quality faculty
- Relatively small class size (Small student/faculty ratio)
- Excel in student advising
- Various delivery methods used: Traditional, hybrid
- Faculty diversity that matches student diversity
- Course schedules to match working students
- Student loyalty (both undergraduate and graduate)
- Students graduate on time
- Interdisciplinary cooperation
- Very good job placement rates for graduates
- Campus Location (Southern California)/ Beauty
- Self-Support programs attract funds that help support other local activities
- Less expensive in comparison with other programs that are similar in content and quality
- Attractive to international students
- Open to students from various science and engineering backgrounds
- Close collaboration with International Council on Systems Engineering (INCOSE)

5)   Areas for improvement (from the faculty perspective) for Master in Systems Engineering Program:

The following is a list of weaknesses of our master in systems engineering program:
- Weak outreach and marketing (national and international)
- Lack of Institutional data on performance of graduate programs
- Lack of student financial aid information
- Graduate students get no service for their student success fees
- Relatively high tuition for international students attending a self-support program (in comparison with state-support programs)

The following is a list of opportunities for improvement for our master in systems engineering program:

- Use external constituents (Industry, agencies, etc.) to help us recruit students
- Partnerships with external constituents on projects and research
- Attract more international students
- Develop state of the art courses with new technologies
- Offer funding/financial aid to graduate students (through various forms of assistantships)
- Increase university emphasis on graduate programs
- Offer programs at locations other than campus for students' convenience
- Increase conference/paper presence of our students
- Potential to select higher quality students
- Capitalize on "Masters is the new Bachelors" reality
- Offer Graduate Certificate programs
- Possibility of offering Systems Engineering certificates at the campus for both undergrad and graduate students, in collaboration with International Council on Systems Engineering (INCOSE)

6) Anything important about the upcoming review (from the department, college, and/or university perspective)

Our reviewer 1 (Dr. James Elliott Moore) is coming from USC which has a similar competing program. We used that program as a benchmark when we were developing our own master in systems engineering program. Both reviewers are active members of the systems engineering community. The reviewers can provide us with valuable insights on how to enhance our program from both academic and industry aspects.

From the 10 faculty members assigned to teach the master in SE classes, about 50% of them are from academia and 50% are from industry. This mix will provide our students with a great education from both industry and academic perspectives.

Our first cohort of 5 students graduated last year and our new cohort has about 15 students.
This rate of growth shows significant opportunities for further growth of this program. Moreover, about 45% of our students are international and about 30% of them are female which shows the strength of attracting international and minority students.

Appendix C – MSSE External Review Summary

External Review Summary Sheet for Program Review

Degree/Major: Master of Science in Systems Engineering   Date of Review: Mar 21-22, 2018

Reviewer 1:   David Mason   Organization: Project Performance International

X _David Mason_ (signature)   Lockheed Martin (Retired)

Reviewer 2: /   Prof. Jim Moore   Institution: University of Southern California

X _____

Please rate the following program review criteria using the following:

E = Exemplary	S = Satisfactory	N = Needs Improvement	U = Unclear	N/A = Not Applicable

Review based on Self-Study

Section 1 – Introduction (Criteria to Consider)	Evaluation
Has the program listed their mission and goals and provided a relationship to those of the College and University.	S
Has the program reviewed the recommendation from their past program review. Based on the recommendation has the program implemented changes that have resulted in improvements? **Corrections have been made based on student feedback at the course level. This is not a program-wide revision, but reflects attention to continuous improvement.**	N/A **New program**

Section 2 – Program Description (Criteria to Consider)	Evaluation
The curriculum *content* is appropriate to the level and purpose of the program and reflective of current debates, trends, technologies, and latest important developments in the discipline. In addition, is the program making the appropriate curricular changes?	E **Well designed**
Are the general education, service learning, honors and or other service courses appropriate to the program?	N/A **Graduate program**
If the program has bottleneck courses, do they provide an analysis and plan on how they will address these courses?	N/A **No bottle necks**
Curriculum Offering: Does the program have adequate course offerings over the past several years for the degree programs.	E **All courses available**

External Review Summary Sheet for Program Review

Degree/Major: Master of Science in Systems Engineering   Date of Review: Mar 21-22, 2018
Reviewer 1:   David Mason   Organization: Project Performance International
X_____   Lockheed Martin (Retired)
Reviewer 2:   Prof. Jim Moore   Institution: University of Southern California

Please rate the following program review criteria using the following:

E = Exemplary	S = Satisfactory	N = Needs Improvement	U = Unclear	N/A = Not Applicable

Review based on Self-Study

Section 1 – Introduction (Criteria to Consider)	Evaluation
Has the program listed their mission and goals and provided a relationship to those of the College and University.	S
Has the program reviewed the recommendation from their past program review. Based on the recommendation has the program implemented changes that have resulted in improvements? **Corrections have been made based on student feedback at the course level. This is not a program-wide revision, but reflects attention to continuous improvement.**	N/A **New program**

Section 2 – Program Description (Criteria to Consider)	Evaluation
The curriculum *content* is appropriate to the level and purpose of the program and reflective of current debates, trends, technologies, and latest important developments in the discipline. In addition, is the program making the appropriate curricular changes?	E Well designed
Are the general education, service learning, honors and or other service courses appropriate to the program?	N/A **Graduate program**
If the program has bottleneck courses, do they provide an analysis and plan on how they will address these courses?	N/A No **bottle necks**
Curriculum Offering: Does the program have adequate course offerings over the past several years for the degree programs.	E All **courses available**

Section 3 – Program Assessment (Criteria to Consider)	Evaluation
The listed student learning outcomes (SLOs) reflect the most important skills, knowledge, and values of the discipline/profession. **Catalogue descriptions vary somewhat relative the course contents called out in the syllabus. A process should exist to ensure that Catalogue course descriptions are sufficient current. These are at present, but some degree of divergence is apparent.**	**E Recent revision**
Curriculum Map: The *design* of the curriculum supports student achievement of the SLOs. The curriculum offers the required depth and breadth of study, flow and sequencing of courses with coherence, and ample culminating opportunities for students to demonstrate achievement of SLOs. **Aside from introductory and project courses, sequencing of courses is not presented to the review. If is a preferred sequence is established, we recommend it be published.**	**E/S Little sequencing is required**
Program has an assessment process where they collect and analyze evidence that shows students are achieving the stated SLOs. **Assessment data has been used to modify one course. The practice should extend to all courses going forward.**	**E Systematic process**
The program assesses the SLO and uses the results to make program, curricular and pedagogical changes (close the loop). **Assessment data has been collected, but has been subject to limited use at present. The introductory course has been extensively revised.**	**S Systematic process**

Section 4 – Program Quality (Criteria to Consider)	Evaluation
Faculty competencies/credentials are appropriate for the discipline and degree (need resumes).	E
Teaching quality is adequately assessed (e.g. computer-generated discipline averages of course evaluations, teaching awards).	**N/A New program**
Fulltime faculty are adequately supported and engaged in ongoing professional development necessary for staying current in their field and continuously updating their courses/curriculum. **No information appears in the self-study, but the faculty CV's provided by the program provide substantial evidence.**	S/E

Fulltime faculty are engaged in service to the department, college and university. **No information appears in the self-study, but the meetings with faculty and students provide substantial evidence.**	E
Fulltime faculty are engaged in research, scholarship and or creative activity. **No information appears in the self-study, but the faculty CV's catalogued by the program provide substantial evidence.**	E Research active
The program provides adequate opportunities for extra-curricular involvement, internships, practica, professional development, and/or field experiences, as appropriate for students.	Unclear **Most students employed full time**
The program provides clear evidence of the accomplishments of their graduates through the number of graduates employed in a field, number in graduate schools and or numbers passing licensing exams.	N/A **New program, but most graduates are employed**
The program makes use of evidence obtained from student/alumni/employers for its improvements and goals. **Work examples have been brought into the classroom on an as available basis. This should be encouraged.**	N **New program**

Section 5 – Resources (Criteria to Consider)	Evaluation
Admission Trends: number of inquiries, applications, deposits, and enrollment indicate program health and increasing student selectivity is provided.	E **Good 2nd year growth**
Retention and graduation rates are consistent with disciplinary standards. The program proposes effective strategies to improve in these areas as appropriate.	S **Small sample**
Retention and graduation rates for underrepresented students, Pell Grant recipients, women and first generation students are comparable to those of the overall program. The program proposes effective strategies to improve in these areas as appropriate. **Working students are accommodated well.**	S **Small sample**
The program adequately address faculty resources, retirement projections, plans for hiring new faculty, and trends in numbers of faculty by gender and ethnicity.	S

The program makes use of existing IME faculty and industry faculty members as needed.	

Additional Comments based on the Self-Study:

The program seems well structured and the compliment of regular faculty who contribute to it is made up of very qualified personnel. The focus on continuous improvement is apparent and has resulted in modifications of content. This appears to have been a successful change.

The degree of assessment seems appropriate for the length of time the program has been in operation. The heavy reliance on the Systems Engineering Project course for outcome assessment is logical and appropriate. The approach parallels ABET related practices at the undergraduate level, and these are effective.

Only two courses have been consolidated to accommodate the shift from quarters to semesters. This may result in students taking more courses simultaneously, and this may prove to be a burden for the students, particularly for working professions. The revised schedule seems reasonable but student satisfaction and performance should be monitored, probably during the advisement process. Further consolidation of coursework may be in the students' interests, but current arrangements may work out fine.

The problems and opportunities for improvement noted are typical of any new start-up program. There are no obvious problems with respect to how the program is structured nor with the content of the coursework. Marketing efforts might include a distinction between systems engineering and engineering management.

Review based on Site Visit

Curriculum of the Program - Criteria to Consider	Evaluation
Extended Course Syllabi: Outline course learning outcomes that are appropriate to the level of the course and degree awarded.	S
Do you recommend any changes to enhance the curriculum (content, currency, design, relevance, courses ability) based on the self-study and site visit? **The syllabi are complete and relatively detailed. The initial set of SLOs was very high level. The revised SLOs are more specific relative to systems content. The SLOs should be made more specific still. This need not unduly burden the assessment process.** **An assessment rubric should be developed to facilitate assessment in each course contributing metrics.**	

Instruction in the program - Criteria to Consider	Evaluation
Students are provided with sufficient experiences with the equipment and technologies that will prepare them for success after graduation.	N/A at the MS level
Faculty specialties correspond to program needs and to the concentrations in which they teach. **Full time faculty are very committed to the program and positioned to contribute. The CVs of industry faculty members summarize backgrounds very relevant to the curriculum.**	E
The system for evaluating teaching practices facilitates continuous improvement of teaching and learning throughout the program and encourages pedagogy that fosters curricular diversity and inclusive learning environments. **The elective courses introduce intellectual diversity.**	E
Do you have any recommendation on the teaching/instruction within the program based on the self-study and site visit?? **The students would benefit from access to research seminars and advanced practice seminars, guest speakers, and curriculum-targeted field trips. This is a co-curricular focus.**	

Student Experience – Criteria to Consider	Evaluation
Students feel that support services, staff and administration are adequate and supportive. **Faculty are responsible for advisement, and provide a high level of service.**	E
Students receive the kind of advising they need from faculty to improve their chances for success.	E
Students are satisfied with the overall quality of their learning experience and feel adequately supported through the curriculum to graduation. **All students have proceeded on schedule.**	S
Students are aware of program requirements and SLOs.	E
Do you recommend any changes to improve student experiences and the learning environment based on the self-study and site visit?? If so, please explain and advise. **We understand from the faculty leadership that the program will become more flexible going forward. The number of core courses will be decreased and elective options increased to provide students with increased flexibility. This is reasonable and appropriate. This adjustment parallels the structure of competing programs.** **We note above the merits of using more detailed student learning objectives.** **We note above the merits of improved co-curricular options.**	

Faculty - Criteria to Consider	Evaluation
Tenure and Promotion: Guidelines are updated regularly and establish a high standard for tenure and promotion. **As a reminder, the work of faculty teaching in the program should be assessed in a fashion consistent with institutional merit review procedures.**	N/A

Do you recommend any changes to improve student experiences and the learning environment based on the self-study and site visit?? If so, please explain and advise.

The regular and industry faculty compliment is appropriate for the scope and content of the program.

Assessment of Student Learning – Criteria to Consider	Evaluation
Based on your review of student work samples, the educational effectiveness evaluation plan, and annual learning outcomes assessment reports; the program regularly and effectively uses assessment findings to improve student learning.	S N

Do you recommend faculty changes to enhance program quality and student learning based on the self-study and site visit?? If so, please explain and advise.

Student learning outcome assessments are satisfactory given the newness of the program. Improvements going forward might include definition of more specific outcomes, development of standardized rubrics, and collection of mid-program data.

Facilities - Criteria to Consider	Evaluation
The program has adequate facilities for teaching, research and scholarship.	S
The equipment within the laboratory is adequate	N/A

Do you recommend facility changes to enhance program quality and student learning based on the self-study and site visit?? If so, please explain and advise.

There is an opportunity to use distance education to expand student access and increase enrollments. Some university resources such as Studio 6 are being put to effective use.

Infrastructure for a large scale distance learning initiative would have to be developed for such an initiative to succeed. Perhaps this is a role for the College of Extended University.

Diversity and Climate - Criteria to Consider	Evaluation
Students feel that the learning environment in the program is inclusive and that diversity is valued.	S
Faculty feel that the working environment in the program is inclusive and that diversity is valued. **Cal Poly Pomona's role in undergraduate education is widely understood to be transformative. We assume this new graduate program will reflect similar priorities.**	U

Overall - Criteria to Consider	Evaluation
The goals and proposed changes are appropriate to the latest developments in the discipline and responsive to the program's most important needs.	E
The program's website and marketing material are accurate **This key marketing function has not been adequately developed.**	N
What are the strengths of the program? **Immediate relevance in the workplace.** **Student impact on professional practice.** **Systematic development of the curriculum reflects industry trends.** **Deeply-experienced faculty, both full time personnel and industry faculty.** **Focus on constant improvement of the curriculum and program.**	
What are the weaknesses of the program? **The program is not adequately marketed.**	

The small student compliment makes it difficult to organize team-based project experiences. Engagement with professional societies should be amplified. This could include organizing opportunities for students to receive professional certifications.

What are the top three goals that you would suggest that the programs set for the next five years?

Promote growth in enrollments.
Develop and execute a marketing program.
The curriculum is very good but not cutting edge. Maintain the focus on principles, but expand use of tools throughout the program.
The IME faculty are doing great work, but build connections to additional full time faculty in related disciplines who can contribute as the program grows.

Additional Recommendation for Programs:

You have our best thoughts.