From:	noreply@wsu.edu
To:	curriculum.submit
Subject:	426935 Engineering and Technology Management Requirements Revise - Revise or Drop Graduate Certificate
Date:	Tuesday, March 06, 2018 2:31:59 PM
Attachments:	2018.03.06.14.31.43.35.FormData.html 2018.03.06.14.31.42.15.currentCatalogFile_Cerificate_Rationale_for__SEM_568_and_569.docx 2018.03.06.14.31.42.15.currentCatalogFile1_SystemsArchitectingJustification.docx

Patricia Elshafei has submitted a request for a major curricular change. His/her email address is: pelshafei@wsu.edu.

Requested change: Revise or Drop Graduate Certificate

Title: Systems Engineering Management

Requested Effective Date: Fall 2019

Revise certificate requirement: Yes

Dean: Field, David - Assoc Dean - VCEA - Grad,

Chair: Zentz, Kim,

UCORE Committee Approval Date	All-University Writing Com / Date

Catalog Subcommittee Approval Date	GSC or AAC Approval Date	Faculty Senate Approval Date

From:	Zentz, Kim
To:	Field, Dave; curriculum.submit
Subject:	418 RE: 426935 Engineering and Technology Management Requirements Revise - Revise or Drop Graduate Certificate
Date:	Wednesday, March 07, 2018 3:37:35 PM
Attachments:	2018.03.06.14.31.42.15.currentCatalogFile1_SystemsArchitectingJustificationREV.docx image003.png

I approve this proposal with revisions. Revisions are attached.

Kim Zentz

Kim Zentz, P.E., MEM, *Director*
Engineering and Technology Management
Voiland College of Engineering and Architecture
Washington State University
PO Box 1495 | CCRS 232 | Spokane, WA 99210-1495
kzentz@wsu.edu | 509-358-2030 | cell 509-995-5287
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From: Field, Dave
Sent: Tuesday, March 06, 2018 2:52 PM
To: curriculum.submit <curriculum.submit@wsu.edu>; Zentz, Kim <kzentz@wsu.edu>
Subject: Re: 426935 Engineering and Technology Management Requirements Revise - Revise or Drop Graduate Certificate

I approve of this in it's present form.

Dave

From: curriculum.submit@wsu.edu <curriculum.submit@wsu.edu>
Sent: Tuesday, March 6, 2018 2:31:43 PM
To: Zentz, Kim; Field, Dave
Subject: 426935 Engineering and Technology Management Requirements Revise - Revise or Drop Graduate Certificate

Zentz, Kim,
Field, David - Assoc Dean - VCEA - Grad,
Patricia Elshafei has submitted a request for a major curricular change.
Requested change: Revise or Drop Graduate Certificate
Title: Systems Engineering Management
Requested Effective Date: Fall 2019
Revise certificate requirement: Yes

From: Field, Dave
To: curriculum.submit; Zentz, Kim
Subject: Re: 426935 Engineering and Technology Management Requirements Revise - Revise or Drop Graduate Certificate
Date: Tuesday, March 06, 2018 2:51:41 PM

I approve of this in it's present form.

Dave

From: curriculum.submit@wsu.edu <curriculum.submit@wsu.edu>
Sent: Tuesday, March 6, 2018 2:31:43 PM
To: Zentz, Kim; Field, Dave
Subject: 426935 Engineering and Technology Management Requirements Revise - Revise or Drop Graduate Certificate

Zentz, Kim,
Field, David - Assoc Dean - VCEA - Grad,
Patricia Elshafei has submitted a request for a major curricular change.
Requested change: Revise or Drop Graduate Certificate
Title: Systems Engineering Management
Requested Effective Date: Fall 2019
Revise certificate requirement: Yes

Both Chair and Dean approval is required to complete the submission process. Please indicate that you have reviewed the proposal by highlighting one of the statements below and **reply all** to this email. (curriculum.submit@wsu.edu.)
[Details of major change requested can be found in the attached supplemental documentation]

1. I approve this proposal in its current form.
2. I approve this proposal with revisions. Revisions are attached.
3. I do not approve this proposal. Please return to submitter.

If you do not respond within one week, you will be sent a reminder email. If no response is received within three weeks of the submission date, the proposal will be returned to the submitter.
Thank you for your assistance as we embark on this new process. If you have any questions or concerns, please let us know wsu.curriculum@wsu.edu.

Suzanne Lambeth, Assistant Registrar
Graduations, Curriculum, & Scheduling
Washington State University
Registrar's Office

Systems Engineering Management Graduate Certificate rationale for adding Risk Analysis and Management and Systems Architecting

At the fall Engineering and Technology Management faculty meeting it was voted to update the Systems Engineering Management graduate certificate. EM 590 Leading Design and Innovation is being eliminated (no longer a good fit).

EM 569 Systems Architecting (new) is being added as an option to E M 564 Project Management. Systems engineering management requires both an understanding of systems management and technical depth in the area of systems engineering, analysis, and architecture. To this end, students who complete the systems engineering management graduate certificate who previously only had the option to complete EM564 Project Management, are now being offered a choice between adding to their technical expertise by choosing EM569 Systems Architecting or adding to their project management expertise by choosing EM564 Project Management. This is a good option for one of the four courses required towards completion of the systems engineering management graduate certificate. Additional justification for EM569 Systems Architecting can be found in the detailed course justification for this new course.

E M 568 Risk Analysis and Management is being added as an option along side E M 530. The complexity of modern systems and projects has demonstrated that it is no longer possible to rely on design evolution and associated tools to improve and develop a system. To address this complexity, system engineering has evolved along with new methods and modeling techniques to better comprehend engineering systems as they grow more complex. System engineering is a holistic, robust approach to the design, creation and operation of systems. It consists of identification and quantification of system goals, creation of alternative system design concepts, performance of trade studies, selection and identification of the best design, verification that the design is properly built and integrated, and post implementation assessment of how well the system meets the customer goals and needs.

The system engineering method deals with systems as an integrated whole, comprised of diverse subsystems and functions and works to optimize overall system functions and achieve maximum compatibility of its elements. This course focuses on how complex engineering projects should be managed over the life cycle of the project. It deals with the work processes and tools to handle large-scale complex engineering projects in a sustainable environment and overlaps with the technical and human disciplines characteristic of these projects.

Requirements:

E M 565 Introduction to Systems Management
E M 566 Systems Engineering Analysis and Practice
Either: EM569 System Architecting ((***proposed change – new course approved***)– Alice Squires) or E M 564 Project Management

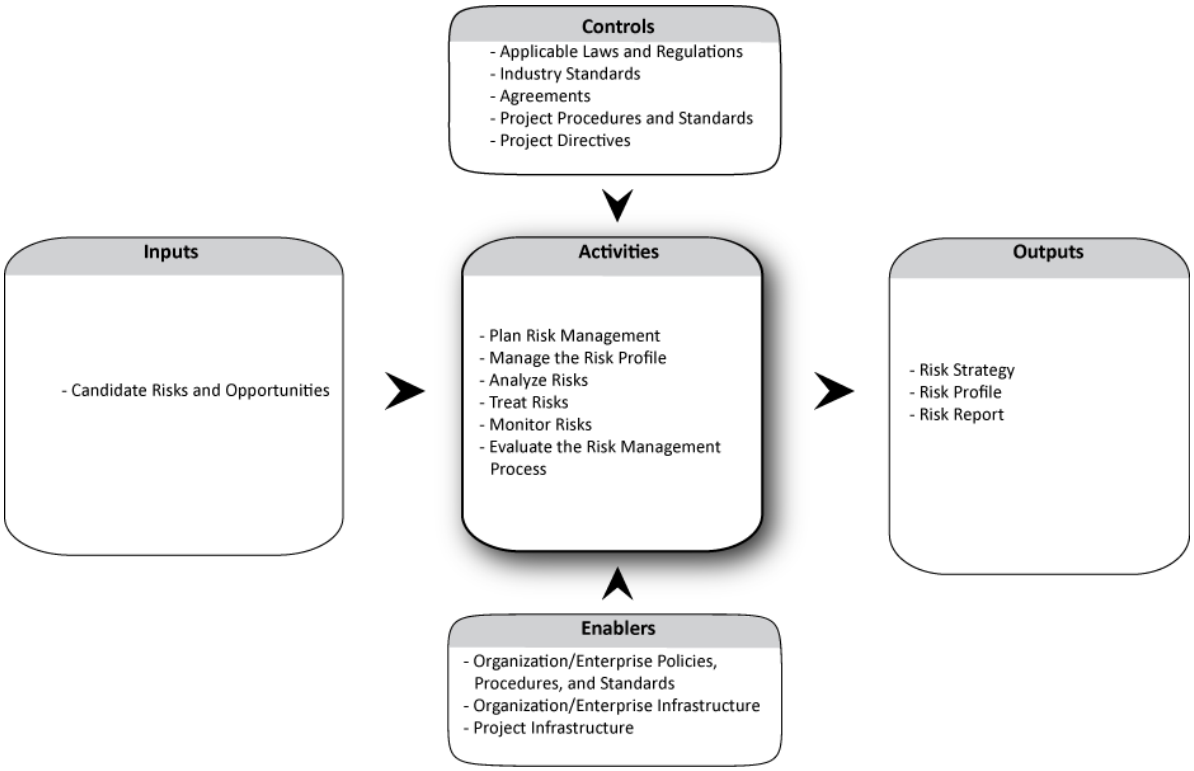
Either:

E M 530 Applications of Constraints Management
or ~~E M 590 Design for Product and Service~~ Realization (drop – no longer applies)
or EM568 Risk Management (***proposed change—new course approved*** – Luna Magpili*)*

Rationale:
In 2013, The international Council on Systems Engineering (INCOSE) launches the "Systems Engineering Body of Knowledge" SEBOK.
http://sebokwiki.org/wiki/Guide_to_the_Systems_Engineering_Body_of_Knowledge_(SEBoK)

For SEBOK, risk management falls under the umbrella of Systems Engineering Management. The purpose of risk management is to reduce potential risk to an acceptable level before they occur, throughout the life of the product, project, or service. It is considered an integral part of the systems engineering management process. The SE risk management process includes the basic activities- risk planning, risk identification, risk analysis, risk handling, and risk monitoring.

The figure below shows a typical risk management process from the view of systems engineering-



Hamelin, R. D., Walden, D., & Krueger, M. (2010). *INCOSE Systems Engineering Handbook v3.2: Improving the Process for SE Practitioners.* Internatioanl Council on Systems Engineering.

Benchmark of other SEM certificates and inclusion of risk in the curriculum:

Stevens Institute
EM 612 Project Management of Complex Systems
SYS 625 Fundamentals of Systems Engineering
SYS 660 Decision and Risk Analysis
EM 680 Designing and Managing the Development Enterprise

Citadel, Military College of South Carolina
Required Core Courses
PMGT 680 Systems Engineering Fundamentals
PMGT 681 Requirements Development and Management
PMGT 682 System Verification and Validation
Plus One Elective Course
PMGT 683 Systems Modeling and Integration
PMGT 684 Human Systems and Integration
PMGT 685 Decision and Risk Analysis

Because of this ETM faculty-approved change, the SEM graduate certificate courses will be:

1. EM565 Introduction to Systems Management
2. EM566 Systems Engineering Analysis and Practice
3. Either: EM569 System Architecting (NEW – Alice Squires) or EM564 Project Management
4. Either: EM568 Risk Analysis and Management or EM530 Applications of Constraints Management

Former Requirements

1. EM565 Introduction to Systems Management
2. EM566 Systems Engineering Analysis and Practice
3. EM564 Project Management
4. Either EM530 Applications of Constraints Management or E M 590 Leading Design and Innovation

#418 as revised by K. Zentz
3-7-18

Justification for new course in the
Engineering and Technology Management (ETM) Curriculum
~~SYS569~~EM569: System Architecting

Washington State University's Engineering and Technology Management (ETM) program enables engineers and business professionals to become leaders in the management of technology. Technology-based leadership in the 21st century requires, at its very foundation, a strong understanding of system concepts, principles, and practices. Furthermore, a systems mindset is essential for leaders to understand and manage the complex and emergent properties of today's interconnected sociotechnical systems. To this end, ETM provides a fundamental basis in systems engineering management and systems analysis in practice in two courses, similarly named, EM565 and EM566, which also comprise two of the four required courses for a Systems Engineering graduate certificate. These courses have been offered as part of the ETM Masters nearly every other year. A missing core area in the systems-based series is a course that addresses the principles and techniques used in architecting modern, complex systems. System architecting is a required initial step in complex system designs such as computer and information systems, command and control systems, space systems, transportation systems, agricultural systems, and health management systems, to name a few. The bottom line is that engineering managers and technical leaders require hands-on experience in the art and science of systems architecting to manage and lead development of individual systems, systems of systems, and federations of systems, and the proposed course EM569 System Architecting will address that need.

The median salary of a system architect according to salary.com as of September 27, 2017 is $115, 236. System architecture is a core area of Domain 9: Systems Engineering of the Fourth Edition of "A Guide to the Engineering Management Body of Knowledge (EMBOK)" (2015), defined as: "The arrangement of elements and subsystems and the allocation of functions to them to meet system requirements." System architecture is addressed as a knowledge area as part of "The Guide to the Systems Engineering Body of Knowledge (SEBoK)" (see sebokwiki.org) which covers the system architecture as a logical architecture and a physical architecture, defined as a prerequisite to system design. A survey of Masters in Engineering Management, Systems Engineering Management, and related degrees and graduate certificates shows that many (but not all) engineering and management focused programs offer a course in systems architecting or systems architecture as either a core course or as part of an elective track. A subset of examples from a cross section of universities follows:

- Georgetown University Masters of Systems Engineering Management
  - MPSE 510: System Architecture & Design – 1 of 4 required foundational courses
- Naval Postgraduate School Joint Executive Systems Engineering Management Masters
  - SI4022: Systems Architecture for Product Development
  - SE4150: Systems Architecture and Design
- Johns Hopkins University Master of Science in Engineering in Systems Engineering
  - 645.761: Systems Architecting

- MIT Architecture and Systems Engineering: Models and Methods to Manage Complex Systems Professional Graduate Certificate
    - Architecture of Complex Systems
- Rose-Hulman Institute of Technology Master of Science in Engineering Management and Master of Engineering Management
    - EMGT 564: Systems Architecture
- University of Texas at Dallas Masters Systems Engineering and Management (SEM)
    - SYSM 6301: Systems Engineering, Architecture and Design

The graduate course offered by the WSU Engineering and Technology Management program will be an elective for a Masters of Engineering and Technology Management and will be a new course that can be completed as one of four courses towards a graduate certificate in Systems Engineering which will be defined as follows:

1. EM565 Introduction to Systems Management
2. EM566 Systems Engineering Analysis and Practice
3. Either: EM569 System Architecting (NEW) or EM564 Project Management
4. Either: EM568 Risk Analysis and Management or EM530 Applications of Constraints Management