**MISSOURI DEPARTMENT OF HIGHER EDUCATION**

**FORM NP: NEW PROGRAM PROPOSAL FORM**

**Sponsoring Institution(s):** **Washington University**

**Program Title:** **Master of System Integration**

**Degree/Certificate:** **degree**

**Options:** _____

_____

_____

**Delivery Site(s):** **Washington University, Danforth Campus**

**CIP Classification:** **11.1099**

**Implementation Date:** **Fall 2011**

**Cooperative Partners:** **(none)**

**Expected Date of First Graduation: Spring 2014**

**AUTHORIZATION**

Name/Title of Institutional Officer:

Edward S. Macias, Provost

Signature _____ Date _____

Person to Contact for More Information:

Susan E. Hosack, Director, Office of Student Records/Registrar

Telephone: (314) 935-5567

**MISSOURI DEPARTMENT OF HIGHER EDUCATION**

**Form SE: STUDENT ENROLLMENT PROJECTIONS** (see attached document)

| Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Full Time | | | | | |
| Part Time | | | | | |
| Total | | | | | |

**Form PS: PROGRAM STRUCTURE** (see attached document)

A. Total credits required for graduation: _____

B. Residency requirements, if any: _____

C. General education: Total credits: _____

Courses (specific courses OR distribution area and credits):

_____ ___cr. _____ ___cr. _____ ___cr.

_____ ___cr. _____ ___cr. _____ ___cr.

D. Major requirements: Total credits: _____

_____ ___cr. _____ ___cr. _____ ___cr.

_____ ___cr. _____ ___cr. _____ ___cr.

E. Free elective credits: _____ (Sum of C, D, and E should equal A.)

F. Requirements for thesis, internship or other capstone experience:

_____

_____

_____

G. Any unique features such as interdepartmental cooperation:

_____

_____

_____

**MISSOURI DEPARTMENT OF HIGHER EDUCATION**

**Form PG: PROGRAM CHARACTERISTICS AND PERFORMANCE GOALS** (see attached document)

Institution Name: Washington University

Program Name: Master of System Integration

Date: June 10, 2011

(Although all of the following guidelines may not be applicable to the proposed program, please carefully consider the elements in each area and respond as completely as possible in the format below. Quantification of performance goals should be included wherever possible.)

Student Preparation

- Any special admissions procedures or student qualifications required for this program which exceed regular university admissions, standards, e.g., ACT score, completion of core curriculum, portfolio, personal interview, etc. Please note if no special preparation will be required.
- Characteristics of a specific population to be served, if applicable.

Faculty Characteristics

- Any special requirements (degree status, training, etc.) for assignment of teaching for this degree/certificate.
- Estimated percentage of credit hours that will be assigned to full time faculty. Please use the term "full time faculty" (and not FTE) in your descriptions here.
- Expectations for professional activities, special student contact, teaching/learning innovation.

Enrollment Projections

- Student FTE majoring in program by the end of five years.
- Percent of full time and part time enrollment by the end of five years.

Student and Program Outcomes

- Number of graduates per annum at three and five years after implementation.
- Special skills specific to the program.
- Proportion of students who will achieve licensing, certification, or registration.
- Performance on national and/or local assessments, e.g., percent of students scoring above the 50th percentile on normed tests; percent of students achieving minimal cut-scores on criterion-referenced tests. Include expected results on assessments of general education and on exit assessments in a particular discipline as well as the name of any nationally recognized assessments used.
- Placement rates in related fields, in other fields, unemployed.
- Transfer rates, continuous study.

Program Accreditation

- Institutional plans for accreditation, if applicable, including accrediting agency and timeline. If there are no plans to seek specialized accreditation, please provide reasons.

Alumni and Employer Survey

- Expected satisfaction rates for alumni, including timing and method of surveys
- Expected satisfaction rates for employers, including timing and method of surveys

Washington University in St. Louis

Engineering

Henry Edwin Sever Institute

# Master of System Integration Degree Program

# Table of Contents

# Introduction

The Master of System Integration Degree Program is a 30 credit hour master's degree program designed for working professionals and other students who wish to increase their knowledge and skills related to the field of systems integration.

System integration techniques are critical to successful execution of very complex projects such as design of aircraft or microprocessors, software integration, infrastructure development, and others.

This program will enable students to conceive, plan, create, execute, use, test, analyze, support, and retire a complex system throughout its entire life cycle.

Local companies, such as Boeing, employ thousands of individuals who need and desire these skills but do not have a local source for formal education.

# Part I
# Program Overview

Program Purpose:

This degree program is designed to enable students to master concepts and techniques necessary for a multidisciplinary approach to facilitating the realization of a complex system through its entire lifecycle.

Serving the Mission:

This program will uphold Washington University's mission to serve local community educational needs through cutting-edge educational program offerings. The program will increase the University's reach into mid-level technical, engineering and management positions.

Henry Edwin Sever Institute (Sever) within the School of Engineering and Applied Science provides professional education with professional master's degrees in Project Management, Information Management, Engineering Management, Construction Management, and Graduate Certificates in Project Management and Construction Management. This program is similar and within the bounds of Sever's mission for providing professional education.

Department Proposing:

Henry Edwin Sever Institute within the School of Engineering and Applied Science.

# Part II
# Need for New Degree Program

Audience:

System integration techniques are critical to successful execution of very complex projects such as design of aircraft or microprocessors, software integration, infrastructure development, and many others. Local companies, such as Boeing, employ thousands of individuals who need and desire these skills but do not have a local source for formal education.

Currently, the two primary options for similar programs in St. Louis area are through distance learning offerings from the Missouri University of Science & Technology and the University of Southern California. Both programs were developed in cooperation with Boeing several years ago and are the primary venues available to Boeing employees in St. Louis.

Sever's proposed program has two distinct advantages over the existing programs:

1. Since it is newly developed, the Sever program has been designed to be currently relevant to the industry's needs.
2. The Sever program will provide students a local option for top-tier traditional education model of in-class, face-to-face instruction, teamwork, etc.

Existing University Programs:

A similar University program does not exist currently.

Competence:

The School of Engineering and Applied Science has significant competence in teaching analysis and integration of complex systems and has access to a deep pool of faculty with theoretical and practical expertise in the field. Among other competencies, this program will leverage Sever's decades of expertise in providing graduate education in project management.

Students and Demand:

Based on input from local industry representatives, it is estimated that initially 30-40 students will participate in the program with a steady state of 60-70 students.

# Part III
# Program Requirements

**Degree requirements:**

- 30 units of graduate-level credit (400-level or higher) approved by the program director, all of which must be taken for a grade. At least 18 of the 30 units must be at the 500-level, excluding independent study or project units. Figure 1 outlines the proposed curriculum sequence as further described below.

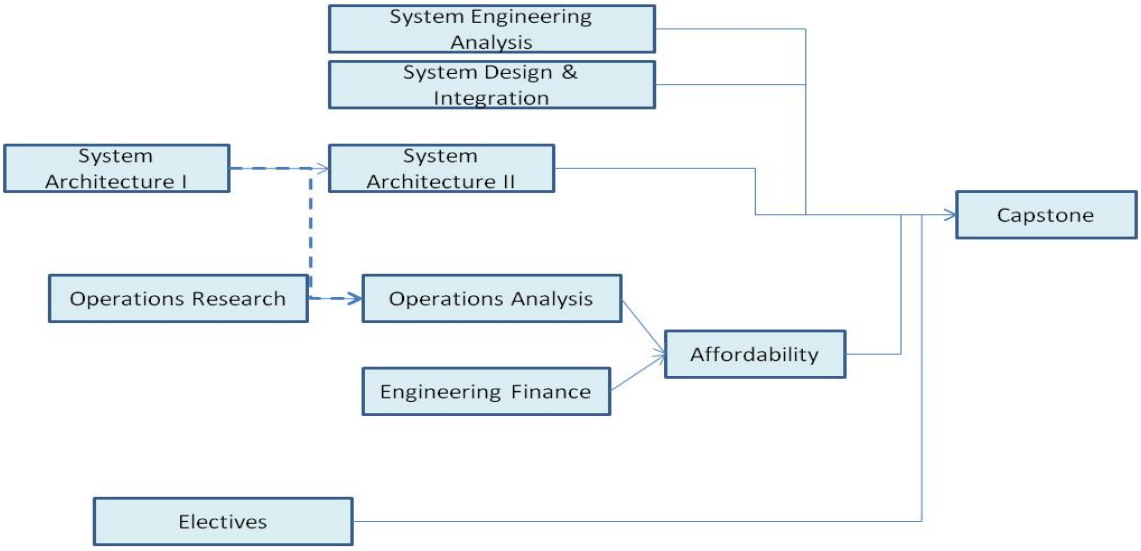


**Figure 1. Curriculum Sequence**

- **Required courses: 18 units**
  - Systems Engineering Analysis (3 units)
  - System Design and Integration (3 units)
  - Systems Architecting I (Operational) (1.5 Units)
  - Systems Architecting II (System/Technical) (1.5 Units)
  - Fundamentals of Operations Research (1.5 units)
  - Operations Analysis (Effectiveness, Engagement, Mission, Campaign Modeling, SoS Optimization (1.5 Units)
  - Engineering Finance (1.5 Units)
  - Affordability Engineering (Finance, Ops Analysis, Analysis of Alternatives) (1.5 Units)
  - Capstone Project (3 units)

- **Elective courses: 12 units**

    - Systems Engineering Management (3 units)
    - Project Management Fundamentals (3 units)
    - Strategic Management of Multiple and Complex Projects (3 units)
    - Technology Change Management (3 units)
    - Quality Management for Engineers (3 units)
    - Additional topics to be considered as need arises: Supportability, Producibility, Maintainability, Human Factors, Quality Engineering, Lean Systems, Availability, and others.

- **Overall GPA of 2.75 or higher**

Students currently enrolled in similar programs at Missouri University of Science & Technology and the University of Southern California will be allowed to transfer up to 9 credit hours with approval.

**Course Descriptions:**

***Required Courses:***

**Systems Engineering Analysis** (NEW), 3 units, required

The concepts of systems engineering provides the basic knowledge and tools of transforming an operational need into a defined system configuration through the interactive process of analysis, system integration, synthesis, optimization and design. These tools and concepts are reinforced with projects and case studies.

**System Design and Integration** (NEW), 3 units, required

A practical examination of the later stages of the product lifecycle development through preliminary design, detailed design integration and test, system validation and verification. Analysis of physical design alternatives and applying methods from design analysis for selection of the system design. Includes design process, design disciplines and design practices.

**Systems Architecting I, (Project/Operational)** (NEW) 1.5 units, required

This course will introduce the student to project portfolio relationships, project timelines and project to capability mapping. In addition, the capability considerations of the architecture will be covered to include: vision, capability taxonomy, schema, phasing, dependencies, mapping of capability to organization development, capability to operational activities and mapping of capabilities to services. Finally, this course will cover operational considerations like: High Level operational Concepts, Resource flow descriptions, organizational relationships, operational activity decomposition to activity modeling, event trace and state transition descriptions.

**Systems Architecting, II (System/Technical)** (NEW), 1.5 units, required

The objective of the course is to provide the basic tools and concepts of systems architecting for complex systems design and operations. The following topics are covered: the need for the

architect and architecting teams, the process of architecting, architecting methods, design of architects, and the architect's role during system life cycle.
Use Cases, Capabilities, Requirements, KPP's, MOE's, Functions, Operational Views, System Views, and Technical Views. Other considerations would include system interface definition, Resource flow, system to system interface, operational activity to system trace, System measures, Technology and skills forecast, System rules and state transition description.

**Fundamentals of Operations Research** (NEW), 1.5 units, required

Introduction to the mathematical aspects of various areas of operations research, with additional emphasis on problem formulation. This course would cover Optimization to include Linear Programming, Nonlinear Programming, Linear Goal Programming, Discrete Event Simulation and associated statistical and probability theory.

**Operations Analysis** (NEW) 1.5 units, required
Introduction to effectiveness analysis of systems and system of systems to include engagement analysis, mission analysis, campaign analysis, System of Systems Optimization, network centric operations and communications analysis. Introduction to survivability, vulnerability, lethality, etc.

**Engineering Finance** (NEW), 1.5 units, required

This course would cover Development cost, flyaway cost, System Cost, Production cost, Acquisition cost, Operating and support cost and Total Ownership cost, source of data, summary of data and estimation techniques.

**Affordability Engineering** (NEW) 1.5 units required

This course would combine the techniques from Engineering Finance (cost of technology) and Operational Analysis (effectiveness estimates) to balance performance, cost and schedule with an introduction to Analysis of Alternatives. The focus would be on product design and strategy for the 'best value" system or System of Systems solutions. This will include applications of techniques such as Design to Cost, Cost as an Independent Variable and Target Costing. Demonstrate how to coordinate and tract cost targets and assist in defining affordability initiatives as well as major Risk.

**Capstone Project** (NEW), 3 units, required
The capstone project incorporates Systems Engineering Concepts, Processes and Products including the lessons learned through the coursework to demonstrate student's mastery of systems integration and analysis techniques. Students will work in multidisciplinary teams, delivering a final product that applies their cumulative coursework within a context of a real industry project.

***Elective Courses:***

**Project Management Fundamentals** (T81-5504), 3 units, elective

A practical orientation for using what is known about organizations and how to apply this knowledge to managing projects. Review of the project management paradigm, the basic ingredients of a project, critical stakeholders and roles, and the normal project life cycle will be provided. An introduction to the project management mastery model is covered along with explanations for ways to integrate current and future knowledge into the model. How project approaches should differ by how to segment the problem space - monolithic, incremental, or evolutionary.

**Strategic Management of Multiple and Complex Projects** (T81-5507), 3 units, elective, prerequisite: T81-5504

This course addresses the strategic alignment and prioritization of multiple and complex projects with an organization's business objectives and directions. Major areas covered include: stakeholder value, return on investment, balancing the tradeoff between project priorities and operational imperative business benefit; establish and implement program governance of multiple projects to ensure consistent alignment with organizational strategy; balancing and coordination of project resources across multiple projects; coordination of schedules among multiple projects using traditional and advanced methods; current trends and practices in Program and Project Portfolio Management

**Technology Change Management** (T81-503C), 4 units, elective

This course focuses on how innovations, such as new technologies, find their way into organizations through managerial approaches. Topics will include assimilation and diffusion of technology, effects of technology on organizations and organizations on technology, and how organizations may be analyzed to assess the role of innovations. Emphasis will be placed on how to understand the organization's social system and what can be done to prepare it for an innovation. Disruptive technologies, organizational culture, and how organizations change will also be covered.

**Systems Engineering Management** (NEW), 3 units, elective

This course covers modern methods of effective management of complex systems, and systems of systems. Effective team building and integrated product and process development in a diverse and global work environment is the central theme. Topics include leadership, quality tools, concurrent engineering, communication and performance evaluation.

**Quality Management for Engineers** (NEW), 3 units, elective

Principles of quality management, quality philosophies and frameworks, quality leadership and strategic planning, process management, and performance measurements.

# PART IV

# Selection of Candidates and Admission Criteria

Admission Requirements:

Bachelor of Science in engineering, technology or a related science from an accredited university. Relevant work experience may also be considered.

Application Review Process:

Standard School of Engineering and Applied Science and Sever application review process will be followed.

# PART V

# Resources and Support

The program is designed to take full advantage of existing University resources. The program faculty will be selected from a broad pool of existing faculty members with expertise relevant to teaching in the area of system integration. The faculty pool will be augmented through recruitment of experienced faculty able to effectively combine industry and academic components.

Logistically, the program will better employ the existing underutilized campus infrastructure, such as classrooms that are currently not used in the evenings.

Tuition:

Standard School of Engineering and Applied Science part-time graduate tuition rate will apply to the program and collected in normal semester fashion.

# PART VI

# Program Administration

General Administration:

The program will be administered by the Henry Edwin Sever Institute within the School of Engineering and Applied Science.

Program Director:

Eldar Causevic
Executive Director of Professional Development
School of Engineering and Applied Science

Student Performance:

Individual and group assignments will be given in each class, with standard letter grading (A – F) with each student receiving a grade for each course. Student progress will be measured by these grades according the established grading standards for the School of Engineering and Applied Science.

Advising:

Henry Edwin Sever Institute's existing capabilities for advising part-time working professionals will be utilized in this program.

# PART VII

# Evaluation of Program

Administrative:

Program director and Sever representatives will review course evaluations at the end of each semester and provide feedback to instructors. This will include evaluation of guest lecturers and the topics of case studies and other assignments.

Professional:

At the end of each cycle of program completion faculty, industry leaders, and Sever administration will meet to review the program for applicability, quality, and timeliness.

Other:

At the end of each program the class completing the program will be provided the opportunity to give their general feedback to the program director and other faculty members during an open review session.