# Administrative Information

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| --- | --- | --- | --- |
| **Professor** | [**Dr. Lou**](http://people.mst.edu/faculty/pape/index.html) **Pape** | **NOTE: Residence in Central Time Zone** | |
| **Communica-tions** | **Primary:** | **Secondary:** | |
| Phones | 636-734-6789 Cell (preferred | 314-233-5782 Desk | |
| **Fax** | Use Canvas or e-mail | [Assignments](#_Schedule_and_Assignments) | |
| **E-mail** | [lep7df@mst.edu](mailto:lep7df@mst.edu) (preferred – put “***SE6196”* in front of subj line, please**) | Canvas mail less preferred, but OK | |
| **Website** | All course materials (except videos of lectures) are posted in Canvas: <https://mst.instructure.com/> | | |
| **Texts** | **REQUIRED**   * *Systems Engineering Handbook: A guide for System Life Cycle Processes and Activities*. 4th edition, 2015, ISBN 9781118999400. * Munro, Roderick A. et al., “The Certified Six Sigma Green Belt Handbook” 2nd edition (2015), ISBN 9780873898911. (The library has an online copy of the text. Individual chapters in the book may be downloaded as PDFs for use by students. The link is <http://libproxy.mst.edu/login?url=https://app.knovel.com/web/toc.v/cid:kpCSSGBHE1/viewerType:toc/root_slug:certified-six-sigma-green> )   But it’s a very good reference and worth the price to keep as a reference, if you can afford it | | |
| Other References that may be useful  * H. William Dettmer, “The Logical Thinking Process,” ASQ Quality Press: Milwaukee, WI (2007) ISBN 978-0-87389-723-5 * Dr. Benjamin S. Blanchard, “System Engineering Management,” 4th Edition (2008), ISBN 978-0-470-16735-9. * SE Fundamentals, Defense Acquisition University, January 2001, [http://www.everyspec.com/DoD/DOD-DAU-DSMC/DAU\_SYSTEMS\_ENG\_FUNDAMENTALS\_2001\_22394/](http://www.everyspec.com/DoD/DOD-DAU-DSMC/DAU_SYSTEMS_ENG_FUNDAMENTALS_2001_22394/%20%20) (download) * Howard Eisner, “Essentials of Project and Systems Engineering Management,” 3rd Edition (2008) ISBN 978-0-470-12933-3 | | |
| **Class Locations** | * Library 00316 <http://vcc.mst.edu/> * Zoom: <http://vccmedia.mst.edu/> * Archived lectures are available in Mediaspace only to 1DIS students <https://mst.mediaspace.kaltura.com/> | | |
| **Day/Time** | **Monday, 7-9:30 Central, (5:00 - 7:30 p.m. Pacific Time)** | | |
| **Credits** | **3 credit hours** | |  |
| **Grading** | **Item** | | **% of Grade** |
| Distribution | Class participation/Discussions input | | 10 |
|  | Homework | | 10 |
|  | Midterm Project | | 40 |
|  | Final Project | | 40 |
| Level | “A” – Exemplary – goes beyond minimum and demonstrates depth of discussion, analysis, or insight | | > 90 to 100% |
|  | “B” – Minimally satisfies all criteria | | ≥ 80 to ≤ 90 |
|  | “C” – Fails to satisfy some criteria | | ≥ 70 to < 80 |
|  | “F” – Unacceptably deficient | | < 70 |

# Course Description and Objectives

The topics covered are Systems Engineering Management Plan (SEMP), Systems Engineering processes, process re-engineering, standards, and systems engineering case studies. Students will apply the skills and theory that they mastered in previous five core courses to the analysis of assigned cases. Recommended prerequisites: SysEng 6105 and 6104[[1]](#footnote-1).

This capstone course requires each student to synthesize their learning from prior core courses into two major deliverables: 1) a project systems engineering management plan related to their prior course work, and 2) a case study analysis and improvement activity for a complex system development activity.

This course assumes knowledge of the basic Systems Engineering technical processes. The course will cover SE management processes not previously addressed in detail in core courses, process reengineering, and analysis and discussion of complex development projects using case studies.

**COURSE OBJECTIVES (Learner Outcomes)**

At the completion of the course the student will be able to:

1. Create a Systems Engineering Management Plan for a project
2. Describe methods for continuous organizational process improvement
3. Analyze a complex system development activity and define and implement an improvement activity using good systems engineering and process improvement practices.

# Course Overview

This course will use weekly readings, lecture, and homework to aid student learning. The course will operate as a virtual community, with the instructor and students connecting to the classroom electronically. Other student-instructor contact is expected to be via electronic mail or telephone (see above). The instructor’s location is near St. Louis.

**Class:** The class meeting is intended to amplify and extend the reading material, demonstrate concepts using sample problems, and discuss specific issues as a group. Students are responsible for the assigned material whether or not covered explicitly in class. Likewise, students are responsible for all material covered in class, whether or not in the assigned readings, including any guest lecture or student project materials. Students are expected to take initiative to contact the instructor for assistance outside of class rather than losing valuable time by waiting until class. Please advise the instructor if you must miss class due to work or illness. Missing class causes you to miss important discussions, and you are expected to provide some discussion as make up in Canvas!

**Projects:** Two major projects will be required during the semester. A [midterm project](#_MIDTERM_PRESENTATION) requires the student to complete a systems engineering management plan for a standard example or their own project begun in prior core courses. A [final project](#_FINAL_PROJECT_–) requires analyzing a complex system development program and simulating a related process improvement activity. Weekly homework for the first 7 weeks will be drafts of sections of the midterm SEMP. Weekly homework for the final 5 weeks will be drafts of the sections of the improvement project.

**Operations**: We will use the MS&T “Canvas” Internet capability to communicate[[2]](#footnote-2). Check regularly for assignments and any changes. Assistance is available on the same website. Students are responsible to be web-enabled, gain access to Canvas, and check regularly for assignments and course announcements. **All students are included in the “1A” section in Canvas.**Distance students have *additional* access to videos in the Canvas 1DIS section.

All homework and project submittals must be made to the **Assignment** link within Canvas. Acceptable formats are Microsoft Office (Word, PowerPoint, Excel), or \*.RTF for other text documents. \*.PDF files are also acceptable but *not* preferred. Instructor comments are embedded in returned papers on the same **Assignment** link. Do NOT use special characters in file names (e.g., #, $, %) as these cause problems in Canvas. If you have problems with a submission, promptly send the instructor an e-mail.

Weekly **Discussion** grades are based on class participation. Posting to the Canvas Discussion Board is evaluated only when (a) class is not held for any reason or (b) arrangements are made for student absence. All other submissions are ignored. Discussion Board postings are due at the beginning of the normal class time unless other arrangements are approved by the instructor.

Grading for each student will be kept in Canvas and updated each week. Please bring any questions or perceived discrepancies to the attention of the instructor as soon as noted. The S&T [Connect](https://blackboard.mst.edu/webapps/portal/frameset.jsp?tab_tab_group_id=_141_1) system in Canvas may be used to ensure students understand any significant deficiencies.

Required information:

• **Title IX**

Missouri University of Science and Technology is committed to the safety and well-being of all members of its community. US Federal Law Title IX states that no member of the university community shall, on the basis of sex, be excluded from participation in, or be denied benefits of, or be subjected to discrimination under any education program or activity. Furthermore, in accordance with Title IX guidelines from the US Office of Civil Rights, Missouri S&T requires that all faculty and staff members report, to the Missouri S&T Title IX Coordinator, any notice of sexual harassment, abuse, and/or violence (including personal relational abuse, relational/domestic violence, and stalking) disclosed through communication including but not limited to direct conversation, email, social media, classroom papers and homework exercises.

Missouri S&T’s Title IX Coordinator is interim chief diversity officer Neil Outar. Contact him (naoutar@mst.edu; (573) 341-6038; Temporary Facility A-1200 N. Pine Street) to report Title IX violations. To learn more about Title IX resources and reporting options (confidential and non-confidential) available to Missouri S&T students, staff, and faculty, please visit http://titleix.mst.edu.

• **Student Honor Code and Academic Integrity:**

The Honor Code developed and endorsed by the Missouri S&T Student Council: the Honor Code can be found at this link: <http://stuco.mst.edu/honor-code/>. Students should read and reflect upon the Honor code and its emphasis on HONESTY and RESPECT.

Page 30 of the Student Academic Regulations handbook describes the student standard of conduct relative to the University of Missouri System's Collected Rules and Regulations section 200.010, and offers descriptions of academic dishonesty including cheating, plagiarism or sabotage (<http://registrar.mst.edu/academicregs/index.html>). Other informational resources for students regarding ethics and integrity can be found online at <http://academicsupport.mst.edu/academicintegrity/studentresources-ai>.

• **S&Tconnect**: https://canvas.mst.edu/ (S&Tconnect icon on left toolbar)

Office of Academic Support • 105 Norwood Hall • 320 West 12th Street • Rolla, MO 65409-1520 Phone: 573-341-7276 • Email: ugs@mst.edu • Web: <http://ugs.mst.edu/> *An equal opportunity institution*

S&Tconnect provides an enhanced system that allows students to request appointments with their instructors and advisors via the S&Tconnect calendar, which syncs with the faculty or staff member’s Outlook Exchange calendar. S&Tconnect will also facilitate better communication overall to help build student academic success and increase student retention. S&Tconnect Early Alert has replaced the Academic Alert system used by Missouri S&T.

• **Classroom Egress Maps:**

On campus students should familiarize themselves with the classroom egress maps posted on-line at: <http://designconstruction.mst.edu/floorplan/>.

• **Accessibility and Accommodations:**

It is the university’s goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please contact Student Disability Services at (573) 341- 6655, [sdsmst@mst.edu](mailto:sdsmst@mst.edu), visit <http://dss.mst.edu/> for information, or go to [mineraccess.mst.edu](mineraccess.mst.edu/) to initiate the accommodation process.

*\*Please be aware that any accessible tables and chairs in this room should remain available for students who find that standard classroom seating is not usable.*

• **LEAD Learning Assistance** http://lead.mst.edu

The Learning Enhancement Across Disciplines Program (LEAD) sponsors free learning assistance in a wide range of courses for students who wish to increase their understanding, improve their skills, and validate their mastery of concepts and content in order to achieve their full potential. LEAD assistance starts no later than the third week of classes. Check out the online schedule at <http://lead.mst.edu/assist>, using zoom buttons to enlarge the view. Look to see what courses you are taking have collaborative LEAD learning centers (bottom half of schedule) and/or Individualized LEAD tutoring (top half of the schedule). For more information, contact the LEAD office at 341-7276 or email [lead@mst.edu](mailto:lead@mst.edu).

• **The Student Success Center**

The Student Success Center is a centralized location designed for students to visit and feel comfortable about utilizing the campus resources available. The Student Success Center was developed as a campus wide initiative to foster a sense of responsibility and self-directedness to all S&T students by providing peer mentors, caring staff, and approachable faculty and administrators who are student centered and supportive of student success. Visit the SSC at 198 Toomey Hall; 573-341-7596; [success@mst.edu](mailto:success@mst.edu); facebook: <www.facebook.com/SandTssc>; web: <http://studentsuccess.mst.edu/>

# Schedule and Assignments

Each meeting day has (1) a reading assignment to be read in preparation, and (2) assigned homework based on the prior lecture. **Homework and discussion postings are normally due at the beginning of class**; late work will not be given credit without pre-coordination. Classroom discussion is valued and participation contributes to the course grade. “Discussion” in written homework requires stating *and* supporting a thesis, not merely asserting a position.

The following schedule will be observed as closely as possible.

| Week | Lec | Lecture Subjects | **Assignments** | |
| --- | --- | --- | --- | --- |
| Reading | **Homework Due** |
| 19 Aug 19 | 1 | Introduction to the Systems Engineering Management Plan – SEMP 1 & 2 – | INCOSE SE Handbook (ISEH)  Ch. 1, 2, 8, 5.1.2.2 | 1- See Canvas - HW1 - Prerequisites is due 21 Aug |
| 26 Aug 19 | 2 | SEMP 3 – Program Organization | ISEH 3, 6.1, 6.2, 9.7, 10.1-10.13 | HW 2 - See Canvas – SEMP sections 1 & 2 |
| 2 Sep 19 |  | Labor Day |  |  |
| 9 Sep 19 | 3 | SEMP 4 – Technical Processes | ISEH 4 | HW 3 - See Canvas – SEMP section 3 |
| 16 Sep 19 | 4 | SEMP 5a – Technical Management Processes 1 – Technical Planning and Assessment | ISEH 5.1, 5.2, 5.7 | HW 4 - See Canvas – SEMP section 4 |
| 23 Sep 19 | 5 | SEMP 5b – Technical Management Processes 2 – Cost/Schedule, Decision Analysis, Risk, Issue, Opportunity Management | ISEH 5.3, 5.4, 10.1 | HW 5 - See Canvas – SEMP section 5.1-5.2 |
| 30 Sep 19 | 6 | SEMP 5c – Technical Management Processes 3 – Configuration, Interface, and Information Management | ISEH 5.5, 5.6, 9.6 | HW 6 - See Canvas – SEMP 5.3-5.6 |
| 7 Oct 19 | 7 | SEMP 6 – Organizational Investment | ISEH 7; Repenning & Sterman article | HW 7 - See Canvas – SEMP 5.7, 5.8 |
| 14 Oct 19 | 8 | Project Reengineering – Value Methodology  Enterprise Considerations – Introduction to Process Reengineering | ISEH 10.14  Certified Six Sigma Green Belt Handbook (C6σGBH) Ch. 1, 2, 3 | [Midterm SEMP Due](#_Midterm_Project:_Systems)  **2400 16 Oct**  **Central Time** |
| 21 Oct 19 | 9 | Process Reengineering: Define | C6σGBH, Ch. 4-7 | HW 9 – See Canvas |
| 28 Oct 19 | 10 | Process Reengineering: Measure | C6σGBH,  Ch. 8, 10-13, 15 | HW 11 – See Canvas |
| 4 Nov 19 | 11 | Process Reengineering: Analyze | C6σGBH,  Ch. 16-17, 19 | HW 12 - See Canvas |
| 11 Nov 19 | 12 | Process Reengineering: Improve | C6σGBH, Ch. 18, 20 | HW 13 - See Canvas |
| 18 Nov 19 |  | Thanksgiving Break |  |  |
| 25 Nov 19 | 13 | Process Reengineering: Control | C6σGBH, Ch. 22-23 | HW 14 - See Canvas |
| 2 Dec 19 | 14 | Organizational Learning and Leadership | C6σGBH, Ch. 9,  Hughes “QF32” article | HW 15 – See Canvas |
| 9 Dec 19 |  | No class/Test  [Final Grades Due Dec 12] | None | Final [**Projects**](#_FINAL_PROJECT_–) **Due 1900 Central Time** |

# Midterm Project: Systems Engineering Management Plan

Students are expected to prepare a Systems Engineering Management Plan for prior SysEng course projects in SysEng 5101, 6102, 6104, or the 2007 DARPA Urban Challenge (materials are provided in Canvas). The Systems Engineering Management Plan is intended to address relevant life-cycle phases for the project. An annotated outline is provided in Canvas (Midterm Assignment) into which students will populate project-specific information to address such topics as technical objectives, development processes, organization and allocation of systems engineering tasks, continuous improvement, and life-cycle support.

**Grading**:

* 40% of course grade for the SEMP (Midterm). The SEMP will be graded based on completeness of each of the outline topics (or justification for exclusion), and the relationship of the content to the project. The SEMP must address **what** will be done (goals, objectives, major deliverables, tasks, subtasks), **why** it is relevant to the project, **how** it will be done (processes and tools), **who** will do it (organizations and allocation of work), to **what standards** work will be done (measures of quality and completeness), and **when** it will be done (event-based plan). Coherence of the plan is essential, both in its relationship to the project and in its internal integration. A detailed outline for the complete SEMP is provided in the Midterm assignment for week 8. The plan should be approximately 30 pages. The weekly homework assignments are used to draft and build the SEMP.
* Proper citation of sources is expected and normal rules regarding plagiarism apply (see <http://www.lib.berkeley.edu/how-to-find/cite-sources> for proper formats).

# Final Project – Process Improvement Activity

**Grading**: 40% of course grade. Select one of the following cases (posted in Canvas):

|  |  |
| --- | --- |
| * A-10 Attack Aircraft | * C-5A Galaxy |
| * F-111 Fighter/Bomber | * Global Hawk |
| * Global Positioning System | * Hubble Space Telescope |
| * International Space Station | * Theater Battle Management Core System (TBMCS) |

**Read** the case study to identify a problem to be analyzed, and as a source of data. **Collect** more information as required from other sources regarding the system described in the case and the problem you identify. Execute a **simulated** process improvement activity using the Six-Sigma structure of **D**efine, **M**easure, **A**nalyze, **I**mprove, and **C**ontrol (DMAIC). Attention should be paid to the realism, effectiveness, and feasibility of your proposed improvements. Analysis is expected to justify your recommendations. Grading will consider the depth of analysis and demonstrated use of tools and techniques discussed in class and in the text.

You may use any graphics that you like to convey your concepts better. I am expecting approximately 3-6 pages for each section. Your final paper should be 20-30 pages long, single-spaced. The majority of the content should be your writing, not quotations from the case study. Please adhere to common citation practices described for the midterm.

Papers should be organized as follows; detailed expectations are provided in an annotated outline in Canvas.

**Title**: Identification of the case study, Student Name.

1. Introduction and Summary
2. Define the Problem
3. Measure the Problem
4. Analyze the Problem
5. Improve the Problem
6. Control the System

# External Links – Resources

* Robert Lucky, “Unsystematic Engineering”, (IEEE Spectrum September 2006) <http://spectrum.ieee.org/energy/renewables/unsystematic-engineering>
* “Who Killed the [FBI] Virtual Case File?” (IEEE Spectrum September 2005): <http://www.spectrum.ieee.org/computing/software/who-killed-the-virtual-case-file>
* “Why Software Fails” (IEEE Spectrum September 2005), <http://www.spectrum.ieee.org/computing/software/why-software-fails>
* DARPA Urban Challenge <http://archive.darpa.mil/grandchallenge/>
* Information on US Military systems for further research
  + Federation of American Scientists <http://www.fas.org/man/dod-101/sys/>
  + Global Security <http://www.globalsecurity.org/>
* US Department of Defense (DOD)
  + Systems Engineering Technical Reviews <https://acc.dau.mil/docs/technicalreviews/dod_tech_reviews.htm>
  + Defense Acquisition Guidebook, Ch. 4, “Systems Engineering” <https://acc.dau.mil/CommunityBrowser.aspx?id=638295>
* GAO Reports
  + GAO 16-329SP, “Assessments of Selected Weapon Programs,” (New ones every few months) <http://www.gao.gov/products/GAO-16-329SP>  
    <http://www.gao.gov/assets/680/676281.pdf>
* NASA
  + Systems Engineering Handbook, NASA/SP-2007-6105 Rev1, [9MB] <http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20080008301_2008008500.pdf>
  + Space Systems Engineering training materials <http://spacese.spacegrant.org/>
  + “Lewis Spacecraft Mission Failure Investigation Board Final Report”, 12 February 1998, <http://spacese.spacegrant.org/Failure%20Reports/Lewis_MIB_2-98.pdf>
  + NASA Space-to-Space Communications System” 1994, <http://www.nasa.gov/pdf/384149main_SSCS_case_study.pdf>
* US Federal Aviation Administration (2006)
  + *National Airspace System, System Engineering Manual* (Version 3.1). Washington, DC: ATO Next Gen and Operations Planning. <http://www.everyspec.com/FAA/FAA-General/FAA_NAS_SEM_VER3--1_11OCT2006_18720/>
* Standards (standards are available for purchase or occasionally from the library)
  + EIA-632, “Processes for Engineering a System”, cf., <http://standards.sae.org/eia632/>
  + ISO/IEC/IEEE 15288 – 2015, “Systems and Software Engineering – System Life Cycle Process”, <http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=63711>
  + IEEE 1220 – 2005 – <http://standards.ieee.org/findstds/standard/1220-2005.html>
  + IEEE/ISO/IEC 24748-4-2016, “International Standard for Systems and Software Engineering -- Life Cycle Management -- Part 4: Systems Engineering Planning” <http://www.iso.org/iso/catalogue_detail.htm?csnumber=56887>
  + ISO 9000 Series <http://www.asq.org/learn-about-quality/iso-9000/overview/overview.html>
* International Council on Systems Engineering <http://www.incose.org/>
* Value Methodology or Value Engineering (Society of American Value Engineers, SAVE) <https://www.value-eng.org/>
  + <http://www.fhwa.dot.gov/ve/>
* Example SEMPs
  + Gamma Ray Large-Area Space Telescope: See Canvas - <http://www-glast.slac.stanford.edu/Reviews/InternalReview/Documentation/SYSTEM%20ENGINEERING%20MANAGEMENT%20PLAN%20(SEMP).PDF>
  + Landsat (USGS) – See Canvas <http://www.usgs.gov/contracts/acq_opp/EROS_tech_library/TSSC%20Recompete/Reference%20Library/Landsat%20Documentation/LS-DIR-04%20Landsat_SEMP.pdf>

Additional interesting system engineering sources available in the file “SE helpful Links 2019.docx” in Supplementary Material folder

1. From the course catalog [↑](#footnote-ref-1)
2. Course number: SYS\_ENG 6196: SYS ENG CAPSTONE; **all students are included in the “1A” section.**  [↑](#footnote-ref-2)