

ETLS 509 –Verification and Validation

Fall Semester 2009

Instructor:	Neill Radke
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Background:	MBA University of Minnesota BS North Dakota State University
Time:	Tuesdays, 6-9 pm
Location:	St. Paul, OSS 122
Required Text(s):	Wasson, Charles S.,_System Analysis, Design, and Development – Concepts, Principles, and Practices, John Wiley & Sons, Inc., 2006. Grady, Jeff O., System Validation and Verification, CRC, 1998. <u>International Council on Systems Engineering (INCOSE) Systems Engineering Handbook</u> , INCOSE –TP-2003-002-03, Version 3.1, August 2007. (INCOSE is a professional society for systems engineers. Members can download the handbook from www.incose.org free of charge. Non-members can purchase the handbook from the same site.) Selected readings from web sites as defined in the detailed course outline below.
Suggested Readings:	BS <u>ISO/IEC 15288:2002 Systems engineering – Systems life cycle processes</u> , 2006.
Course Description:	This graduate course considers two closely related but distinct concepts in systems engineering, <i>verification</i> and <i>validation</i> . Verification is “The process of evaluating a system or component to determine whether the products of a given development phase satisfy the conditions imposed at the start of that phase.” (IEEE Standard Glossary of Software Engineering Terminology, Standard 610.12-1990.) Validation is the act of assessing the requirements, design, and development of a product to ensure that it will meet the user’s requirements, operational needs, and expectations at the time of delivery. These activities occur throughout the systems engineering cycle, not simply at the end. Systems engineering verification and validation practices will be studied and applied in appropriate situations.
Prerequisites:	ETLS 507 - Introduction to Systems Design ELTS 508 - Systems Design
Course Objectives:	In this course, the student will be exposed to the second half of the systems engineering life cycle as defined by ISO/IEC 15288, paragraphs 5.5.2 and 5.5.3, and will be exposed to methods, procedures, and practices necessary to effectively implement the life cycle activities on projects.

Learning Outcomes:

Students will be required to demonstrate their skills by participating in two major system engineering design reviews – the first test readiness review (based on a defined project), and the second test readiness review (based on a project of team choice).

Upon successful completion of the course, the student will be able to:

Outcome	Methodology	Objectives
Define and implement system integration strategy.	E, P, TRR	YE1, YE2, YE3, YE4, YE5
Define and implement system verification strategy.	E, P, TRR	YE1, YE2, YE3, YE4, YE5
Transition product from design to product to operational use.	E, P, PRR	YE1, YE2, YE3, YE4, YE5
Define and implement system validation strategy.	E, P, TRR, PRR	YE1, YE2, YE3, YE4, YE5
Define system operational and maintenance procedures.	E, P, PRR	YE1, YE2, YE3, YE4, YE5
Define system disposal criteria.	E, P, PRR	YE1, YE2, YE3, YE4, YE5

Course Methodology:

Lectures, course reading, and course exercises are used to familiarize the student with the systems engineering concepts presented throughout the course. During the semester, the student will be involved in the analysis and design of a complex system. Results of the project will be presented in the form of the two major system reviews.

This project is an important part of the course because it provides the opportunity to confront real-life situations and problems during the systems analysis and design process. It is, therefore, essential for the student to be actively involved in this project. Students are required to learn the necessary technology to contribute to the project in a meaningful way.

Major Assignments:

Course exercises will be based on the assigned readings. Students are required to develop and present material related to their projects at each of the two major system reviews.

Course exercises (E) – 10%

Class participation (P) – 10%

First Test Readiness Review (TRR) – 40%

Second Test Readiness Review (TRR) – 40%.

An important aspect of this class is the ability to synthesize the concepts presented, with personal experiences, knowledge and abilities. Everyone in class will benefit from your participation.

Grading Policy:

Class members will be graded on a curve based on overall performance of the class. Late assignments will not be encouraged. Grades will be affected by timeliness of completion.

- Academic Integrity:** All students are expected to understand and follow the University of St. Thomas policies on Academic Integrity. These are described at: www.stthomas.edu/engineering/graduate/policies
- Students with Disabilities:** Qualified students with documented disabilities who may need classroom accommodations should make an appointment with the Enhancement Program – Disability Services office. Appointments can be made by calling 651-962-6315. You may also make an appointment in person in O’Shaughnessy Educational Center, room 119. For further information, you can locate the Enhancement Program on the web at <http://www.stthomas.edu/enhancementprog/>.
- Attendance Policy:** Students are expected to attend all class sessions. Circumstances, which prevent attendance, will be honored up to two instances. Absences in excess of two times may result in an incomplete grade for the course. Contact the instructor when a special situation arises. All absences require that the instructor be informed in advance.
- Exams:** Exams are one of the instruments used to evaluate the knowledge gained by an individual student of the class subject matter, and the progress towards meeting the outcomes of the class and the degree. In this class, two group projects (i.e., presentations) are to be completed in lieu of any exams.
- Bibliography:** See Required Texts and Suggested Readings above.
- Instructor Bibliography:** Neill Radke was most recently a Senior Systems Engineer with Eaton Corporation. He has over thirty years of experience in the design and development of state-of-the-art, systems and has been the systems engineering lead on programs at Alliant Techsystems Advanced Weapons Division, Goodrich Aerospace, and Lockheed Martin Tactical Systems. Neill is co-President of the INCOSE North Star Chapter in the Minneapolis/St. Paul area. He is a past President of the chapter and has been their Director of Government and Academia.

Course Outline ETLS 509 Verification and Validation

Date	Topic(s)	Assignment(s)
Session 1 15 Sept	Module 1 - Systems Life Cycle Processes Overview <ul style="list-style-type: none"> • Course Overview <ul style="list-style-type: none"> ○ Course Overview ○ Class Project • Systems Engineering Overview <ul style="list-style-type: none"> ○ System, subsystem, component ○ Program, project ○ Systems engineering, systems engineer ○ Verification, validation ○ Systems Hierarchies • Systems Life Cycles System Engineering Process Models <ul style="list-style-type: none"> ○ Wasson ○ Capability Maturity Model Integrated (CMMI) ○ ISO 15288 • System Life Cycle Processes Overview <ul style="list-style-type: none"> ○ Agreement Processes ○ Enterprise Processes ○ Project Processes • Technical Processes covered in ETLS 508 <ul style="list-style-type: none"> ○ Stakeholder Requirements Definition ○ Requirements Analysis ○ Architectural Design ○ Implementation • Technical Processes with emphasis in this course on: <ul style="list-style-type: none"> ○ Integration ○ Verification ○ Transition ○ Validation ○ Operation ○ Maintenance ○ Disposal 	Wasson: - Review Chapters 3 – 7 - Read Chapter 36-43 INCOSE Handbook: - Read Sections 2, 3, and 6

Date	Topic(s)	Assignment(s)
Session 2 22 Sept	Module 2 - Decision Support <ul style="list-style-type: none"> • Analytical Decision Support • Statistical Influences on System Design • System Performance Analysis, Budgets, and Safety Margins • System Reliability, Availability, and Maintainability • System Modeling and Simulation • Trade Study Analysis of Alternatives 	Wasson: - Read Chapter 47-52 - Homework: Chp 37 – Org Centric Exercise 2, page 438 Chp 38 – Org Centric Exercise 2, page 450 Chp 39 – Org Centric Exercise 2, page 464 INCOSE Handbook: - Read Sections 7.1 and 9.6
Session 3 29 Sept	Module 3 - Integration <ul style="list-style-type: none"> • Integration <ul style="list-style-type: none"> ○ Process definition ○ Process inputs and outputs ○ Process activities • Incremental Integration • Integration Planning • Integration Procedures 	Wasson: - Read Chapters 44 and 55 - Homework: Chp 44 – Org Centric Exercise 1, page 542 Chp 44 – Org Centric Exercise 2, page 543 Grady: - Read Chapters 1 and 2 INCOSE Handbook: - Read Section 4
Session 4 6 Oct	Module 4 - Integration (continued) <ul style="list-style-type: none"> • Integration Conduct • Requirements Verification • Integration Reporting 	Wasson: - Read Chapters 44 and 55 - Homework: Chp 55 – Org Centric Exercise 1, page 757 Chp 55 – Org Centric Exercise 2, page 757 Grady: - Read Chapter 3

Date	Topic(s)	Assignment(s)
Session 5 13 Oct	Module 5 - Verification <ul style="list-style-type: none"> • Verification <ul style="list-style-type: none"> ○ Process definition ○ Process inputs and outputs ○ Process activities • Verification Fundamentals <ul style="list-style-type: none"> ○ Verification Ethics ○ Cross Reference Matrix <ul style="list-style-type: none"> • Verification Requirements Analysis ○ Verification Methods ○ Product and Verification Levels <ul style="list-style-type: none"> • Item Qualification • Qualification Testing • Verification Planning • Product Configuration Management 	Wasson: - Read Chapter 53 - Homework: Chp 53 – Org Centric Exercise 1, page 708 Grady: - Read Chapters 4, 5, 6, and 7 INCOSE Handbook: - Read Section 4.7
Session 6 20 Oct	Module 6 - Verification (continued) <ul style="list-style-type: none"> • System Verification • Acceptance Testing • System Audits and Reviews <ul style="list-style-type: none"> ○ Physical Configuration Audit ○ Functional Configuration Audit ○ Test Readiness Review ○ Formal Qualification Review 	Wasson: - Read Chapters 45, 46, and 54 - Homework: Chp 45 – Org Centric Exercise 1, page 561 Chp 46 – Org Centric Exercise 1, page 573 Chp 54 – Org Centric Exercise 1, page 731 Grady: - Read Chapters 8, 9, and 10
Session 7 27 Oct	Module 7 – First Test Readiness Review <ul style="list-style-type: none"> • Student Project Presentations – First Test Readiness Reviews • Class presentations stating that the design activities are complete with detail planning for all verification activities associated with their class project. • The result should be a “customer” approval of the verification plans. 	First Test Readiness Review Presentation

Date	Topic(s)	Assignment(s)
Session 8 3 Nov	Module 8 - Transition <ul style="list-style-type: none"> • Transition <ul style="list-style-type: none"> ○ Process definition ○ Process inputs and outputs ○ Process activities • Transition – Development to Operational Usage <ul style="list-style-type: none"> ○ Transition planning ○ Site preparation ○ System installation ○ System activation • System demonstration 	Wasson: - Read Chapter 56 - Homework: Chp 56 - Org Centric Exercise 1, page 772 Grady: - Read Chapters 11 and 12 INCOSE Handbook: - Read Section 4.8
Session 9 10 Nov	Module 9 - Validation <ul style="list-style-type: none"> • Validation <ul style="list-style-type: none"> ○ Process definition ○ Process inputs and output ○ Process activities • Validation Responsibility and Leadership • Validation Expectations • Validation Methods 	Wasson: - Read Chapter 53 (Review) - Homework: Chp 53 – Org Centric Exercise 2, page 708 Grady: - Read Chapters 13 and 14 INCOSE Handbook: - Read Section 4.9
Session 10 17 Nov	Module 10 - Operation <ul style="list-style-type: none"> • Operation <ul style="list-style-type: none"> ○ Process definition ○ Process inputs and outputs ○ Process activities • Operation strategy and User Training 	Wasson: - Read Chapter 57 - Homework: Chp 57 –General Exercise 2, page 787 INCOSE Handbook: - Read Section 4.10

Date	Topic(s)	Assignment(s)
Session 11 24 Nov	Module 11 - Maintenance <ul style="list-style-type: none"> • Maintenance <ul style="list-style-type: none"> ○ Process definition ○ Process inputs and outputs ○ Process activities • Maintenance strategy- http://www.maintenanceworld.com/Articles/worshamw/ispreventive.html • Logistics 	Wasson: - Read Chapter 57 (Review) - Homework: Chp 57 - Org Centric Exercise 1, page 787 INCOSE Handbook: - Read Section 4.11
Session 12 1 Dec	Module 12 - Disposal <ul style="list-style-type: none"> • Disposal <ul style="list-style-type: none"> ○ Process definition ○ Process inputs and outputs ○ Process activities • Disposal • Recycling 	Wasson: - Read Chapter 57 (Review) INCOSE Handbook: - Read Section 4.12
Session 13 8 Dec	Module 13 - Summary <ul style="list-style-type: none"> • Systems Engineering Metrics • Additional System Engineering Related Topics <ul style="list-style-type: none"> ○ Cross Functional Teams ○ Value Engineering ○ Concurrent Engineering ○ Design for Manufacturing ○ Design for the Environment • Course Review • Tailoring 	Wasson: - Read Chapter 54 (Review) - Homework: Chp 54 - Org Centric Exercise 3, page 732 Grady: – Read Chapter 15 INCOSE Handbook: - Read Section 10
Session 14 15 Dec	Module 14 – Second Test Readiness Review <ul style="list-style-type: none"> • Student Project Presentations – Second Test Readiness Reviews • Class presentations associated with verification and validation activities that need to be performed prior to production. • The result will be the completion of their class project. • Course Evaluations 	Second Test Readiness Review Presentation