

ENGSCI 9185 – Risk Assessment and Management in Engineering Systems

Course Outline – Summer 2019

Instructor:

Lucas Thung – lthung@uwo.ca

Class Schedule:

Classroom Location: **Spencer Engineering Building SEB 2100**

Class #	Date	Class Time
1	Thursday, June 27	8:30 am to 12 pm
2	Thursday, July 4	8:30 am to 12 pm
3	Thursday, July 11	8:30 am to 12 pm
4	Thursday, July 18	8:30 am to 12 pm
5	Thursday, July 25	8:30 am to 12 pm
6	Thursday, Aug 1	8:30 am to 12 pm
7	Thursday, Aug 8	8:30 am to 12 pm
8	Thursday, Aug 15	8:30 am to 12 pm

Description:

This course introduces the concepts and general principles of risk analysis, assessment and management in engineering systems. The course discusses the qualitative risk identification methods and the quantitative risk assessment methods and techniques. It also explains in a detailed approach the risk management strategy and the process of managing risks, starting by the identification stage, and followed by the initial assessment and the response and mitigation stage. The risk management regime and the contingency management components are identified. The risk management tools and techniques are clarified through considering the risk and value management by different implemented case studies related to different Engineering fields. The principles of risk modeling will be introduced. Managing financial risks in major projects will be illustrated through case studies. Break-Even, sensitivity and risk decision models will be discussed by examples.

Risk management is not about predicting the future. It is about understanding a project and making a better decision regarding the management of that project, tomorrow. To achieve this aim a systematic approach is followed to identify the risk sources, then quantify their effects (risk analysis), hence develop management responses to risk, and finally to provide for residual risk in project estimates. These stages comprise the process of risk management. Risk management can be one of the most creative tasks of project management.

The benefits of risk management can be summarized as follows:

- Project issues are clarified, understood and considered from the start
- Decisions are supported by thorough analysis
- The definition and structure of the project are continually monitored
- Clearer understanding of specific risks associated with a project
- Compilation of historical data to assist future risk management procedures

Various case studies related to different engineering fields will be discussed.

Course General Objectives:

- To develop understanding of the general principles of risk management and increases the participants awareness on risk management implementation in the industry.
- To enable participants and future risk assessors to visualize the risk management strategy and enable them to find solutions to respond to these risks within their engineering projects or business growth.
- To enable participants to examine the potential pitfall along with the project's overall time, cost and quality targets, enables them to consider risk efficiency.

After completing this course, students should be able to:

- Learn the principles of risk assessment and management and how and when it can be implemented towards achieving project objectives.
- Develop the sense in identifying the hazards and risks sources and explore sufficient knowledge in creating the risk assessment and management model incase such hazards turned to be future risks.
- Become familiar with the different risk assessment techniques and decision models.
- Participants will have confidence in assessing project risks and responding for such risks with the most efficient mitigation strategies.
- Develop the experience in the risks calculations and taking decisions towards wise risk management strategies.
- Develop high awareness to deal with risk environment and its exposures.

- Through the case studies participants will visualize the efficient systematic approach of classifying the risks, calculating the risks factors for their projects which will help them in managing their projects smoothly.

Main Topics:

1. Nature of risk and its definition
2. Introduction to risk management
3. Risk assessment and management definitions and concepts
4. Risk vs. uncertainty
5. Risk assessment life cycle
6. Risk management vs. project management
7. Benefits of risk management
8. Risk analysis and management
9. Risk efficiency
10. Role of risk management in engineering systems
11. Decision making in risk management
12. The risk management strategy
13. The process of managing risks
14. Identification and initial assessment
 - Controllable and uncontrollable risks
 - Brainstorming
 - Interviews
 - The Delphi technique
 - Expert systems
 - Questionnaires
 - Combined approach
 - Qualitative assessment
 - Classification and reference
 - Description of the risk
 - Risk trigger
 - Relationship to other risks
 - Potential impact
 - Likelihood of occurrence
15. Risk Management Response and Mitigation
 - Risk avoidance

- Risk reduction
 - Risk transfer
 - Residual or retained risk
16. Detailed quantitative assessment of risk
- A brief introduction to statistics
 - Methods of risk assessment
 - Simple assessment
 - Probabilistic analysis
 - Multiple estimating using risk analysis
 - Break-even analysis
 - Sensitivity analysis
 - Decision trees models
 - Monte Carlo Simulation
 - Latin Hypercube sampling
 - Accident models
17. The Risk Management Regime
- Reporting
 - Contingency management
18. Risk classification
19. Aggregating individual project risks
20. Internal, specific and external risks

Note: The depth and coverage of the above topics will vary.

Required Textbook: None

References:

- 1) Ang, A. and Tang, W. (1975). *Probability Concepts in Engineering Planning and Design, Vol. 1, Basic Principles*. John Wiley & Sons
- 2) Ang, A. and Tang, W. (1975). *Probability Concepts in Engineering Planning and Design, Vol. 2, Decision, Risks, and Reliability*. John Wiley & Sons
- 3) Aven, T. (2011). *Quantitative Risk Assessment: The Scientific Platform*. Cambridge University Press
- 4) Jardine, A.K.S. and Tsang, A.H.C. (2013). *Maintenance, Replacement, and Reliability: Theory and Applications*. CRC Press
- 5) Modarres, M. (2006). *Risk Analysis in Engineering: Techniques, Tools and Trends*. Taylor & Francis
- 6) Rausand, M. and Hoyland, A. (2003). *System Reliability Theory: Models, Statistical Methods, and Applications*. John Wiley & Sons

Evaluation:

1) Group Project	30%
2) Individual Research Project	25%
3) Final Exam	45%
Total	100%

1) Group Project

Students will work in groups to apply Risk Management and Assessment to engineering cases.

The instructor will randomly assign students into different groups to:

- Allow ample time for each group to present their projects followed by a “Questions and Answers (Q&A)” session.
- Simulate a realistic work situation since employees rarely have the option of selecting their group members. Students will be challenged with the task of working with other individuals whom they may not normally work with.

Students will also discuss the effects and benefits of their efforts in class interactively.

2) Individual Research Project

Student should select an area of his/her interest and write **eight (8) pages** (excluding references) of literature review of the application of Risk Assessment to that field. The area of interest may be consulted with the instructor.

Notes:

- Must be academic in style and content
- Must have a clear focus
- Must present ideas in a logical and well thought-out flow
- Arguments, analysis and conclusions must be based on clearly identified research
- Must cite all references from other sources
- Must be typewritten (Times New Roman, Font 12; Double spaced; MS Word format)

3) Final Exam

A non-programmable calculator and two (2) letter-sized (i.e. 8.5" x 11") aid sheets are allowed. You may use both sides of the sheets and make any notes you wish.

Late Assignments:

Late Assignments will **not** be accepted. If you miss any part of the course due to a medical condition (i.e. a valid medical certificate must be produced), the weight of the missed assignment(s) will be added to the Final Exam.

For example: If you missed the **Group Project** due to a medical condition, then your **Final Exam** will be worth **75% [= 30% + 45%]**.

Communication Policy:

- 1) **OWL** will be used in this course for the purposes of posting lecture slides, assignments, and conveying announcements.
- 2) Do **not** email "***general, class-related***" questions to the course instructor. Please post such questions to **OWL** so others can benefit from your questions and the replies. Questions posted to **OWL** will be answered within two (2) business days.
- 3) Do email "***specific, student-related***" questions to the course instructor.
 - a. Please email such questions using your **Western University issued email address** (i.e. @uwo.ca), including "**ES 9185**" in the **subject line**.
 - b. The instructor will respond (i.e. either via email or in class) to students' emails within two (2) business days.

Repeating All Components of the Course:

In accordance with Senate and Faculty Policy, students who have failed an Engineering course must repeat all components of the course. No special permissions will be granted enabling a student to retain any marks from previous years.

Previously completed assignments and laboratories cannot be resubmitted for grading by the student in subsequent years.

Use of English:

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final exam may be returned without grading.

If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Attendance:

Any student who, in the opinion of the instructor, is absent too frequently from class in any course, will be reported to the Associate Chair (Graduate), after due warning has been given. On the recommendation of the Department concerned, and with the permission of the Associate Chair (Graduate), the student will be debarred from taking the regular examination in the course.

Cheating:

University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program.

If you are caught cheating, there will be no second warning (see Scholastic Offence Policy in the Western Academic Calendar).

Plagiarism:

Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar). Western University has software for plagiarism checking. Students may be required to submit their work in electronic form for plagiarism checking.

Conduct:

Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others.

Sickness and Other Problems:

Students should immediately consult with the instructor or Associate Chair (Graduate) if they have problems that could affect their performance in the course. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 519-661-2111 x 82147 for any specific question regarding an accommodation.

Notices:

Students are responsible for regularly checking their @uwo.ca Western University email **and** notices posted on **OWL** course website.

Consultation:

Students are encouraged to discuss problems with the instructor.
Office hours will be arranged for the students to see the instructor.
Other individual consultation can be arranged by appointment with the instructor.