Department of Mechanical Engineering
M.Eng. Capstone Project Guidelines

Overview

The M.Eng. program focuses on technical and professional development and engineering practice rather than the creation of new knowledge. Therefore, the capstone project is intended to apply knowledge learned during a student's program to a technical or academic challenge, industrial process, and/or social or regulatory concern. The capstone project might additionally or alternatively consist of an in-depth, critical review of the technical literature.

The capstone report is not expected to be a "mini-thesis" and original research is not required. Whether the capstone project involves conceptual design/analysis or work done *in-silico*/in a laboratory setting, the focus is on technical objectives rather than research contributions, terms that are defined below.

> **Technical objective:** Application of engineering principles to answer or solve a specific technical or technoeconomic question.
>
> **Research contribution:** Application of engineering principles to generate new knowledge or a new line of inquiry.

The emphasis of the capstone project is therefore on the application, interpretation, synthesis and/or pragmatic extension of existing knowledge. M.Eng. students are expected to combine material learned in their graduate classes plus information independently acquired through the detailed study and evaluation of particular theories, methodologies, technologies, governmental policies or case studies.

In the following list, sample projects drawn from previous capstone reports are provided for several areas of engineering inquiry. In addition, each example briefly contrasts how a capstone project, focused on technical objectives, differs from a thesis-based program, focused on research contributions. These examples are provided for reference purposes and M.Eng. students should not interpret the following as a complete listing of representative capstone projects.

Examples of possible capstone projects include:

- Heat conduction modeling for estimating burn severity (Possible technical objective is to develop Green's function-based heat conduction models to predict the temperature and heat flux profiles in human skin when exposed to a simulated fire. By contrast, a research contribution might additionally include the development of an experimental program using a surrogate material for human skin and/or an evaluation of fire retardant fabrics in reducing the maximum skin temperature.)
- Computer simulation of an endoscopy department renovation (Possible technical objective is to use advanced industrial engineering principles coupled with staff/patient survey data to inform key (re)design decisions. By contrast, a research contribution might additionally include ongoing "living lab" data collection with advanced statistical analyses of failure rates and causes.)

- Working curve development of photopolymerization composite resins (Possible technical objective is to use statistical techniques and design of experiments to develop models that explore the relationship between light source intensity and resin curve depth. By contrast, a research contribution might comprise more advanced model development coupled with extensive laboratory verification using a variety of resin types.)
- Assessing failure rates of polymeric foams in cold environments (Possible technical objective is to use a custom-built impact device and high-speed cameras to study the high rate of failure of select polymeric foams. By contrast, a research contribution might comprise a much more extensive experimental campaign coupled with the development of corresponding analytical and FEA models.)
- How to optimize the placement of wind turbines in a windfarm (Possible technical objective is the evaluation of wind-shadow effects using output from commercial CFD software. By contrast, a research contribution might comprise numerical modelling using different algorithms plus a comparison with novel field data collected as a part of the research project.)
- Optimal network planning (Possible technical objective is the application of genetic algorithms for capacity planning in complex networks e.g. telecommunications, transportation. By contrast, a research contribution might additionally compare the predictions of such genetic algorithms with industrially-derived data and the predictions of different classes of models.)

As outlined below, capstone reports must meet professional engineering quality standards. Writing a successful report requires a significant investment of time and independent study.

Course registration, capstone topic selection

A student may work on the capping exercise during more than one academic term, however, he/she must register in MEC E 910 for the term in which the project is to be completed. Normally the capping exercise topic and academic supervisor will be identified only after the student's other program requirements have been substantially completed. A list of open capstone topics and prospective academic supervisors is available from https://www.ualberta.ca/mechanical-engineering/graduate-studies/meng-capstone. A student may also propose a capstone topic directly to a prospective academic supervisor. In the exceptional circumstance that no academic supervisor can be found through either of the above methods, the department chair or associate chair (graduate) may appoint an academic supervisor.

Q? I work full-time and would like to base my capstone project on a technical problem related to my employment. Is this allowed?

First and foremost, the capstone project/report is expected to be a piece of scholarship. Although students are free to propose capstone project topics related to their employment, they are subsequently expected to perform and describe analyses that extend well beyond their general duties as employees. As such, progress reports or internship summaries will not be accepted in place of a capstone report meeting the expectations described above.

Please also note that:

- The capstone report is an open document and should not therefore contain any sensitive information that a company wishes to withhold from public disclosure. In a similar spirit, there should be no redacted text or data unless quoting from a governmental report.
- Although students can solicit feedback from workplace supervisors in the execution of the capstone project, the work must formally be completed under the (arm's length) direction of an academic supervisor, whose precise function is described in the next section.

Q? Is a research stipend provided for the period during which I am working on the capstone project?

No. As is typical with course-based Master's programs at U. Alberta, the Mech. Eng./Eng. M. capstone project is a requirement of the degree. Your research supervisor may assist in formulating the project topic and may additionally provide some resources in the execution of the research (e.g. access to specialized software or laboratory equipment) but he/she will not provide a research stipend.

Q? My specialization area is Engineering Management, but I cannot find a professor from the Engineering Management group who is willing/able to serve as my academic supervisor. What should I do?

All professors in the Dept. of Mechanical Engineering can supervise M.Eng. students irrespective of degree specialization. For example, you might be earning your degree in engineering management but complete a capstone project on a topic from mechanical engineering. When this happens, you can introduce yourself to professors working in other areas, such as fluid or solid mechanics, heat transfer, combustion, bio-medical engineering, robotics and controls. You can also approach professors in other engineering departments provided that a co-supervisor from the Department of Mechanical Engineering is later identified.

Academic supervisors, report evaluation

The academic supervisor is responsible for providing general guidance over the course of the capstone project. He/she may request a project proposal that outlines the focus of the project, including the rationale, purpose and methodology. Such a proposal is especially encouraged in the event that you are, for example, interviewing subjects or working with non-anonymous medical data and require ethics approval.

A further responsibility of the academic supervisor is to read and evaluate the capstone report to ensure that appropriate standards of quality are met. Once he/she is satisfied in this regard, the report will be forwarded to the M.Eng. advisor who will arrange for an independent evaluation of the capstone report by an individual unconnected to the research project. In the event that the opinions of the outside evaluator differ significantly from the academic supervisor, the case will be referred to the associate chair (graduate) for resolution.

Capstone reports are graded on a pass/fail basis and no numeric grade is assigned. Students will often receive a conditional pass subject to revisions, which must be implemented before the capstone project can be considered complete.

Report guidelines

Typical capstone reports are approximately 10,000 words in length. The minimum acceptable length is 5,000 words. As with all effective technical writing, the report should strive to present material in a way that is accurate, well-organized and concise. The inclusion of tangential material or "filler" is therefore discouraged.

Unless specifically instructed otherwise, the main body text should be in 12 point font (Arial, Calibri or Times New Roman). Double line spacing should be used with a 1 inch margin all around.

In preparing their capstone reports, students may find it helpful to refer to Heather Silyn-Roberts's eBook "Writing for science and engineering: papers, presentations and reports", 2nd ed., London: Elsevier Science, 2013. This eBook is available through the University of Alberta Library at https://www.library.ualberta.ca/catalog/7578702

Plagiarism

The University of Alberta is committed to the highest standards of academic integrity and the capstone report is therefore expected to conform to both the usual standards of good scholarship and the **university**'s Code of Student Behavior[1]. M.Eng. students are expected to be familiar with these standards and to uphold the policies of the university in this respect. They are therefore particularly urged to avoid any behaviour which could result in suspicions of plagiarism, a misrepresentation of facts and/or the disclosure of sensitive third-party information. Citations are expected to be used throughout the report and the direct use of others' arguments is to be included only within quotation marks ("…"). Academic dishonesty is a serious offence and can result in suspension or termination of a student's M.Eng. program.

[1] See https://www.ualberta.ca/governance/resources/policies-standards-and-codes-of-conduct/code-of-student-behaviour

Report content

Title page

Front matter should include the following components:

- Executive summary
- Table of contents
- List of figures
- List of tables
- Nomenclature/definitions

Material appearing in the front matter does not contribute to the word count.

The main body should include the following components:

- Introduction
- Literature review/foundational information
- Problem statement
- Methods
- Results
- Discussion
- Conclusion/recommendations

Finally, the report should contain a bibliography and appendices containing, for example, sample calculations, CAD drawings or other technical drawings, operating procedures. Any such material does not contribute to the word count.

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