Industrial Engineering Major Qualifying Project (MQP) Syllabus[1]

Industrial Engineering Program
School of Business, WPI

(Updated in June 2014)

1. Overview of MQP

MQP at WPI is a project in the major field of study. This project should focus on the synthesis of all previous study to solve problems or perform tasks in the major field with confidence, and communicate the results effectively (http://www.wpi.edu/academics/Projects/index.html).

Your MQP is an experience that will help you to begin the transition from undergraduate academic life to the business world or graduate school. As a capstone design experience, your project will involve developing a system, component or process to meet a desired need. What this means is that you will be creating, rather than only studying, something for a client who defines a need. Most IE MQPs are sponsored by external organizations, but your client may also be an internal WPI group. The project is an opportunity to strengthen technical, communication, interpersonal, and project management skills.

Because it is equivalent to three courses (1 unit, or 9 credits), your MQP is an important part of your IE degree requirements. The MQP provides you with the opportunity to deepen your understanding of the theory you've been exposed to in courses by applying it in a real-world setting. You should expect to learn (in many cases, on your own) subject matter not covered in courses as well as to experience frustrations when you encounter constraints.

In addition, your MQP aims to enhance your skill set as follows:

(1) ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;

(2) ability to function on multidisciplinary teams

(3) ability to communicate effectively;

(4) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;

(5) a recognition of the need for, and an ability to engage in life-long learning;

(6) ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
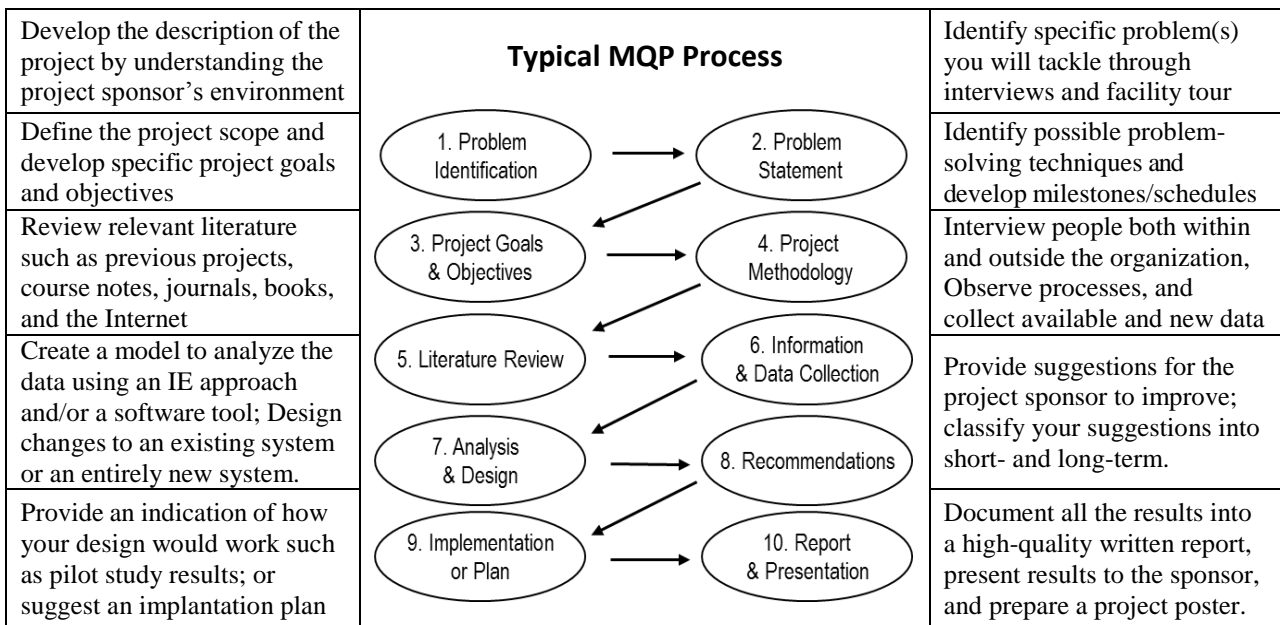
2. IE MQP

For IE students, the MQP represents a capstone *design* experience representative of the type of work you might do in your first job after graduation. Your project advisor will need to verify on the project registration form that your project meets the capstone design requirement.

What is design? Engineering design is the process of devising a system, component, or process to meet

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[1] For general questions, please contact Professor Amy Zeng, Director of IE Program, via azeng@wpi.edu or 508-831-6117; for project related questions, please talk to your project advisor.

desired needs. It is a decision-making process (often iterative), in which engineering sciences as well as basic science and mathematics are applied to develop a solution to a problem that meets stated objectives. In the field of IE, the engineering sciences include such areas as optimization, simulation, quality control techniques, financial methods, production planning and control, process analysis and improvement, facility layout, and human factors. Industrial engineering is focused on *integrating* systems, including such components as people, information, materials and equipment. Among the fundamental elements of the design process are the establishment of objectives and evaluation criteria, synthesis, analysis, construction, testing, and evaluation. It is essential to consider standards and to include constraints, which in reality limit potential solutions due to economic, safety, reliability and other factors.

Despite the difficulty in defining exactly what an MQP will involve, nearly all MQPs progress through the stages illustrated in the following chart. Keep in mind that project process is not really linear; you will probably return to an earlier stage as the project progresses because you learn more and encounter unexpected obstacles.

	Typical MQP Process	
Develop the description of the project by understanding the project sponsor's environment		Identify specific problem(s) you will tackle through interviews and facility tour
Define the project scope and develop specific project goals and objectives	1. Problem Identification → 2. Problem Statement	Identify possible problem-solving techniques and develop milestones/schedules
Review relevant literature such as previous projects, course notes, journals, books, and the Internet	3. Project Goals & Objectives → 4. Project Methodology	Interview people both within and outside the organization, Observe processes, and collect available and new data
Create a model to analyze the data using an IE approach and/or a software tool; Design changes to an existing system or an entirely new system.	5. Literature Review → 6. Information & Data Collection	Provide suggestions for the project sponsor to improve; classify your suggestions into short- and long-term.
	7. Analysis & Design → 8. Recommendations	
Provide an indication of how your design would work such as pilot study results; or suggest an implantation plan	9. Implementation or Plan → 10. Report & Presentation	Document all the results into a high-quality written report, present results to the sponsor, and prepare a project poster.

3. Expectations, Deliverables & Grading

Weekly Meetings and Group Work

Completing an MQP can be a difficult technical problem, but it is often not the technical problems that slow you down the most! You will need to learn to work together to meet interim project milestones. To facilitate this process, you will meet with your project advisor regularly (usually once a week) to discuss your progress towards milestones and any problems that you've encountered.

Keep in mind that your faculty advisor and the company liaisons are guides or coaches rather than directors! You are expected to take responsibility for your own project by making decisions and taking initiative. If you get behind schedule, your advisor will be anxious to hear you describe your plans for getting back on schedule.

Based on WPI's expectation, you should be spending approximately 17 hours per week per person per 1/3 unit (e.g., if you are doing 2/3 units of project work in one term, this would be 34 hours per week per

person) working on the project. You need to find effective ways to allocate work among individuals, and each team member should take responsibilities.

Some project advisors will ask you to submit a weekly progress report, often by email, which contains:
- progress in last week - what you have accomplished in the previous week
- weekly plan - what you expect to accomplish in the coming week
- problems/obstacles/questions

Even if you don't formally submit a progress report, you can use the above as an agenda for each weekly meeting. Again, you are responsible for the project and you need to make sure that your advisor knows what you have accomplished. You need to play a role in setting the agenda!

Deliverables

At a minimum, your project advisor will require that you complete the following as part of your MQP:

(1) *Project Proposal* (Due no later than the end of the first 1/3 unit of work): Usually contains three Chapters:
- Ch1: Introduction - project motivation, background, problem statement, and goals and objectives
- Ch2: Literature Review - background research about the problem and the methodology to be used.
- Ch3: Methodology - a project schedule indicating the expected completion time of project milestones and associated methods to be employed

(2) *Project Report* (Due immediately at the end of the project or the University's mandated deadline): While each report may have different number of chapters and components, the following items are particularly important and will be reviewed:
- Abstract: no more than 80 words
- Introduction
- Project objective(s)
- Metrics are used to tell how well the objective was achieved
- Background/Literature review
- Methodology
- Analysis
- Conclusions/Recommendations
  - In addition to recommendations, remember to include the discussion of testing and implementation. If the project team is unable to implement, an implementation plan including specific steps, priorities, and how constraints or barriers might be minimized should be provided
- Reflection on the project (required for IE students)
  - *Discussion of design in the context of the project*
    Using a definition of engineering design as discussed in Section 2, identify what has been designed (e.g., a process, a quality control tool, etc.) and describe how the design process is applied.
  - *Discussion of constraints considered in the design*
    What constraints, including economic, environmental, social, political, ethical, health and safety, manufacturability, and/or sustainability are considered? And how are they handled in the design alternatives?
  - *Discussion of the need for life-long learning*
    What are your overall project experiences? What have you learned from the project not covered in the coursework? How would you continue the learning endeavor?
- References and bibliography

(3) *Oral Presentation*: At least two presentations:
- o Poster presentation on Project Presentation Day in April
  - o Refer to http://www.wpi.edu/Academics/ATC/Media/poster-design.html for poster design tips and templates;
  - o Your poster must be printed at Academic Technology Office (ATC) and the cost will be covered by the School;
  - o If you think your project deserves recognition, you can self-nominate the project to participate in the Annual Provost's Best MQP Award. The solicitation email for nominations is usually sent out in mid-March;
- o A formal oral presentation to the sponsor of the MQP.

Grading Standards

The WPI faculty recently endorsed the following grading guidelines for MQPs:

(1) Each term a student is registered for a project, the student receives a grade reflecting the advisor's judgment of accomplishments for that term. Note that the team members may receive different grades in each term reflecting different levels of performance;

(2) Upon completion of the project, students will receive an overall project grade. It is important to note that this grade reflects not only the final products of the project (e.g., results, reports, etc.), but also the *process* by which they were attained. No amount of last-minute effort should turn a mediocre project effort into an A.

(3) The available grades and their interpretations are as follows:

- **A:** a grade denoting a consistently excellent effort and attaining the stated project goals.

- **B:** a grade denoting a consistently good effort and attaining the stated project goals.

- **C:** a grade denoting an acceptable effort and partially attaining the stated project goals.

- **SP:** a grade denoting an effort sufficient for the granting of the credit for which the student is registered. This grade provides students with no feedback, and its use is discouraged except for special circumstances.

- **NA:** a grade denoting an effort unacceptable for the credit for which the student is registered. Note that this grade is entered into the student's transcript.

- **NR:** a grade denoting an effort insufficient for the credit for which the student is registered. This grade is appropriate when the project has not proceeded due to circumstances beyond the control of the student, or for project extensions which do not represent the full amount of credit for which the student is registered.

(4) The results of a project should be such that an outside reviewer would reasonably deem the project as being worthy of the credit and grade given, based on evidence such as the project report.

(5) In light of the above grading criteria, it is strongly suggested that a formal project proposal or contract be developed early in the project activity, so that all participants in the activity have a clear understanding of the project goals and the expectations of both the advisor and the student team.

It is important to recognize that projects receiving "B" grades are good projects, in which all project goals are attained. As in your classes, a project grade of an "A" reflects outstanding effort and project process as well as outcome. Your advisor should discuss with you about his/her definition of outstanding work, perhaps through examples. You should also ask for feedback as the project progresses.

4. Check Lists

Before-project Checklist:

(1) Attend the MQP information seminar
(2) Attend an IRB seminar: http://www.wpi.edu/offices/irb.html (if project involving human subjects)
(3) Read "Human Subjects" guideline at http://www.wpi.edu/academics/Projects/humansubjects.html if the project may involve human subjects
(4) Register the MQP with an assigned project code for a total of 1 unit
(5) Set up a myWPI site (if needed)
(6) Complete all paperwork for the sponsor (if appropriate)
(7) Complete PQP (1/6 unit) (if the project is through one of the project centers)
(8) Read samples of previous MQP report

During-project Checklist

(1) Set up meeting schedules with the advisor
(2) Set up meeting schedules with the sponsor
(3) Complete the proposal containing the following chapters: Introduction, Literature Review and Company Profile, Methodology, and Bibliography
(4) Present the proposal to the sponsor
(5) Turn in the written proposal to the advisor

End-of-project Checklist

(1) Complete the final report with all the related chapters by the desired deadline
(2) Include a Reflective Section in the final report with the following items (IE students only)
    a. Discussion of design in the context of the project
    b. Discussion of constraints considered in the design
    c. Discussion of the need for life-long learning
(3) Read and follow the eProject Submission and Approval Checklist at http://www.wpi.edu/Pubs/E-project/checklist.html
(4) Present the final project results to the sponsor
(5) Email the final report to the sponsor
(6) Prepare a project poster for the Project Presentation Day
(7) Complete the E-CDR form and hand it in to the advisor (for signature and final project grade)
(8) Print the project poster at ATC: http://www.wpi.edu/Academics/ATC/Media/poster.html
(9) Attend and present the project poster on the Project Presentation Day in April