What is an MQP?

The Major Qualifying Project should demonstrate application of the skills, methods, and knowledge of your discipline to the solution of a problem which would be representative of the type to be encountered in your career. The project's content area should be carefully selected to complement your total educational program.

MQP activities range through research, development, and application, can involve analysis or synthesis, can be experimental or theoretical, and can emphasize a particular sub-area of the major or combined aspects of several sub-areas. Serious thought should be given to which of these types of activities are to be included.

In addition, most MQPs will provide you with *capstone design experience*. What this means is that the MQP is a project that culminates your WPI education with the application of ideas from your coursework to designing a product, instrument, device, or program, which *integrates theory and practice*. Although most MQPs satisfy this WPI requirement, it is possible that your MQP will not. You should discuss the design content with your potential MQP advisor to determine if it provides a capstone design experience. If it does, make sure your project advisor checks the capstone design box when you get your registration form signed. If the MQP you are interested in does not qualify as capstone design, then your MQP advisor will tell you how you can satisfy this requirement, possibly by doing additional independent study work with that advisor, or taking additional courses.

Since you can do nearly anything that requires engineering skill as an MQP, it is difficult to create a definition that will apply to all MQPs. Indeed, every MQP progresses somewhat differently depending on the individual student's needs, the advisor's interest, the student's motivation, team dynamics, and many other factors. While this looseness might be disquieting for some, it can be the MQP's biggest asset since it allows you to participate in a real engineering project that you have a hand in defining, thus allowing you to fully experience the thrill of solving a challenging problem and the agony of chasing false leads.

Project Definition

During the project definition phase, you will begin to determine exactly what you will do for your MQP. The idea for the project might be something that you thought up on your own, or it might be one of the project ideas that have been presented by the faculty. In either case, you'll have some homework to do in order to turn an idea into a project. The process of defining the project usually involves writing a *project proposal*. At this stage, this proposal might be a short (3-5 page) paper where you establish the *basic definition* of the project along with the project goals, projected schedules and budgets, and the methodology you will use to satisfy the project objectives. During the first term

of your MQP, you'll probably spend a lot of time refining this proposal, but it's best to get started now so that you're ready when the time comes.

Writing a proposal, even at this stage, probably won't be a trivial task. To define the project you'll have to do some *research* to understand more about the topic area that the project involves. Even if you're a wizard at some of the skills you need, chances are that the project will involve skills that are not so well developed. Doing this initial research might require you to dig out some old course notes, or go to the library to find books on the subject. After spending some time reading about the subject, you should begin to get a good idea about what the project might involve.

Once you have an idea about what's involved, you can determine what skills you're strong in and which skills you need to acquire. At this point you can start *selecting a team* to work with you on the project. Just like a manager in industry, you should put together a team that 1) is really motivated and excited about the project and wants to do a great job and 2) collectively thinks they have, or can teach themselves, all of the skills they need to be successful.

Now, you and your team can get together to identify the *project goals*. The more you learn, the more you'll discover you need to learn, but you have to start somewhere. Start by creating a prioritized list of tasks that must be accomplished. Next, the team can decide who will be responsible for each task in the MQP. You can now *make a project* schedule, which shows the order in which tasks must be done and who will do each one. Along with the schedule you should develop *milestones*, or intermediate objectives, that will give you a sense of accomplishment and progress. Nothing is more satisfying than reaching an important milestone on time (or, better yet, early!).

The *methodology* you use to accomplish your project is essentially a description of how you intend to proceed from milestone to milestone. Typically, your methodology will involve: researching a topic; defining requirements; getting an idea about how to satisfy those requirements; validating the idea; designing, building, and testing the idea; and verifying the result. Again, you'll spend a lot of time refining your methodology as you learn more about the project, but it's never too early to start thinking about the issues.

Now that you've done your homework, you can take all the notes you've gathered and start writing your proposal. Typically, this proposal will be organized as follows:

1. Introduction

A good concise description of what the project is. This section should orient the reader by explaining what the project definition and goals are, why it is a good or important thing to do, and what your general approach will be.

2. Literature Review

A summary of what the current, state-of-the-art is based on your reading about the topic. In this section, you must prove to your reader that you know what you're talking about, and therefore, are the best one for the job.

3. Methodology

In this section, you must describe, as completely as possible, how you intend to accomplish the goals you presented in the introduction. Your job here is to convince the reader that you not only know what you're talking about, you have a plan to get there!

4. Schedule and Budget

This is where you present a detailed description showing the projected completion date and cost associated with each project step. Often schedules are presented in the form of a Pert or Gantt chart. These charts clearly show the relationship between tasks and the effect of missing a milestone on the project deadline. In industry, engineers and managers are rated on how well they do in terms of meeting milestones on time and on budget. Your schedule should show the reader that you understand the relative sequencing of events and, to some extent, you understand their complexity.

5. A project specification

By the end of your proposal you should be able to come up with a fairly detailed list of the features and functions that you expect your completed project to perform. Given such a specification, you will be able to quickly focus your MQP efforts on those aspects of the project that are important to achieving your goals. You'll also have a perfect basis for evaluating both your progress and the quality of your work.

Research

The research phase of a typical MQP begins in the first term. This is when you will start refining the initial proposal that you wrote to get the project going. Based on your initial proposal, your advisor will probably have comments and suggestions for sources of specific information that you will need. Your advisor will probably also identify areas that you missed originally, that you now need to explore. In addition, you may have obtained more information about the project since you wrote the initial proposal. During this phase, you will start following-up on all of these directions. You should keep a notebook and write down all of the questions that need answers and possible sources of information. You should also write down the answers to questions as you find them and also the sources, including page numbers, where you found the answers (just in case you need to go back).

Your biggest source of information for this phase will probably be your course notes, texts, and the library. There are PCs in the library that you can use to search for books and journal articles. In addition, the library has an electronic card catalog where you can search for material from any workstation on campus.

Once you've completed the research phase, you will be fairly knowledgeable about the problem you are working on. You will know what others before you have done, how well their approach worked, and how you can do better. You will fully understand the nuances of the problem, and will know the tools and techniques that are needed to solve the problem better, faster, or less expensively than anyone else. If you've kept careful notes along the way, you will also have a significant store of information that will prove useful when you write your MQP report.

Now its time to put your ideas to work!

Design

The design phase of a project can take many forms, depending on the nature of your particular MQP. Although each MQP will have different kinds of design components, the design phase is really that time when the theoretical knowledge you have accumulated about the project, along with the skills you've learned in the classroom (e.g. in BE 2300), are applied to solve a real problem. In engineering terms, design is the point in time when you take a theory and reduce it to practice. This means creating theoretically justifiable designs, *not* making guesses and creating a working design through trial and error during system debugging!

Of course, no design effort is complete until the results are proven!

Evaluation

Proving that your design is correct can be difficult, but it is essential. For example, if you are designing a new controller for a heart rate controller in a pacemaker, it's no good to tell the patient that it "should" work. You've got to demonstrate that it <u>does</u> work (and will continue working)!

Part of this proof is done in the design phase where you calculate the current flows, power dissipations, logic timings, and other design parameters. The rest of this proof is done when you take your constructed device into the laboratory and test it.

Again, the nature of the testing depends on the specific type of project. If you're testing theoretical results, you may be running experiments and taking measurements to correlate theory with observation.

The purpose of the evaluation stage is to ensure that your design meets the specifications you derived. Usually, you will have certain expectations for your results that are a result of the research you did. Now is the time to verify these expectations. Often, you'll find one or more deviations from the specifications. When this happens, you'll have to determine if the original specification is somehow in error, of if there was an error that occurred during the design phase. Indeed, by the time you successfully complete the evaluation phase, it's quite likely that you will have done additional research, updated your design, and re-evaluated your results one or more times.

But, once you're done, you really have something to shout about!

Reporting Results

In an engineering environment, disseminating your results usually takes the form of reporting your findings to your colleagues, customers, and possibly the engineering community through presentations and through written reports. Although few beginning engineers realize it, the best way to communicate to your boss how well you are doing is to make good presentations and to write excellent reports. To teach you about this process, all MQPs conclude with a substantial written report and an oral presentation. The *MQP report* documents the entire project. In this report, you will present the project, the research you did, the details of your design, and the results of your evaluation. It would be difficult to overstate the importance of a quality report and, even though it is the last thing you will turn in related to the project, you should start writing it when the project begins

The *MQP Oral Presentation* is similar to the written report, but is presented in a more abbreviated format. Details on the oral presentation are discussed later. In brief, the oral presentation will briefly introduce the project, describe the major innovations that made the project succeed, present an evaluation or demonstration of the project, and then will conclude by assessing the project status and prospects.

Finding the Right Project

To prepare for finding a project, and to be able to properly assess the suitability of a project to your educational objectives, ask yourself the following questions.

- 1. Out of all the BME, basic science and mathematics courses you have taken, which did you enjoy the most? Which did you not enjoy? When answering these questions, try to identify project areas in which you would be willing to invest three or four terms of intensive work. Try not to limit yourself to one single sub-discipline.
- 2. What do you want to do after you graduate? Try to be specific! An honest answer to this question will lead you to an understanding of the skills you need to perform the job you envision. If you cannot specify what you want to do, try starting by figuring out what you are not interested in doing.
- 3. What do you want to learn while you work on your MQP? If you tell your MQP advisor what you want to get out of your MQP, it is often possible to structure the project to emphasize those areas of interest.
- 4. What type of project partners do you want? Working with your best friend might be either the best or worst decision you could make. Your partners' talents should complement some of your own, particularly if the project requires diverse abilities.

What To Do if You Have A Project Idea

If there are projects that interest you, make appointments to discuss them with the faculty who have suggested them. Do this as early as you can since some of the most interesting projects are often those that appeal to the largest number of students. Do not wait until you have found a team of project partners - often, the faculty member who has proposed the project can help form teams from among those who have shown interest. And, while it is important to get an early start, there is often no need for concern that a project will be taken by the first group that applies. Typically, faculty interests in a specific project area are sufficiently broad that more than a single project can be undertaken related to a specific MQP topic.

But, what if there is nothing among the list of projects that interests you. Beyond that, what if you have a project idea of your own. The answer is to develop the project yourself or with a group of like-minded partners. In fact, many project advisors encourage students to take this approach since the project undertaken is more likely to satisfy your personal educational and professional goals.

If you plan to take this option, it is extremely important that you do some groundwork in advance of seeking a project advisor.

For an MQP, the student should identify a problem / topic that would challenge their competency in their major area of study.

For an MQP, the following steps should be followed:

- 1. Write a paragraph describing the issue / problem / topic and a goal or result that would be achieved upon completion of the project.
- 2. Prepare copies.
- 3. Identify a short list of faculty to approach as potential advisors.
- 4. Visit each in order of preference. Offer a copy of your idea, and solicit their interest in being your advisor.
- 5. Repeat as often as needed until a faculty member agrees to be your advisor.
- 6. Register your project with the **Projects & Registrar's Office**.

If you have difficulty securing an advisor, meet with Chuck Kornik, Administrator of Academic Programs, Boynton Hall, to get a recommendation for pursuing other faculty as advisors.

Practical Expectations

Remember, you and your advisor can tailor most project ideas to address your ideas and needs. Remember too that advisors will be anxious to scale-back ideas that are too ambitious. It is far better to scale-back the goals of the project so that the probability of successfully achieving those objectives is high than to fail to achieve a set of unreasonably ambitious ones.

It is also important to stress that the relationship that will exist between you and your advisor will be distinctly different from the student/faculty relationship you have experienced thus far. This is because one of the important objectives of the MQP is to begin your transition from undergraduate academic life to that which you will encounter in graduate school or in the commercial world. As such, most advisors will play the role of a supervisor with whom you have made a contract. You have promised to achieve a series of goals with a defined set of resources and in accordance with an established schedule and your supervisor will be meeting with you regularly to observe and discuss your progress.

Do not expect that your advisor will direct you. If you run into problems, which you are having difficulty to overcome, your advisor may direct you to consult with some other member of the faculty or to review some source material - BUT - your advisor will not do your work for you. Most advisors will let you make mistakes and deal with their consequences. If you get behind schedule, your advisor will be anxious to hear you describe your plans for getting back on schedule.

In brief, your MQP will be a taste of engineering life as you will encounter it after you have obtained you Bachelor's degree.

Co-op Students

If you are now a co-op student, or plan to become one, it is very important for you to make arrangements for a project now. Trying to find a project a few weeks before you return from a co-op assignment is extremely difficult at best. At worst, you may find that you will miss your planned graduation date. It is also important that you plan your schedule with the help of your academic advisor. Once you are on co-op, keep in touch with your future MQP advisor and partners.

Off-Campus Projects and Project Centers

There is no rule that requires performing your MQP entirely on campus (although it must have a faculty advisor). It is possible to perform an off-campus project. These off-campus projects offer several advantages:

- 1. Access to laboratory equipment not available at WPI,
- 2. A corporate, engineer liaison advisor,
- 3. The possibility of continuing on full time after graduating (although not a policy, it happens often enough to be of interest),
- 4. Working on a "real world" problem, in a corporate environment.

The disadvantages of off-campus projects include:

- 1. You may have to travel to do project work,
- 2. The corporate engineer advisor may not always be available for advising.

Working on an off-campus, corporate sponsored project can be a valuable educational experience that is well worth the trade-offs involved. First, contact the faculty advisor associated with the off-campus project. If the project still looks interesting, contact the corporate sponsor/advisor for the project. A listing of off-campus projects is available in the <u>Projects Office</u>.

BE Department Laboratories

To support student projects and faculty research, the BE department maintains several different laboratories. In addition to the following laboratories listed, it is possible that other facilities may be available depending on the advisor/director of the lab, availability of the room, etc.. Visit the <u>BE department site</u> for a complete listing of their facilities.

1) MQP Projects Laboratory -SL 415

This laboratory is equipped with PC's, general electrical testing equipment, and other common laboratory equipment/supplies to perform various kinds of MQP's. This laboratory is strictly for MQPs.

2) PC Computing / Imaging Laboratory - SL 412

This laboratory is equipped with computer clusters that have access to word processing software, internet hookups, email, etc..

General Laboratory Hours

The General Laboratories are open 24 hours a day. Access is available through an electronic card reader. Students should see the department secretary to arrange access to these rooms.

General Laboratory Policy

In order to provide a safe, functional laboratory environment the BME Department has established the following laboratory policy, which must be followed by all students using a laboratory:

- 1. Students must clean up their area after using the laboratory. This includes putting chairs and stools under benches and returning equipment to its proper place.
- 2. PCs and printers may not be moved or disconnected.
- 3. Project equipment may not remain set up overnight or between unmonitored periods without prior permission.
- 4. Equipment may not leave the laboratory without permission.
- 5. Any equipment that is found to be malfunctioning should be reported to the BE department office by whomever discovers it.

Project Operation and Support Services

Project Expenses

- 1. Students should plan on submitting a budget to their advisor(s). The budget should include anticipated component costs. All charges for components will be made against the project account.
- 2. Each project is allowed to spend up to \$125 per registered student for hardware and software expense. Incidental copying, travel, books and related material are the student's responsibility, the only possible exception being funded off campus projects, which are handled through the Projects Center. As a general rule, only project costs that are approved by the project advisor are reimbursable.
- 3. Under certain circumstances, you may need to purchase a component on your own. Before purchasing the component, you must fill out a component request form and have it approved and signed by your project advisor. This gives you permission to purchase the component(s) and be reimbursed. Failure to follow this procedure may result in the component cost not being reimbursable. WPI will allow only one reimbursement per project and this is normally done at the end of the project. Please note it is the student's responsibility to keep the project within budget and orders or reimbursements over this amount will not be approved.
- 4. At the conclusion of your project, all components and equipment must be returned to the BME department. Exceptions to this would be projects kept by the advisor or a student. If a student should want to keep a project, a payment equal to the cost of the components must be made to WPI c/o the BME department.

Oral Presentation Guidelines

Introduction

This document is intended to provide some general guidelines for the content and style of oral MQP presentations. The ability to give effective oral presentations is one of the most important skills a technical professional can possess; no matter how good your work is, if you cannot effectively communicate its results and significance in both written and oral formats, you and your work will not be fully appreciated. Fortunately, the MQP provides an opportunity for you to gain experience giving an oral technical presentation. This presentation is a requirement in the Department of Biomedical Engineering.

While some of the guidelines refer specifically to MQP presentations, and others to technical presentations, many of them are common to all presentations. No matter where your career path leads, it is highly likely that you will need to develop effective presentation skills to be successful. You will be called upon to give presentations to supervisors, managers, prospective employers, clients, customers, research sponsors, colleagues, conference attendees, and so on. You will be judged not only by what you

have to say, but also by how well you say it, and even how you look while you are saying it. This document will try to address some of the concerns resulting from this fact of professional life.

Designing Your Presentation

A presentation must be carefully tailored to the specific format, audience, presentation media, and level of formality associated with the presentation forum. In this section, the appropriate form and content for an MQP presentation will be discussed.

Format

The format for MQP presentations is very brief; typically ten minutes per project plus 3-5 minutes for questions and answers with the audience. The brevity of this format may please you at first, but it is one of the most difficult things about the format. Simply put, there is not nearly enough time for you to give a detailed description of your project. Instead, you must focus on an overview that gives the audience a general appreciation for:

- what you did,
- why it's worth doing,
- how you did it, and
- how well it worked.

More specifically, an outline of your talk should be not unlike the outline of a written report, with:

- An introduction which describes the problem and motivates its solution;
- A brief **background** section describing such things as special theory or devices you used, or previous work done on the same problem by others;
- Your **approach**, giving a broad overview of your solution to the problem, preferably at the macroscopic level;
- The **results** of your work, including (when appropriate) a demonstration; and
- A **conclusion**, perhaps touching upon improvements or future work that could be done.

It is considered extremely unprofessional to exceed the allocated time for a presentation. You should focus on the "big picture" at the expense of technical details that you might feel are important. There simply isn't enough time to talk about everything you've done (if there is, then you haven't done much). You will find that tailoring your talk to the right length and level of detail might require several tries.

A demonstration of your project is nice, *if*:

- it is brief and to the point;
- there is something that can be easily seen or heard by everyone in the room; and

• you are sure that it will work.

Audience

The audience for MQP presentations generally consists of junior and senior BME students and BME faculty. The level to which you should gear your talk is that of a competent junior or senior BME student, *i.e.*, assume that the listener understands basic BME concepts. The talk should be accessible to the students without boring the faculty to tears.

Presentation Media

It is said that a picture is worth a thousand words; depending upon the image resolution and the richness of your vocabulary, it may even be worth more, from an information theoretical viewpoint. The visual aids you use for your talk can make a deep impression (either good or bad) on your audience. The best visual aid for this type of presentation is a set of viewgraphs (also known as overhead slides or transparencies). These can be easily generated by a photocopier from any clear original with good contrast. Every major point in your presentation should be represented in some form on a viewgraph. They convey information to the audience and help to prompt the speaker.

Here are some guidelines for using viewgraphs:

- A horizontal format is somewhat better than vertical; it is easier for the eye to scan horizontally than vertically.
- Use typeset material; MS Word or some other document preparation system is recommended.
- All viewgraphs should be easily readable from anywhere in the room, so large type (14-16 point) should be used to generate them.
- Do not overload your slides! It is better to keep them simple and use a few extra than to cram them full of information.
- On the other hand, each slide should contain more than just a few words. Try to achieve a balance.
- Data, such as tables, graphs, etc., should be particularly clear, uncluttered, well-labeled, and easy to understand.
- Don't put up a slide unless you're going to give the audience enough time to look at it. If you're rushing through them, you have too many.
- On the other hand, if a slide is up too long, it is either too detailed or irrelevant to what is being said. A good balance is usually achieved by a rate between 0.5 and 1 slide/minute.
- A block diagram describing your system or procedure is usually a good way to describe the project. Make sure that any block diagrams are kept simple by combining subsystems into systems, etc., until the diagram is easily understandable.
- You might want to have a felt-tip marker with you in case you need to write on your viewgraphs during the presentation to clarify or emphasize something.

• Take care not to stand near the projector, where you will block the view for a large segment of the audience. It is best to stand near the screen. If you wish to point out details on your slides, use a pointer at the screen.

Remember that your viewgraphs don't have to tell the whole story-that's what you're there for. They should, rather, focus the attention of the audience to key points and provide a basic understanding of how any pieces of the project fit together.

Level of Formality

The word that best describes the impression that you should try to give the audience is "professional". This applies to your appearance, manner of speech, and visual aids. You should dress as if you are going on a job interview. Speak in clear and complete sentences, avoiding slang and obscure technical jargon. Your viewgraphs should be typeset using some sort of package designed for the presentation of technical materials; the one you are using for your report will probably do nicely, as long as you can select an appropriate font size (or enlarge it on a photocopier). If hand drawings must be used, they should be very carefully prepared.

Presentation Style

Once you have determined the content of your talk and visual aids, you must pull it together into a presentation. This will require practice-it is easy to find yourself tongue-tied the first time that you attempt to describe or explain something, even if you understand it well. Here are some pointers for preparing the presentation.

- Introduce yourselves, give the title of your project, and indicate who the advisor is. This information should be presented on a title slide.
- Don't jump into the details of your project until you have given the audience enough introductory and background information to understand what your project is all about.
- If possible, try not to read from your viewgraphs. It is better to use them as cue cards with brief phrases or lists serving to remind you of the topics you wish to discuss. If you find that you absolutely have to read from the viewgraphs, at least try to *ad-lib* a bit of introduction, insight, and/or summary.
- Practice, practice, practice. The first run might be just among the project partners, or in front of some close friends. Then, recruit some BMEs to listen and give you feedback and questions. Ask them to be brutally honest. After a few tries, you should have the length of the presentation down to within a few minutes. Now you are ready to give the presentation for your advisor, who may suggest that you change the whole thing. Do so, for this person will be grading you! Then go back to the beginning of this paragraph and start over.
- Don't go too fast. This is a common problem for nervous presenters. People would rather be a little bored than completely lost; remember that most of your audience may have never even thought about your project before. Make sure that important

ideas have time to sink in; give enough time to look at any figures, equations, etc. that may appear in your viewgraphs.

- For multiperson presentations, transitions should be smooth. Lead into the following section ("Now that the problem has been defined, Joan will describe our approach..."); tie into the previous section ("As we have mentioned, verifying Ohm's Law will require some resistors...").
- Try to make your conclusion as upbeat as possible while still being honest. Even a project, which does not produce a working system, can have educational merit. Be sure to acknowledge anyone who has contributed significantly to the project other than the project team and advisor. Welcome questions.
- Look at the audience! A person speaking from behind a pile of notes is incredibly boring!

Handling Questions

The best way to handle questions from the audience is to be prepared. Elicit questions from the practice audiences. Try to anticipate anything that might confuse or intrigue people. Be aware of anything you have done which is unconventional or impractical, and be ready to discuss why. Your advisor may be of some help here.

It is a good idea, if you can anticipate certain questions, to prepare "backup slides" for answering them. For example, there may be derivations, data, circuit diagrams, or whatever that were too detailed for the main body of your presentation, but would serve to answer a tough question quickly and painlessly.

Don't try to snow anyone. If you don't know the answer to a question, say so. Perhaps someone in the audience can provide an answer; ask for a little help if you need it.

Logistics

This year's MQP presentation day will be announced in advance; no classes will be held that day.

Each presentation will be assigned a specific time slot and room. You should attend the entire session; don't just come in for your presentation. One reason is that any canceled presentations will change the time of yours; another is courtesy to the other presenters. Be sure to contact your advisor immediately if you cannot give your presentation at the assigned time. If your MQP schedule makes a D term presentation impossible (*e.g.* if you finish and graduate B term), see your advisor to schedule a presentation during your final term.

An overhead projector and screen will be available for your use in the presentation rooms; you are responsible for any other equipment you might need for a demonstration (including extension cords, etc.) If you plan to do a demonstration, be sure to arrange your apparatus so that it is easily moved into place for your presentation and out of the way when you are done without causing disruption to the proceedings. Transparencies are quite costly. Make draft viewgraphs on paper to use in rehearsals; practice with the final versions (and show them to your advisor) before making the actual transparencies.

Plan ahead; there will most likely be a long line on the last few days before presentation day.

Summary

Effective presentation skills come with practice; as your career progresses, you will gain more confidence in expressing your ideas to others. This MQP presentation is not meant to be a traumatic experience, but rather a chance to share the results of your work with the WPI community. Be sure to take full advantage of this opportunity by preparing a high-quality presentation.