DEPARTMENT of MECHANICAL & INDUSTRIAL ENGINEERING

MECHANICAL ENGINEERING
and
MECHANICAL ENGINEERING TECHNOLOGY
PROGRAMS

GUIDELINES FOR SENIOR "CAPSTONE" PROJECT SPONSORS

Capstone Course Background

The joint Mechanical Engineering / Mechanical Engineering Technology Capstone Experience provides senior students in ME/MET disciplines with a beneficial, meaningful undergraduate research and design experience that is representative of work to be encountered during their engineering careers. Capstone students face real-world challenges as they work through the numerous phases of design: Project definition, background investigation, specification development, alternatives generation and evaluation, engineering analysis, computer modeling, prototype fabrication, and testing. Project management skills and interpersonal communication skills are developed and exercised throughout the duration of each project. "Capstone" is a mandatory course sequence for all ME and MET students at MSU.

The process is initiated well-prior to each semester when projects from industry and academia are collected and vetted. ME and MET senior students are presented with the list of approved projects at the beginning of their first Capstone term, and make their requests for assignment to projects that interest them: A sorting process occurs, and students are placed in project teams (usually 2-4 students) which remain intact through the two-semester course sequence.

Depending on the character of the project, it is possible and often desirable to form interdisciplinary teams that include students from Electrical Engineering, Physics, Architecture, Business, etc. Team progress is monitored by a faculty advisor or advisors assigned to mentor each group, and by the course instructor(s) who help to guide groups to a successful design.

Capstone Project Objectives

The ME/MET Senior Capstone Design Sequence seeks to provide *students*
- a project experience that takes them from academic life to engineering practice
- the challenge of synthesizing & extending their knowledge & abilities into unfamiliar areas
- a chance to apply their engineering coursework in solving real engineering problems
- an opportunity to develop project management and communication skills
- experience with and an appreciation for all phases and activities of project work, from conceptual design through planning and scheduling, analysis, modeling, drawing preparation, manufacturing, assembly, testing, and thorough documentation of results

The Senior Design Project seeks additionally to provide the *sponsor*
- an opportunity to address challenges that might otherwise be postponed due to lack of internal resources
- satisfaction with helping to train tomorrow's engineers for future industrial employment – possibly even with the sponsoring company!
- enthusiastic and energetic help, in the form of students trained in fundamental engineering skills
- an acquaintance with MSU's technical capabilities and engineering faculty, most of whom are registered professional engineers with industrial experience and unique skill sets

Sponsoring a Capstone Project

The *ideal* Senior Design Project is one that solves a real engineering problem while meeting the expectations of all involved parties. As a Senior Design Project sponsor, you will play a crucial role in the project's success by choosing the appropriate project and assisting in project administration.

Sponsoring a Senior Design Project at MSU begins with a problem you need solved or a challenge pertinent to your organization. Referring to these guidelines, you will formulate a brief written project description. (Example project descriptions are available upon request.) Projects will be individually reviewed, and modifications may be suggested so that the projects meet course objectives, have appropriate scope, and provide a real - but achievable! - challenge for students.

Projects then are listed on the roster of Capstone Design Projects for dissemination to students, who self-nominate for inclusion on project teams. Once a student team is assembled for your project, you will work closely with the students and their faculty advisor in developing the project administration details and 'deliverables' that will lead to a successful outcome.

Capstone Project Timeline

ME and MET Senior students may to begin their 2-term capstone sequence either in the Fall term (with completion Spring Semester), or they can begin in Spring term (with completion in the Fall.) Project proposal documents must be received by the capstone course instructor <u>by mid-August</u> prior to a Fall project offering, or by <u>mid-December</u> for a Spring start. Sponsors are expected to be in regular communication with the student group during project execution, and should plan to participate in informal and scheduled, formal reviews of project work.

Choosing a Capstone Project

- Provide a project that is based on a problem you really want to solve, one that will directly benefit your organization.

- Provide a project that combines a judicious amount of design, analysis, experimentation, development, and communication. Other important considerations include economics, safety, and ethics. A working prototype that can be tested for function is a requirement of the course, so please choose a project in which a prototype can be built and tested in a meaningful way. (Prototypes can be sub-scale versions, or even partial assemblies, if that provides useful information.)

- Provide a project that produces a tangible result, a result that can be seen, felt, heard, displayed -- a result that "does something." We do entertain some 'trade study' type projects where the only outcome is a report, but be aware that these are generally less popular among students and provide a somewhat different (and sometimes less beneficial) experience for engineering student participants.

- Provide a project that can be completed during the academic year (about 30 weeks). A reasonable expectation for time input is around 500 - 1000 person-hours to finish up the project.

- Provide a project that offers students an opportunity to work both independently and as part of a team.

- Provide a project that can stand alone, one that is not tied crucially to any other project or process.

- Provide a project that minimizes the need to deal with sensitive, proprietary, or confidential information: These types of projects are taken on now and then, but they add complexities that are difficult for students to deal with in a university setting: If these issues must be considered, they should be <u>completely</u> worked out before the project starts. Please realize that a university environment is probably not the best venue for keeping information confidential! And we presently cannot perform any projects involving national security interests or classified information.

Administering a Capstone Project

- <u>Empower</u> the design group to explore and investigate multiple, innovative and creative solutions to the problem(s) posed. This is not the time for micro-management: *If you already know exactly how you want the problem solved and require nothing but cheap student labor, the Capstone experience is not the proper place to seek support.*

- Provide a project that can be given the same sort of institutional commitment you might give to a similar in-house project. Although the project may not be crucial to your organization, it <u>is</u> important to the student's successful completion of their degree program. If you're not really interested in results, the students will probably pick up on this fact and will be unlikely to perform at their maximum capability.

- Appoint one individual as the student's point contact, to meet and/or communicate regularly with the design team. Expect this liaison to spend about an hour per week on the project. Good communication is a key to insuring that there are no surprises, and that everyone's expectations are being met. (<u>Avoid</u> multiple points of contact with the design team; those situations often result in conflicting advice and confusion!)

- Provide a liaison with the skills and temperament to interact with a student group. Recent graduates seem especially tuned in to the student lifestyle and experience!

- Provide a liaison with the authority to make immediate decisions if problems arise.

- It is desirable to provide the project team with a tour of your facilities, allow them to meet key personnel, and make them part of your team.

- Plan on working together with the student team as they develop a "Deliverables Statement", also known as 'Level 1 Requirements": In this document, everyone (you, the students, and the faculty supervisor) will approve (in writing) the problem statement and the deliverables to be provided by the projects' end.

General Project Outcomes

- Expect quality effort and meaningful written and physical results.

- Expect a fresh approach to solving your problem.

- Expect a final report containing reasonably thorough discussions of design decisions, alternatives considered, analysis and tests conducted to validate design choices, engineering drawings, manufacturing details, and prototype cost information.

- Expect occasional delays and setbacks just as you would in any project.

- Expect a rewarding experience through helping to train tomorrow's engineers

WHAT YOU SHOULD NOT EXPECT FROM A SENIOR PROJECT

- Do not expect to receive fully automated, perfectly functional production machinery as a result of your sponsorship. Students are not yet equipped to design or fabricate components that provide trouble-free service in a production environment, there are simply too many variables to reach that level of performance. Prototypes – if successful – may still need optimization and refinement.

- Do not expect the students to focus strictly on producing "patentable" designs for your get-rich-quick idea: While some designs might eventually become patentable, that is not the specific intent of the capstone design courses. Additionally, the instructional component in our capstone courses is focused on the design process, not the technical & legal details of the patent process.

- Students generally have a full slate of classes (12-18 classroom hours/week is typical) and many students also work 10-30 hours/week. Please be reasonable and flexible with scheduling: Do not expect students to be at your complete beck and call while working on a project.

Reviews, Results Dissemination

- Near the end of the <u>first</u> academic semester, the students prepare material for a "Critical Design Review." This is an oral presentation describing advanced project status, including predicted performance, design & configuration of detail parts and component assemblies, manufacturing details, and estimated cost. At this point of the process sponsors are asked to confirm in writing that they concur with student decisions - including expense-related items. Please plan to attend this event, or make arrangements for a separate session with students to fulfill these sponsor obligations.

- Near the end of the second academic term, students will present their prototype or project result at our Engineering Design Fair, a campus-wide event open to the public. This day-long open house includes poster sessions, light refreshments, and an air of excitement and pride.

COST:

1. You will be asked to <u>pay all direct costs</u> associated with the project. Examples of costs would include all materials, any custom outsourced manufacturing or machining, specialty test equipment, and travel costs to your facility. A rough estimate of costs can be provided at project initiation, and sponsors are strongly encouraged to review design details and associated prototyping costs as the project progresses.

Follow-on projects, Returning Customers, Spreading the word

Please consider supporting additional projects in the future. Let your business associates know about the program and the opportunities available to them. Our goal is to give <u>every</u> Mechanical Engineering and Mechanical Engineering Technology student a meaningful and representative engineering design project experience.

Disclaimer

- **MSU and the sponsor agree that the sponsor, its agents and employees are not agents or employees of Montana State University. While on MSU grounds, the sponsor must comply with all MSU rules and regulations.**

- **MSU makes no warranties or guaranties regarding the suitability for a particular purpose of the equipment to be used, the development process and the resulting prototypes under this agreement.**

- **Intellectual Property provided by the sponsor or developed as a result of the project remains with the sponsor. IP agreements can be put in the form of signed, formal documentation if necessary. (But most project sponsors treat this in an informal manner, in the spirit of an open learning environment.)**

- **Use of ANY prototype(s) produced is the sole responsibility of the sponsor. If necessary, and <u>at the sponsor's written request</u>, MSU will keep confidential any prototype information that is discussed or developed and will not disclose that information to any other parties without prior written consent from the sponsor.**

- **The sponsor agrees to defend, indemnify and hold MSU harmless from any and all loss, damage or injury to any person or property arising from use of the equipment, the development process and the resulting prototype(s).**

- **No warranty is implied, offered or extended in the development and production of the prototype(s).**

Agreement Signatures

Representing the Sponsor

_____   _____
Signature   Date

_____   _____
Printed Name   Title

Company Name: _____

Company Address: _____

                    _____

Telephone: _____

Email   _____

Representing
MONTANA STATE UNIVERSITY, DEPARTMENT of MECHANICAL AND INDUSTRIAL ENGINEERING

_____   _____
Signature   Date

_____   _____
Printed Name   Title

Telephone: _____

Email   _____