

# Work In Progress – A Fresh Look At Case Studies

Jeffrey L. Newcomer, Ph.D.

Engineering Technology Dept., Western Washington University  
Bellingham, WA 98225-9086, newcomj@cc.wvu.edu

**Abstract - Students in the Manufacturing Engineering Technology Program at Western Washington University complete two assignments in which they must research and prepare a written and/or oral report on an engineering case study. Student-researched case studies address a number of learning objectives, including EAC Criteria 3.f-j and TAC Criteria 2.g-j, they can be used to address technical learning objectives, and they increase student motivation and often provide a fresh look at the case and the lessons it teaches. The most significant challenge to using student-researched case study assignments is developing well structured assignments that are open-ended, but have clear expectations.**

*Index Terms* – Case studies, Communication Skills, Ethics, Manufacturing Safety

## INTRODUCTION

Case studies are a well established method to introduce students to complex issues and the results of human decisions on technical systems. Case studies are normally used for discussion, with all of the students reading the same case, but they can also be used very effectively when students have to provide the narrative account of the events. By putting the research responsibility on students and requiring a written and/or oral report of the case, a well structured, but open-ended case study assignment can give students a fresh look at cases and address multiple ABET criteria, specifically EAC Criteria 3.f-j and TAC Criteria 2.g-j.

Students Manufacturing Engineering Technology (MET) program in the Engineering Technology (ET) Department at Western Washington University (WWU) complete assignments in two courses for which they must research and narrate a case study. In Manufacturing Ergonomics, Safety, and Health students write a short paper to highlight the avoidable errors in an industrial accident, and in Engineering and Society, a course that combines technical writing and ethics, students put together a presentation and a brief written summary on an engineering failure or near miss that highlight the ethical issues involved. In both assignments students research the cases and draw their own conclusions. In their narration students must argue a position that emphasizes what their classmates should learn from the case.

These assignments help students develop many valuable skills, probably the most valuable of which is the ability to organize evidence to create and present a persuasive argument. This paper will outline the two assignments, how students benefit from them, and how these benefits can extend to more technical aspects of engineering.

## STUDENT LEARNING GOALS

Student-researched case study assignments can meet a number of different student learning goals, including both ABET criteria and the reinforcement of technical material. A well designed case study assignment will help students develop communication skills (EAC 3.g and TAC 2.g), as students must develop a coherent argument in order to explain and defend their conclusions regarding the case clear. When students are responsible for independently researching a case and drawing from multiple sources, they will develop the skills they need to maintain lifelong learning (EAC 3.i and TAC 2.h). Finally, case studies that explore engineering accidents, failures, or near misses force students to address issues of professional, ethical, and social responsibility, the impact of engineering solutions, and quite often contemporary issues in a diverse world (EAC 3.f,h,j and TAC 2.i-j). Good case study topics also require critical thinking, as there are often large grey areas as to responsibility for mishaps, as well as room for disagreement. As such students must be able to sift through and sort evidence in order to create a coherent argument.

In addition to addressing ABET criteria, case study assignments can also be used to reinforce technical material. The cases must be chosen more carefully, but there are still many options. For example, the collapses of the Hyatt Regency walkway, the Kemper Arena, and the Hartford Civic Center can be used to reinforce the areas of free body diagrams, beam deflection and metal fatigue, and beam buckling respectively in an introductory or advanced structures course. The case assignments will still address ABET criteria, but the students can be required to develop extra detail that reinforces technical concepts, and if students must explain concepts, and reach and defend conclusions, they will need to understand the technical details in order to succeed.

## STRUCTURING ASSIGNMENTS

Developing well-structured assignments is the most challenging aspect of using student-researched case studies. Without clear expectations students have a tendency to write and present in a journalistic style—lots of drama, limited technical information—or a Hollywood style—build suspense for the surprise ending. While both of these styles have their place, neither one represents good written or oral *technical* communication. Therefore it is important that assignments clearly delineate the intended audience (e.g. other engineers and/or engineering managers so that the expectation of technical information is clear) and the intended style (e.g. students should start with the lesson, support the lesson with evidence, and

then reiterate the lesson as their conclusion). If students are given guidance as to the expected structure and style, they are much more likely to produce a report and/or presentation that reinforces the desired learning objectives.

Along with providing well structured assignments, faculty also need to be able to critique student work, and that means faculty need to know something about the cases too. Fortunately there are many resources available (for a sampling see [1]-[5]), and they are generally interesting and accessible. The only catch is that it is rare to find a single reference that gives thorough information on a case, so it is always advisable to consult multiple sources, which is a good lesson for students as well.

### *Example Assignments*

Students in the MET program in the ET Department at WWU complete two independent research case study assignments, one in Manufacturing Ergonomics, Safety, and Health, and one in Engineering and Society, a course that combines technical writing instruction and engineering ethics. The latter course is taken by students from all majors in the ET Department, and even the former course is occasionally taken as an elective by non-MET students, but only MET students are required to take both classes.

The assignment in Manufacturing Ergonomics, Safety, and Health is for students to complete a report on an industrial accident. From the standpoint of content, the purpose of the assignment is to link compliance (or lack thereof) with OSHA standards to industrial accidents. Students are to take the perspective of someone working for a competitor in the industry in which the accident occurred. The report is for a supervisor who is concerned that the accident might be replicated at the operation at which the student is 'employed', so the report needs to contain information about the events leading up to the accident, the accident itself, and the relevant OSHA standards, and it needs to be precise and concise. The assignment not only requires students to find good information on the accident itself, it requires them to do a thorough search of OSHA standards. Students find some very interesting accidents, although some of them have trouble finding accidents that fall under the OSHA umbrella. Students also have a tendency to write accident reports, especially the introductory sections, with a dramatic flair that is not compatible with the goal of precise and concise technical writing, so the assignment expectations need to be explicit.

The assignment in Engineering and Society also requires students to research and report on a case, but unlike the assignment in Manufacturing Ergonomics, Safety, and Health, students in Engineering and Society must give an oral presentation to their classmates and provide their classmates with a brief (2 page maximum) written summary. Students are expected to clearly link the events of the case to expectations for professional ethics. Students are allowed to choose from a list of 60 engineering failures and near misses, or to propose a case themselves (subject to instructor approval). These cases are all well documented, so information on them is available

from multiple sources, but not all of the cases are clear ethical lapses, so students generally have some latitude in reaching their conclusions. Limiting the set of cases also allows the instructors to keep track of them so that if the research is poorly done the rest of the class is not left with a false impression of the case. Since Engineering and Society includes instruction in technical writing, the preciseness and conciseness of both the oral report and summary are emphasized. Students are expected to clearly state their theses at the onset of their reports, and then are expected to convince their audience of the veracity of their claims. Students are primarily rated on the clarity and completeness of their arguments regarding what they decide everyone should learn from the cases.

### OBSERVATIONS

Case studies seem to be effective learning tools because students find them to be interesting. When students become interested and engaged they are more likely to put the necessary effort into an assignment. Requiring students to do their own research (as opposed to everyone having the same assigned reading) and draw their own conclusions encourages students to look more deeply into the cases, and it also results in some fresh conclusions as to what the most important lesson is in the various cases. The oral presentations make the assignment in Ethics and Society a little more effective than the assignment in Manufacturing Ergonomics, Safety, and Health since the students get to see each others work, but the presentations also take more class time, and so they are not feasible in all situations.

### FUTURE PLANS

The assignments in both classes seem to be effective, although they will continue to be adjusted based on experience and students feedback. Thus, at this point the next task is to develop a method for assessing the impact of the case study assignments. Overall the anecdotal evidence is that the students benefit from the student-researched case study assignments; now some concrete proof is required.

### REFERENCES

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