

Modeling Sustainable Decision Making in an Engineering Classroom

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MOTIVATION

Engineers have significant power to influence individual clients and wider society through their contributions. There is a need for engineers to not only utilize their expertise but become aware of the impact of their design decisions. As the bridge between science and society, engineers constantly have to balance the demands of industry, government, and the public. Likewise, sustainability requires the balancing of natural, human, and economic resources to enhance the safety, welfare, and quality of life for all of society so that future generations can meet their own needs.

The modern ethical engineer is uniquely equipped and placed to take on the challenges of sustainable development. An engineering degree at Utah State University must prepare students for those challenges by incorporating sustainability themes into their curriculum. The more sustainability is incorporated into individual engineering classes, the more likely a student will be to accept their role to adhere to the principles of sustainable development in an ethical and responsible manner. This poster introduces the approach to introduce early engineering students to sustainability during Fall 2016.

ENGR 1500: INTRODUCTION TO ENGINEERING

ENGR 1500: Introduction to Engineering is a newly revamped course offering in the College of Engineering at Utah State University. The main objective of the class is to help students acquire basic problem-solving techniques while helping students identify which careers in engineering that best fits their interests and needs. With a focus on problem-solving, improving communication, and professional responsibility, the class is designed to help engineering and non-engineering students understand what is required of them to be a 21st century engineer.

Professional responsibility and ethics is a recurring theme in the class and is introduced in Module 2: Ethics and Professional Responsibility of Engineers but will be presented again throughout lectures and assignments in the middle and end of the semester. To be ethical, the modern engineer has to be technically competent and "hold paramount the safety, health, and welfare of the public" (NSPE Code of Ethics). Engineering ethics serves as the ideal place to integrate sustainability themes because they both require recognition of multiple stakeholders and consideration of broader societal issues.

During the Module 2 lecture, students were asked to read and reflect on a case study (see "Content" box) that integrated an environmental issue. Students were asked to consider the pressures imparted to the engineer (Marvin) by industry to act in their best interest. Through discussion questions, the National Society of Professional Engineers Code of Ethics, and the creation of a concept map, students understood that priorities in their decision making will affect the steps that they follow (ethically) and their duty to their stakeholders.



Figure 1. Concept Map Activity Completed by General Engineering Students enrolled in Course

SUSTAINABILITY CASE STUDY EXAMPLE

Marvin Johnson is Environmental Engineer for Wolfog Manufacturing, one of several local plants whose water discharges flow into a lake in a flourishing tourist area. Included in Marvin's responsibilities is the monitoring of water and air discharges at his plant and the periodic preparation of reports to be submitted to the Department of Natural Resources.

Marvin has just prepared a report that indicates that the level of pollution in the plant's water discharges slightly exceeds the legal limitations. However, there is little reason to believe that this excessive amount poses any danger to people in the area; at worst, it will endanger a small number of fish. On the other hand, solving the problem will cost the plant more than \$200,000.

Marvin's supervisor, Plant Manager Edgar Owens, says the excess should be regarded as a mere "technicality," and he asks Marvin to "adjust" the data so that the plant appears to be in compliance. He explains: "We can't afford the \$200,000. It might even cost a few jobs. No doubt it would set us behind our competitors. Besides the bad publicity we'd get, it might scare off some of tourist industry, making it worse for everybody."

SUSTAINABILITY QUESTIONS TO STUDENTS

- In your opinion, are engineers ethically obligated to consider sustainability in their designs? Why or why not?
Focus on multiple stakeholders:
- No doubt many people in the area besides Marvin Johnson and Edgar Owens have an important stake in how Marvin responds to Edgar's request. How many kinds of people are affected by his decision and how do you think they would react? (e.g., employees at Wolfog.)
Focus on global responsibility:
- Consider if this same situation occurred with an American-owned company operating in a country with less stringent environmental regulations than in the United States. Would this still be an ethical dilemma? Does this change how you would react?
- Who do you think the code of ethics is referring to when they mention the public? Does it apply to your immediate surroundings, the country, or the world?

CODE OF ETHICS

FUNDAMENTAL CANONS FOR ENGINEERS:

Engineers, in the fulfillment of their professional duties, shall:

1. Hold paramount the safety, health and welfare of the public.
2. Perform services only in the areas of their competence.
3. Issue public statements only in an objective and truthful manner.
4. Act for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

CONCLUSIONS

Sustainability themes were integrated into an Introduction to Engineering Course by incorporating them into a module about engineering ethics and professional responsibility. In this module students should learn that:

- All engineering decisions involve recognizing and considering the point of view of multiple stakeholders.
- Engineering solutions should consider broader ethical and social issues.
- In serving the public interest, the professional code of ethics encourages engineers to "adhere to the principles of sustainable development in order to protect the environment for future generations".

Students were actively engaged in discussion and responded well to the topic. They quickly grasped that their priority in decision making can affect their perception of who they are serving.

NEXT STEPS

It is our hope to incorporate more sustainability themes into next semester for this course. There is great potential in incorporating environmental responsibility into lectures and activities in more holistic ways throughout discussions of each engineering discipline.

LITERATURE CITED

- NSPE. (2007) Code of Ethics for Engineers. Retrieved from <http://www.nspe.org/resources/ethics/code-ethics>.