W11 CIM 2.1.3 Part B Ethics and Safety

INTRODUCTION

Nearly every decision a professional makes has an ethical impact or safety issue that should be considered. Some issues are clear in how they should be addressed in the decision-making process, while other issues are more obscure in their impact and optimum resolution.

Ethical and safety dilemmas can be approached using a methodical system that you will see in this activity. You will research products with ethical or safety issues and identify issues that the manufacturer may not have addressed. You will also analyze an ethical and safety scenario.

PART A

Procedure

1. Review the Principles of Ethics resource notably the Ethics Flowchart.
2. With a partner, research and select a product that has encountered an ethical or safety issue at some point in the past. Describe the product and then explain the associated ethical or safety issue. Must contain a detailed explanation and cite examples.
   Use the example as a guide.
   a. Description of Product: Baby toys
   b. Source of Information: U.S. Consumer Product Safety Commission
   c. Ethical or Safety Issue: The toys contained lead, which placed human health at risk. The issue brought into question the competence of the engineers involved.
3. Follow your teacher's instructions to share what you've learned with your classmates.
4. Read the Manufacturing Company Ethical Scenario and answer the questions.

DESCRIPTION: Samsung Galaxy Note 7 Smartphone
SOURCE OF INFORMATION: U.S. Consumer Product Safety Commission (CPSC) and Samsung official recalls
ETHICAL OR SAFETY ISSUE: The Samsung Galaxy Note 7, released in August 2016, experienced a critical battery defect that caused devices to overheat, catch fire, and in some cases, explode. The lithium-ion batteries had a manufacturing flaw where the battery's positive and negative layers came into contact, causing thermal runaway and combustion.
This issue placed human health and safety at immediate risk, with reports of burns, property damage, and potential injuries. The phones posed dangers in homes, vehicles, and especially on aircraft, where they were banned by aviation authorities worldwide. Samsung ultimately recalled

approximately 2.5 million devices globally in one of the largest consumer electronics recalls in history. The recall cost Samsung over $5 billion and damaged the company's reputation significantly. This case demonstrates how engineering decisions have far-reaching ethical implications beyond just technical specifications.

Manufacturing Company Ethical Scenario

Derek manages an assembly line at a medical device manufacturing company. He requires all line workers to remove and repair every **defective** device that comes down the line. Derek's team produces the highest number of defective devices at the plant. His supervisor Karen complains about Derek to her good friend Jason, who also serves as the company's Vice President. She insists that Derek's decision to repair defective medical devices costs the company too much money. Jason decides to tell Derek that his team should ignore the defects and sell the devices as-is.

Analyze the data shown and then answer the questions that follow. Be sure to show your work in your PLTW engineering notebook.

- Each device is sold at $69.99 each.
- The total cost to manufacture each device is $44.23.
- It costs $23.87 to repair a device defect.
- The company can manufacture 1,025,000 devices (with and without defects) each year.
- Historical data has shown that customers do not return defective devices.
- Defects are occurring at the rate of one defect per 242 devices.

a. If a distributor purchases 645,000 devices for resale, what percentage of devices will be defective? How many devices is this?

Defect rate = 1/242 = 0.00413 or 0.413%

645,000 ÷ 242 = 2,665 defective devices

b. What is the difference in profit when repairing versus not repairing defective medical devices? How can this be used as an argument for or against ordering repairs?

Given:

Revenue per device: $69.99

Manufacturing cost: $44.23

Profit per device: $25.76

Derek's approach:

Repair cost for defective devices: $23.87

Profit per repaired device: $69.99 - $44.23 - $23.87 = $1.89

Total profit WITH repairs:
Good devices: (645,000 - 2,665) × $25.76 = $16,543,993.60
Repaired devices: 2,665 × $1.89 = $5,036.85
Total: $16,549,030.45

Jason's approach:
Total profit WITHOUT repairs:
All devices: 645,000 × $25.76 = $16,615,200.00
Difference: $16,615,200 - $16,549,030.45 = $66,169.55

Argument for repairs: While the company loses $66,169.55 in immediate profit by repairing defects, this is the ethically correct decision. The cost is relatively small compared to total revenue, and repairing devices prevents harm to patients, protects the company's reputation, and demonstrates commitment to quality and safety.
Argument against repairs: The company could save $66,169.55 by not repairing devices. Since customers don't return defective devices, the company won't face immediate financial consequences.

c. A data analysis report based on sales team feedback found that because the devices are used in the medical field, a defective device may contribute to the death of one out of every 600 patients where a defective device is used. How might this impact the decision to repair defective devices?

With 2,665 defective devices and a death rate of 1 in 600 patients where defective devices are used:
Estimated deaths: 2,665 ÷ 600 = 4.4 patients (approximately 4-5 deaths)
This data transforms the scenario from a simple profit calculation into a life-or-death ethical dilemma. Knowingly selling defective medical devices that could contribute to approximately 4-5 patient deaths is:

- A violation of fundamental engineering ethics (holding public safety paramount)
- Potentially criminal negligence
- Morally indefensible regardless of cost savings
- A breach of trust with customers and patients

This information makes the decision to repair devices not just ethically correct, but legally and morally NECESSARY.

d. Karen and Jason are good friends. Why do you think this statement was included in the scenario?

This detail was included to highlight a conflict of interest and test of ethical principles. Their friendship creates:

- Personal bias: Karen may hesitate to escalate Derek's complaint against Jason's directive because it could harm their friendship
- Ethical tension: Karen must choose between loyalty to her friend and her professional responsibility to advocate for patient safety
- Power dynamics: As Vice President, Jason has authority over Karen, making it harder for her to oppose him
- Moral courage test: The scenario tests whether Karen will prioritize ethics over personal relationships

e. Statistically speaking, how close is the company to meeting the standards of Six Sigma?

Current defect rate: 1 defect per 242 devices = 4,132 defects per million
Six Sigma standard: Fewer than 3.4 defects per million
Comparison:

Current: 4,132 defects per million
Six Sigma: 3.4 defects per million
The company is performing approximately 1,215 times WORSE than Six Sigma standards

The company is **nowhere** close to Six Sigma certification. They would need to reduce defects by over 99.9% to meet this standard. This extremely high defect rate for medical devices is unacceptable and indicates serious quality control problems in the manufacturing process.

> **Remember**: Six Sigma Certification is achieved when a company produces fewer than 3.4 defects per million opportunities.

Part B:

5. Explore the Professional Ethics resource and reflect on the eight fundamental engineering canons.

Note: While the canons were developed by engineering professionals, they are relevant to all professions.

Fundamental Engineering Canons

1. Hold paramount the safety, health, and welfare of the public.
2. Perform services only in areas of competence.
3. Issue public statements only in an objective and truthful manner.
4. Act for each employer or client as a faithful agent or trustee.
5. Avoid deceptive acts.
6. Conduct yourself honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.
7. Continue professional development.
8. Treat all persons fairly.

6. Select one of the incidents or products below to examine from an ethical perspective. Consider whether careful attention to the fundamental engineering canons could have lessened the impact or even prevented these incidents from occurring. After you've researched and reflected on your incident or product, create a two- or three-slide presentation, a poster, or a narrated movie. Include the following details, and be prepared to present your findings according to your teacher's instructions.

- Briefly summarize the event.
- Identify the ethical issue(s) involved.
- Explain any other contributing factors, such as weather, improper use of the device, poor materials choices.
- Share at least one engineering canon that you believe could have lessened the impact or prevented the incident from occurring.

https://docs.google.com/presentation/d/1-hHLLK4LXgxDKWQv0nAHpzNOMvLePT0AajG-4ZjOHdM/edit?usp=sharing

What Does Ethics Have to Do with It?

Choose one of these incidents or products to research and probe from an ethical perspective.

- Volkswagen vehicle emissions cheating
- Space Shuttle Columbia disaster
- Space Shuttle Challenger disaster
- Boeing 737 max flight control system
- Tylenol drug container tampering
- Kansas City Hyatt Regency walkway collapse
- Aqua Dots poisoning
- Minnesota bridge collapse
- Three Mile Island nuclear plan incident
- Citigroup Center building design
- Ford Pinto fuel system fires
- Minamata mercury poisoning
- Chevrolet Corvair design flaws
- Boston molasses disaster
- Quebec Bridge collapse
- Johnstown flood
- Tay Bridge collapse
- Ashtabula River Railroad disaster

CONCLUSION

1. Describe a professional in your life whom you've observed upholding the fundamental engineering canons.

My engineering teacher, Ms. Guzman consistently demonstrates engineering ethics in the classroom. When we were doing potentially dangerous activities, such as soldering or laser cutting, Ms. Guzman always insists on the safety precautions such as safety glasses, proper handling of soldering irons, and the safety procedures in case something does go wrong.

2. Identify at least one professional characteristic or skill that a professional practicing the engineering canons possesses that you hope to also acquire. What steps do you need to take to begin developing that characteristic or skill?

Moral courage -- The ability to speak up and do what's right even when facing pressure, consequences, or opposition from authority figures or peers.

Many engineering disasters occur not because engineers didn't know there was a problem, but because they lacked the courage to push back against management pressure, tight deadlines, or cost concerns. In the Boeing 737 MAX case, some engineers reportedly raised concerns about MCAS, but these concerns were dismissed. Engineers with moral courage could have prevented 346 deaths.

3. Attack or defend the statement, “When matters of life and property are at stake, *not knowing* should be equivalent to *we have a problem*.”

I strongly agree with the statement. When human lives and property are at risk, uncertainty or lack of knowledge must be treated as a critical problem requiring immediate action, not as an excuse for inaction or proceeding blindly.