THE ETHICAL DILEMMA BETWEEN COST AND QUALITY WITHIN THE UNITED STATES NAVY AND MECHANICAL ENGINEERING

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INTRODUCTION

Within the community of mechanical engineers, there are a numerous amount of situations in which an ethical decision must be made. This number is increased even more when you specifically look to the United States Navy. This is due to a harsher working environment, and larger ramifications due to a smaller mishap.

As a mechanical engineer, you know the ins and outs of every project of which you are in charge of. You know exactly how it can operate under extreme stress, and how much time it can last from wear. If it were not a problem, there would be no spending cap, and the best of the best materials would be used no ifs and or buts about it. However, this is almost never the case due to the fact that companies wish to make the most amount of money possible per unit developed.

THE TECHNOLOGY YOU ARE WORKING WITH

You are a mechanical engineer employed by General Electric and the leader of the design team behind the new LM2500 gas turbine. The LM2500 gas turbine is an aero derivative product, which means that it uses similar technology and innovations that a jet turbine engine would use. “It is a simple-cycle, two-shaft, high-performance engine. Derived from GE’s CF6-6 aircraft engines, the LM2500 consists of a gas generator, a power turbine, attached fuel and lube oil pumps, a fuel control and speed governing system, associated inlet and exhaust sections, lube and scavenge systems as well as controls and devices for starting and monitoring engine operation” [1]. The newest model, the LM2500+G4, has additional airflow to optimize both power and efficiency [1]. This new model has an output 130% greater than that of its predecessors [1]. To top it all off, it achieves all of this while still maintaining the same revolutions per minute.

THE DILEMMA AT HAND

Your specific team is tasked with briefing your employer, the United States Navy, on the design, cost, and production time of the LM2500+G4 gas turbine. Although the military is spending billions of dollars annually, they still want the cheapest product possible. The initial test run by your team shows that the quota will not be able to be filled because of the need to use dependable building materials.

The department manager has instructed you to change the materials to a less reliable and therefore cheaper material, because as the saying goes, “remember your weapon was built by the lowest bidder” [2]. Since you are the head of the team, you know what the best for the design is. However what could go wrong if you were to switch some out?

POTENTIAL HAZARDS

Out in the Fleet

The GE LM2500+G4 gas turbine has been used as the main propulsion engine aboard the newest navy surface warfare vessels including the Oliver Hazard Perry Class Frigates, Ticonderoga Class Cruisers, and Arleigh Burke Class Destroyers. Of the four hundred fifty that the United States Navy owns and operates, several instances of high pressure turbine blade failure have caused ships to come back to port and engines to be removed to fix this extreme error. Metallurgical studies done while the ships were under repair can trace the problem back to the materials used by the manufacturer [3].

With each moment that a United States Navy ship is not out at sea, the job becomes increasingly dangerous for those still deployed. This small change to the engine’s design, which probably saved the navy hundreds of thousands of dollars, is putting an unnecessary risk on the American sailors who are already risking it all for their country.

Within the Workplace

There are a large amount of implications that may result within your place of business if you were to not reduce the production cost of the LM2500+G4. This little incident could cause GE to lose its contract with the United States Navy, and thus lose a large amount of revenue within your own personal department. Your failure to “seal the deal,” coupled with the loss of the contract, could cause a job reduction within your department, and it could even be yours.

ETHICAL CODES

The main problem here is the conflict between the need for a money saving solution, and the need of safety of the crew aboard the vessels on which the LM2500+G4 is installed.
The Cost of Integrity

This case study follows the real life account of Dr. William LeMessurier. In this case, he discovers that a design flaw in a 59-story skyscraper he designed is fatal. In fact, just a small gust of wind could topple the building, and in the process kill thousands of innocent people. However, rectifying this problem would require the city officials, building owners, and the press and might negatively impact Dr. LeMessurier’s professional reputation [4].

If he was to do nothing, the doctor would be in violation of a numerous different canons of the National Society of Professional Engineers’ Code of Ethics. The first would be Canon 1, which states, “Engineers shall hold paramount the safety, health, and welfare of the public” [5]. This of course covers the fact that if Dr. LeMessurier was to do nothing, thousands of innocent lives would be lost.

Another violation would be a combination of Canons 5 and 6. They state, “Engineers shall avoid deceptive acts,” and, “Engineers shall conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession,” respectively [5]. The two of these both turn away from ignoring the situation to preserve his professional reputation, and definitely lean towards fixing the problem no matter the cost.

Roger Boisjoly-The Challenger Disaster

Roger Boisjoly had over a quarter-century’s experience in the aerospace industry in 1985 when he became part of the team involved in an improvement on the O-rings, which connect segments of the solid rocket booster on the now infamous space shuttle Challenger [6].

In 1985, Boisjoly began work on the space shuttle. During a post-flight hardware inspection, he noticed that hot combustion gases compromised the primary seals on the two field joints, and a large amount of blackened grease was observed between the two seals [6].

When he noticed this anomaly, Boisjoly immediately went to his superiors, and was then instructed to prepare a detailed presentation as part of the Flight Readiness Review. Although he strongly suggested against launching at a low temperature, NASA management ignored his pleas, and the rest is history [6].

According to Canon 8 of the Code of Ethics for Naval Engineers, “We shall conduct business and advertise in a restrained and highly professional manner avoiding exaggeration and misinterpretation,” [7]. In his situation, Roger Boisjoly was the perfect example of this. He went directly to the people he needed to once he found a problem, and did not exaggerate, sugar coat, or misinterpreted any of the data he encountered. Although he was not listened to, he did what a lot of good engineers may not be able to, and that is stand up and try to defend a problem that he is responsible for.

Fire Code Violations

The final case study follows a fire protection engineer who, while conducting an audibility test of fire alarms, discovers that the alarm could not be heard within all of the residential units, which is a violation of the local fire code [8]. The engineer goes by his best judgment and instructs the owner of the building of the need to replace the audible system.

This case study follows many of the same Canons located within the NSPE. Along with Canons 1, 5, and 6, it also follows Canon 4, which states, “Engineers shall act for each employer or client as faithful agents or trustees,” [5]. The engineer makes the ethical decision by instructing the owner of the problem, without disclosing the information to in a manner which could make it seem not severe, or as severe a violation as it is.

Each of these three case studies are very similar to the ethical dilemma that was described earlier in the paper. Each provides its own insight as to how a design team leader, or another person in a position of power, should react in certain situations, which could be detrimental to innocent people.

HOW TO MAKE A DECISION

When making an ethical decision, there are two main reasons as to why people try to make them, “they wish to make the world a better place for everyone-in a single word, altruism,” or, “they wish to avoid unpleasant consequences, such as fines, incarceration, or loss of job,” [9]. However, in this case both could occur if one does either. Leaving one to question how to make a decision, in a timely manner mind you, on whether or not to replace the more expensive parts with cheaper ones.

Lucky for us, history is replete of examples of people, and even nations, who do not base their decisions solely on whether or not they are acting ethically, and because of this, common occurrence, almost all societies have developed rules, codes, and laws to specify what is and is not acceptable behavior [9].

Due to the fact that many situations, including the one we are discussing, are not very black and white, many different guideline have been developed to assist engineers in their decision making. One of these is a general guideline that uses different approaches [10].

One approach to ethical decision making is to consider the effect of your decision on yourself as the decision make, anyone potentially involved, and the bigger picture [10]. Before making the decision, you need to get all the facts about the situation, identify as many alternate outcomes as possible, consult others, and then make a decision [10].

It is always a wise idea to seek the cousel of others around you who may have more and/or a wider array of experiences and/or who may be better able to have an impartial stand on the issue [10].
It is also always a great idea to ask yourself some questions when dealing with an ethical decision making process. Some example questions are, “what is the action or inaction that is the cause for concern; who or what may be affected, how will they be affected; are there any laws, regulations written or unwritten that may apply; what actions might be taken and what would the consequences of these actions be; and can anything be done to prevent this from reoccurring or to minimize the severity of the consequences?” [10]. Also, it is always a great idea to look back on past situations that you, or others have had to deal with that are similar, for poet and philosopher George Santayana once said, “Those who cannot remember the past are destined to repeat it,” [10].

Another useful decision making process is that of a four-step procedure. This procedure uses both similar and different tactics, as compared to the first guideline, to come to a conclusion in a timely manner.

Step One

You should start by identifying the issues, or the what, and the stakeholders, or the who. Some examples of issues could be that nicotine is poisonous and addictive, or in our case that the cheaper materials could result in a mechanical malfunction at sea. As for the stakeholders, they would be you, your team, the company, and even the United States Navy [9].

Step Two

Next, you must analyze alternative courses of action from different perspectives. Look at the consequences and intent of the different actions that could occur. Then, ask yourself, would someone of good character take part in these actions [9].

Step Three

We now enter the realm of subjective judgment, for you must now correlate the perspectives and information that you have gathered. You would have to weigh the factors identified from the different perspectives, including any that have been overlooked or knowingly omitted, to arrive at your own conclusion. Only you can make this decision, for any decision that you make will affect you and your conscience [9].

Step Four

Finally, you must act on your decision. If your decision was that replacing the parts possesses no threat to your soul, probably little courage is required to follow through, since your career may blossom, or at least not be curtailed. On the other hand, if you believe that doing so is unethical, you need to have the intestinal fortitude to either attempt to change the mind of your department superiors or refuse to change anything, both of which may put your career at risk [9].

CONCLUSION

When looking at any ethical decision, especially one in which a large amount of people could potentially suffer, you must not just think of yourself. Let us take Roger Boisjoly for example. He stood up against the entire NASA board, urging them not to launch the space shuttle Challenger solely because of the small rubber O-rings that he was in charge of. Another great example is how Dr. William LeMessurier handled his slight building calculation error. He was able to push away his personal integrity in order to fix what he was responsible for not doing correctly. He put his professional career on the line in order to extinguish the possibility of thousands of innocent civilians being killed by just a mere gust of wind.

As a mechanical engineer, the importance of making sound and timely decisions is immense. Without it, you may be stuck on the short end of the stick and forced to do the exact opposite action that you wish to perform. Since money is most likely going to be a factor in every engineering build you are ever a part of, using this example, and others that you may find, coupled with the tools that I have laid out earlier in this paper, will give you the tools to success within your career.

REFERENCES

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ACKNOWLEDGEMENTS

I would like to thank Chaz Donnelly for his help editing this assignment.