

Ethics Final Paper

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Ethics in Engineering

All around the world and throughout human history, there has been a need for some kind of engineer; whether it be designing structures over two thousand years ago or developing 21st century technology to make people's lives easier and safer; the need for people that want to create and innovate in society has always been needed and wanted. Many engineers constantly reevaluate, design, develop, and test old and new ideas, methods, and objects in hopes that they come up better. In fact, the job and goal of many engineers is to simply improve something (Sweet). However, some of these old and new innovations have arguably made society and human life worse over long-term use; air pollution and worldwide oil shortages are both negative effects that engineer's inventions and mass production of those inventions have caused. This is partly because some of these technologies were not seen from an ethical perspective and were seen from an efficiency or even profitable perspective. Engineers, because they have such an impacting effect on modern day technology, should always have ethics in mind when creating something new. One of their top priorities as an engineer should be to develop and design something with little to no short-term or long-term negative/harmful effects.

This idea of having engineers that think with an ethical perspective has had worldwide acceptance and has been adopted by many different engineering organizations. The National Society of Professional Engineers (NSPE) has created a code of ethics which breaks down what

it means to have ethics in engineering and even explains what practices to follow. The preamble to this code is as follows:

Engineering is an important and learned profession. As members of this profession, engineers are expected to exhibit the highest standards of honesty and integrity.

Engineering has a direct and vital impact on the quality of life for all people.

Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct (“Code of Ethics”).

This code of ethics for engineering is critical in today’s constant push for innovation because it enforces the fact that engineers need to do the proper testing to ensure that no harm will be done to people or the environment.

It is in the majorities interest that engineer’s creations are fully safe for people to use and safe for the environment. An extreme example of this would be the use of lead paint. Lead paint was known to be washable and durable and was widely used in many industries until it was banned in the 1970s (“Prevention Tips”). It wasn’t until the widespread negative effects of this paint was seen that people found out it put children at risk for high levels of lead in their blood stream. Because of the lack of testing, or long-term testing, of lead paint at the time of production, millions of people were somewhat affected by the paint and still continue to be affected to this day. “All houses built before 1978 are likely to contain some lead-based paint. However, it is the deterioration of this paint that causes a problem. Approximately 24 million housing units have deteriorated leaded paint and elevated levels of lead-contaminated house dust. More than 4 million of these dwellings are homes to one or more young children” and “Even low

levels of lead in blood have been shown to affect IQ, ability to pay attention, and academic achievement. And effects of lead exposure cannot be corrected” (“Prevention Tips”). Since then, “lead pigments have been replaced with titanium dioxide, which is so safe it’s also used in food colourings [sic] as well as in sunscreen” (Crow). This example is brought up because it shows that, even though lead paint had many advantages, the majority of people would rather use a worse product, than have themselves or their family members have any kind of health problems. Additionally, an argument can be made that if more tests were done before mass production of lead paint, then there could have been a chance that the tests would have shown some kind of connection between lead paint and the negative health effects that it has caused.

Once a new method or device is created, it must be expected that more of those devices will be manufactured or produced for different companies and consumers. The problem arises when the base model (first device made) was not tested for negative effects and still put into production; or, even worse, if it was tested for negative effects, showed negative results, and still put into production because of its positive features. There are, of course, other modern-day inventions that have negative effects, but the negative effects of a single unit does not necessarily put anyone or anything in danger. However, in today's fastmoving and consuming society, mass production is a necessity in many industries in order to keep society moving and happy. This mass production of devices, machines, and manufacturing goods is an aspect that an engineer needs to keep in mind throughout the designing process. This is so that when it comes time to mass produce these goods that they can be manufactured quickly and efficiently so that the company can keep up with demand. Additionally, the engineer needs to calculate the negative effects all these devices might make when multiplied; this same idea can be said for methods in that a method, or certain way of doing something, should be safe enough to where it can be

repeated many times with minimal negative effects. For example, in today's current system, a majority of energy companies use fossil fuels to generate electricity. In fact, "In 2015, fossil fuels provided about 81% of the energy used in the United States, including the energy to generate most of our electricity" ("Our Energy Sources"). While this method of burning fossil fuels has been proven to be very stable, it has also led to the increase of damaging air pollution by releasing gases such as Carbon dioxide (CO₂), Carbon monoxide (CO), Sulfur dioxide (SO₂), Nitrogen oxides (NO_x), Particulate matter (PM), and "heavy metals such as mercury" also known as "soot" ("Electricity and the Environment"). Because of the mass production of the fossil fuel burning method and continuous gas being released into the air, it has caused global climate change that, in the not too distant future, can permanently damage earth's natural ecosystem. Even if the global temperature average rose by 1 centigrade, the world could encounter serious consequences ("Air Pollution"). "Possible consequences include melting of polar ice caps; an increase in sea level; and increases in precipitation and severe weather events like hurricanes, tornadoes, heat waves, floods, and droughts. Indirect effects include increases in infectious disease, weather-related deaths, and food and water shortages" ("Air Pollution"). Additional results of these consequences are added "stress on ecosystems and agriculture, and threaten our planet as a whole" and "urban smog and reduced visibility, associated with ozone-forming nitrogen oxides and volatile organic compound emissions" ("Air Pollution"). Currently rare occurrences, such as acid rain, will become much more common. Acid rain, in particular, "is detrimental to forests and other vegetation, soil, lakes, and aquatic life" and will also cause "monuments and buildings to deteriorate" ("Air Pollution"). This will greatly affect earth's ecosystem and will be detrimental to the way we currently grow and raise foods. Because of these consequences, it is said that "We currently rely on an energy system that's incapable of

taking us to into the future” (“The Energy Challenge: We're at a Critical Point”). In fact, about “35% of our climate pollution comes from electricity generation” and about 150 billion dollars are lost per year because of power outages and blackout in the United States alone (“The Energy Challenge: We're at a Critical Point”). The current form of creating energy is not only harmful to the environment, but it is also harmful to public health in numerous ways (“Clean Energy Is Ready to Power the Future”). The Environmental Defense Fund (EDF) explains that:

Air pollution is one of the world’s largest killers, responsible for 6.4 million deaths per year [...]. This is three times higher than the number of deaths from AIDS, Malaria and tuberculosis combined. The World Health Organization estimates that 2 billion children live in areas where outdoor air pollution exceeds international limits. In addition, they estimate that 300 million children live in areas where outdoor air pollution exceeds 6 times international limits. Children, the elderly, and people with heart or lung disease, diabetes, minority and low - income communities are particularly vulnerable to adverse health outcomes from exposure to air pollution, including cardiovascular disease, asthma and other respiratory diseases, and cancer. Recent evidence suggests that air pollution is also linked to higher risk of diabetes, autism, and lower IQ (“Health Impacts of Air Pollution”).

The situation used to be even worse when coal plants were more in use; nowadays, there are still some coal plants that the EDF are trying to retire (“Clean Energy Is Ready to Power the Future”). With all these facts and risks being stated, energy companies should not be allowed to use this method to generate electricity. This is because this method, if repeated many times and for prolonged periods of time, damages the environment and all of humanity, as society has seen within the last few years. Because part of an engineer’s job is to innovate and make people’s

lives easier or, in some way, better their lives, then an engineer should not create a device or method that would harm humanity in any way.

Inventions like lead paint and the fossil fuel method have caused some engineers to try and come up with a new invention that will either reduce or eliminate the negative effects of older damaging inventions. In the past, this has not only helped people and the environment, but it has also helped some businesses increase in popularity which has increased their profits. That being said, it is in the best interest of society and a company that engineers create something that will help, and if not help then not harm, people and/or the environment that others live in. A relatively new and increasingly successful company named Tesla has been doing exactly that. Since the early 2000s, Tesla's mission has been to "accelerate the world's transition to sustainable energy" ("About Tesla"). Because of this well received mission statement, Tesla is now one of the most well-known companies to develop new efficient, clean, and sustainable ways to create and use energy that has minimum to no emissions in both the products they create and even during the manufacturing process of those products. One of the products that Tesla is known for are their unique automobiles; in fact, the original engineers, Martin Eberhard and Marc Tarpenning, pitched the company to Elon Musk as a fully electric automobile manufacturer (Baer).

Tesla was founded in 2003 by a group of engineers who wanted to prove that people didn't need to compromise to drive electric – that electric vehicles can be better, quicker and more fun to drive than gasoline cars. Today, Tesla builds not only all-electric vehicles but also infinitely scalable clean energy generation and storage products. Tesla believes the faster the world stops relying on fossil fuels and moves towards a zero-emission future, the better ("About Tesla").

Tesla has successfully taken a worldwide issue and found a solution that they hope many people will implement into their everyday lives. They have also decided to try and tackle another global issue of a clean and sustainable energy source. Tesla has invested in solar energy and, while collecting solar energy and the invention of solar panels are not necessarily new, they have managed to innovate the technology and make it more efficient and aesthetically pleasing.

Tesla also produces two energy storage products, the Powerwall home battery and the Powerpack industrial-scale battery. In 2016, Tesla became the world's first vertically-integrated sustainable energy company with the acquisition of SolarCity, the leading provider of solar power systems in the United States, and in 2017 released Solar Roof – a beautiful and affordable energy generation product (“Elon Musk”).

This example of Tesla shows that a company focused on clean energy can be very successful while still being able to innovate and develop new and successful designs. Not only is this very good for the company, but it is also very good for the consumer because they are helping the environment, and ultimately themselves, by not doing any harm to it overtime. These inventions would also be considered very ethical because it is not hurting the environment and/or user.

The idea that an engineer's top priority should be to create a system with minimum to no negative effects will cause many problems than it is worth. That being said, an engineer's top priority should not be to create a system with no negative effects but to create the best system possible with the available technology. To try and create a new system that has zero to very minimal negative effects will take a lot of money and time for a product that may not even be worth it in the end. It would take a lot of time because the new system/methods would have to be checked for extreme health and environmental damage; thus increasing the time it take from designing and creating a prototype to full scale production. If this extreme testing became a

standard in the industry, then the consumer would see a drastic increase in time for products to be released from the time they were announced. It is an engineer's job to innovate and help society in that way. By allowing them to innovate freely, engineers are going to be able to innovate more quickly and effectively which, in turn, will better society. This will also allow engineers to solve previous problems that have occurred in the past. The innovation of automobiles is a great example of a system that has been improved. Compared to the vehicles manufactured in the 1970's, there has been huge decrease in the amount of damaging pollutants released into the air by automobiles. In fact, vehicles are now about 99% cleaner since "Congress passed the landmark Clean Air Act in 1970 and gave the newly-formed EPA the legal authority to regulate pollution from cars and other forms of transportation" ("History of Reducing Air Pollution from Transportation in the United States"). Because of the legal push for cleaner air and less air pollution from automobiles, multiple industries exploded with innovation which then created a much healthier system.

EPA vehicle emissions standards directly sparked the development and implementation of a range of technologies. The [sic] automotive catalytic converter, in particular is considered to be one of the great environmental inventions of all time. Emissions standards led to the adoption of many modern automotive technologies—computers, fuel injection, and on-board diagnostics—resulting in cars that are not only much cleaner, but also higher quality, more reliable, and more durable. The vehicle emissions control industry employs approximately 65,000 Americans with domestic annual sales of \$26 billion ("History of Reducing Air Pollution from Transportation in the United States"). This example shows that innovating pre-existing systems that are already in widespread use is very beneficial. This innovation happened because the engineers were allowed to innovate and,

even though it still may not be perfect, the health of the environment and people have greatly increased because of this innovation. If the goal of engineers were to create a system with no or minimal negative effects, then gasoline or diesel powered automobiles would all be replaced with electric powered systems, which have only relatively recently been invented. In fact, if from the very beginning engineering was only about making a healthy system, then automobiles would have never been invented; or they would have at least been banned soon after their creating because of the negative health effects old automobiles had. All of these facts show that innovation and an engineer's intentions should not only be about minimizing negative results, but should focus on improving systems to keep moving society forward.

There is an agreeance within the engineering industry that there should be innovation and there should be a push to create or improve something, whether that be a method or object. However, can it really be considered innovation if the "improvement" ends up negatively affecting the user or environment? As previously stated in the NSPE code of ethics, "[...] the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare" ("Code of Ethics"). This is because an engineer's actions impact people's lives directly. That being said, a big part of an engineer's job is to make people's live better or easier with their method or device. By, even indirectly, harming the user or other people, the engineer is not practicing their job correctly; the engineer is causing more harm than improvement. Therefor causing whatever they create to not be considered innovation; in other words, innovation only has value if it's good for society.

An engineer's job is to innovate and improve a device or method to better help humanity and the environment. Many engineers agree that to fix the problems society currently has, people and engineers will have to change. This means that they will need to change things within their

everyday lives; driving an electric car instead of a gasoline or diesel car for example. Relatively small changes like this will, in the long run, help society. Innovative, effective, and ethical devices, like the tesla automobiles, and methods, such as using solar power, are increasing in popularity constantly. In fact, a sustainable energy source is not only wanted by many engineers and people, but will soon be needed if society continues to damage the planet. Therefore, engineers all around the world should always keep ethics in mind when creating a device, method, or simply innovating current technology.

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