The VW Software Scandal

An Ethical Review

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INTRODUCTION

My name is Vanessa Ulloa and I am currently a student and Senior at California State University Monterey Bay where I am majoring in Computer Science. While I am not a direct member of the Monterey Bay community, I am still a resident of California and I reside in Southern California near Los Angeles, California. I have grown up and lived in other places including Pomona, California and Roanoke, Virginia and been to many places in-between such as Florida and various parts of Texas. However, the consistency in which I grew up with and learned modern technology and how it applies to the world has not changed. This current class CST 373 which covers Ethics and Current Issues in Communication and Technology has give me the ability to see new perspectives in technology and its global applications.

Scandals such as the Volkswagen software that produced fake emission results are important to discuss and understand because as future Software Engineers my classmates and I will have an ethical responsibility to our fellow citizens and inhabitants of the world. I also have two younger cousins that attend California State University Monterey Bay and they are majoring in Biology and Criminal Justice, I think about how any software or technology I work on the future could impact their lives in a very positive or negative way.

This paper will allow us to look at the VW Scandal issue up front and also on an ethical level. This issue is important because it shows how software can be used in a non-positive way and effect many people. The pattern with these types of scandals shows the idea that such unethical behavior in software development is socially acceptable and possibly encouraged in order to achieve a particular goal. The culture of Volkswagen is known to be strict and aggressive where “[a]ll cars at the headquarters should, according to the rules, be parked facing

the same way." (Ewing & Bowley, 2015) This raises the question of corporate culture and the impact on responsible and ethical decisions in the workplace.

HISTORY

In 1999 the Environmental Protection Agency established new Tier 2 rules to replace the old rules (Tier 1) on NO_x emissions in the United States. According to the EPA "Nitrogen dioxide (NO_2) is one of a group of highly reactive gasses known as 'oxides of nitrogen,' or 'nitrogen oxides (NO_x)'." (EPA, n.d.) NO_x is dangerous because it contributes to the formation of ground-level ozone and adverse effects to the respiratory system. The EPA has been setting and reviewing NO_x emission standards in the United States since 1971. The changes made in 1999, the new Tier 2 rules, decreased the NO_x limit from 1.0 g/mi to .07 g/mi in the United States. The allowed phase in period for this new rule was supposed to occur from 2004 to 2009.

In response Volkswagen suspended sales of its current diesel vehicles in order to allow for development of new technology to comply with the new U.S. standards. It was also during this time, in 2007, that Volkswagen was allegedly warned not to use the cheating software that would provide false emission results when the diesel cars were tested. The software that was written was intended only for "test purposes only and not for normal road driving." (Arvinth, 2015) As a result, several countries aside from the United States are investigating Volkswagen on their cheating software.

In 2008 Volkswagen released its new Clean Diesel Cars and cars with the emission cheating software began to sell in the United Kingdom and in 2009 the EPA's Tier 2 emission rule officially took effect and Volkswagen Clean Diesel Cars were beginning to sell in the

United States. As a result of its new Clean Diesel Cards Volkswagen received the Green Car of the Year award for their 2009 Jetta TDI and their 2010 Audi A3 TDI, these awards were later taken away from Volkswagen in 2015 due to the being fitted with emissions cheating software. Aside from receiving awards, car owners also received tax breaks due to the "environmentally friendly" diesel vehicles, much like tax breaks received for driving a hybrid vehicle.

There were early warnings to this issue, in 2011 a report was published by the European Commission's Joint Research Centre which found that the diesel cars substantially exceeded the European emission standards, however after a warning issued in 2013 no action was taken despite the Centre's findings. In 2014, using a portal emissions measurement system, two students a professor began testing vehicles under road conditions. The three vehicles, which were certified at a California Air and Resource Board prior to testing, all exceeded U.S. emission limits by a "'factor of 15 to 35' while the Passat exceeded the limit 'by a factor of 5 to 20'". (Volkswagen emissions scandal explained, n.d.) The students and professor repeated their testing and concluded that there was no mistake on their part, the emissions had exceeded not only European emissions standards but also those of the United States as set by the Environmental Protection Agency.

The International Council on Clean Transportation is a "nonprofit that tries to provide independent science to government agencies that regular the government." (Glinton, 2015) The team at the University of West Virginia consisting of one professor and two students was hired by the ICCT to do emissions tests on Volkswagen diesel cars. The accusation that a giant such as Volkswagen was cheating the emissions testing was a bold claim, however the data collected while driving the Diesel cars was unmistakable.

In September of 2015, the EPA notified Volkswagen that their Diesel cars were in violation of United States EPA emission standards. The EPA alleged that 482,000 cars were affected including "VW-manufactured Audi A3, and the VW models Jetta, Beetle, Golf and Passat." (Hotten, 2015) However, Volkswagen has admitted to over 8 million additional cars in Europe having the cheating software installed. The firmware that was installed on the vehicles was able to detect when the vehicle was being tested and would produce appropriate emissions outputs that complied with U.S. EPA and European allowable standards. However, when the vehicle was on the road there were no controls in place to control the emissions resulting in emissions that exceeded the allowable limits. By suppressing emission controls while driving, the vehicles typically had better fuel economy despite breaking many laws in the process.

For over a year Volkswagen denied any wrong doing and instead "insisted" that the testing results were a result of "technical glitches." (Volkswagen emissions scandal explained, n.d.) Finally, after the results of professor and the two students was verified and replicated by the EPA Volkswagen admitted the use of a that it built "'defeat device' software into a half-million of its diesel cars from 2009 to 2015 that automatically cheated on U.S. air-pollution tests." (Plungis & Hull, 2015) As a result, Volkswagen could face heavy fines, jail time for its high ranking executives.

Volkswagen's solution to this problem, aside from a public apology, was to make plans to retrofit up to 11 million vehicles effected by the cheating software and to recall vehicles as well. In order to cover the cost of the recall, Volkswagen has set aside "€6.7bn [or] (£4.8bn)." (Hotten, 2015) However, the total cost of the scandal could go up to "$37,500 for each vehicle that breach[ed] standards - a maximum fine of about $18bn." (Hotten, 2015) The scandal also raised questions on the emissions tests and results of Volkswagen vehicles and their CO_2

emissions. The Chief Executive and head of American Operations have both stepped down, Martin Winterkorn and Michael Horn and German Chancellor Angela Merkel is urging all the facts to come to light to make the full story and case as transparent as possible.

There was much speculation that the ambitious culture at Volkswagen was party to blame, the race to be number one in car sales and "betting on diesel-powered cars – instead of hybrid-electric vehicles" (Hakim, Kessler, & Ewing, 2015), may have had some part in the cheating software scandal. The United States has strict standards on emissions as set by the Environmental Protection Agency and also strict mileage standards as set by the Obama administration and while Diesel engines offered better mileage they produced more pollutants. Fortunately, there was technology available that would allow for dangerous fumes such as nitrogen oxide to be neutralized, however this would require a specific fluid called BlueTec to be refilled periodically causing inconveniences to the drivers. However, this idea was scrapped by Volkswagen.

Media Views

The Volkswagen scandal is represented as a major Car Company falsely claiming that their Clean Diesel Cars meet emissions standards not only in Europe but also the United States. There are many questions on who will bear the real responsibility of the scandal. The CEO of Volkswagen and the head of the American Operations have both resigned, however Horn (the head of American Operations) maintains that he only was informed of the defeat device a month prior to his Congressional Hearing. The Volkswagen Chairman has also claimed that the scandal was a result of a "chain of errors" and places it on the "company as a whole rather than a handful of rogue engineers." (Domonoske, 2015) At the same time, however, Volkswagen has "blamed a

small group of engineers for the misconduct, and has said that members of its management board did not know of the decade-long deception." (Ewing & Bowley, 2015)

There have been many previous cases of "defeat devices" being installed in vehicles in order to bypass emission standards. For example, in 1973 five separate car companies had to remove ambient temperature switches that effected emissions, in 1996 General Motors paid a fine of "$11 million, and recall[ed] 470,000 vehicles, because of ECU software programmed to disengage emissions controls during conditions known to exist when the cars were not being lab tested by the EPA." (Volkswagen emissions scandal explained, n.d.) In 1998, Honda Motor Company had to recall vehicles to fix a misfiring monitoring device and Ford paid almost eight million dollars to fix a form of cheating software on their vehicles as well.

There is no clear indication yet on whether the cheating software was developed as a result of direction from ranking officers in the Volkswagen corporation or if it was the result of "rogue engineers" as Volkswagen claims. The company also continues to maintain:

> "that only a small group of people were actively involved in designing and installing software that allowed diesel vehicles to cheat on emissions tests. But Pötsch said systematic issues — including, in some parts of the company, a tolerance for rule-breaking — allowed the deception to go undetected." (Domonoske, 2015)

The stories being told in various media outlets focus on the high ranking Volkswagen corporate officials and their alleged role in the scandal and subsequence cover-up. There is not a lot of mention of the Software Engineers themselves except where Volkswagen claims that Engineers did this of their own accord. However, such a claim would bring into question the practice of software validation at Volkswagen. Even if a handful of Software Engineers when "rogue" and

created emission cheating software, how was it validated to maintain the deception? How did such software go past quality assurance workflows and reviews?

The media stories in Europe and the United States do not show a particular bias and Germany will now be conducting "follow-up tests by the state motor transport authority KBA to double-check the results of exhaust tests ordered by the manufacturers." (German to tough rules after VW scandal, 2015)

OTHER VIEWS

Others affected by this issue aside from Governments and Government agencies such as the EPA would be the car consumers. Cart buyers rely on information provided by car companies in order to accurately make a decision on which vehicle they wish to purchase. This also effects many people, whether or not they own and operate a Volkswagen vehicle, who have respiratory problems that can be linked to ground-level ozone. Many conditions include asthma, bronchitis and emphysema. Many environmental consequences can also occur because of increased emissions and many environmental groups would be interested in how this scandal will develop as far as how the corporate will react and how governments will react as well.

As of September 2015 at least "34 class-action lawsuits had been filed in the U.S." (Volkswagen emissions scandal explained, n.d.) I believe the main concerns for consumers will be the effects on health due to the increased emissions and also the effects of the scandal on the retail value of their vehicles. Since consumers were falsely lead to buy Clean Diesel Cars and with the new information that these cars are in fact not environmental friendly this could adversely affect the value of the car and if the car own decides to sell their vehicle.

This issue is non-specific to one specific class or race of people, it affects all vehicle owners and any person around cars that release too much nitrous oxide. However, lower socio-economic groups might be more adversely affected health-wise if those groups or individuals are unable to afford the proper medical treatment or know how to receive information on how to participate in the class-action lawsuits present and future against Volkswagen.

The dissenting viewpoints mainly stem from Volkswagen ranking officials. According to Volkswagen, the scandal was a result of "rogue" engineers and according to newly appointed Volkswagen CEO Matthias Mueller this was all a "technical problem" and a "[mis]interpretation of the American law." (Glinton, 'We Didn't Lie,' Volkswagen CEO Says Of Emissions Scandal, 2016) Mueller also continues by stating that "[they] had some targets for [their] technical engineers, and they solved this problem and reached targets with some software solutions which haven't been compatible to the American Law." (Glinton, 'We Didn't Lie,' Volkswagen CEO Says Of Emissions Scandal, 2016) Mueller, however, continues to deny that there is an ethical problem or dilemma.

Ethical Perspectives

In terms of ethical perspectives, Social Group Relativism absolutely applies here. There was been much criticism of Volkswagen's corporate culture and how ambition to be number one and the best outweighed the decision to "do the right thing". For example, if engineers were pressured for a solution to tighter emissions standards in the United States as set by the EPA that ultimately reflected their job performance and future at the company then a defeat device and cheating software might have been the easiest way to solve a Corporate Problem at the cheapest cost. More expensive solutions such as BlueTec would have no only cost more money but also

forced drivers to spend more time in car maintenance. However, it is more likely that a decision was handed down from senior staff as the process of software design, implementation and validation takes a large group of people and if the culture supported such behavior then this type of behavior becomes acceptable.

Globalization also plays a part, since the emission standards are not the same internationally then large companies must find solutions in order to play as many markets as possible. In the United States the EPA has set stricter emissions standards than Europe and therefore made it more difficult for companies such as Volkswagen to sell Diesel cars in the United States. The only path to passing the emissions standards was to essentially fake it and write software that would display what the EPA wanted to see versus what it was actually producing on an actual road test. This would push toward Volkswagen's goal of encouraging Clean Diesel cars to compete with other car company's hybrid vehicles. In that sense it falls also under Egoism or Self Interest Perspective. The goal of making the high profit goal by selling Diesel cars in the United States outweighed the cost and time it would have taken to properly research and implement the technology to produce safer emissions and meet standards.

The culture at Volkswagen who witnessed the management style of the former CEO Winkterton, said he was "known for publicly dressing down subordinates and occasionally banging are parts on tables to emphasize a point." (Ewing & Bowley, 2015) This type of leadership would encourage an environment where Social Group Relativism can flourish negatively. Along with that perspective is also a sense of fear, fear of being treated publicly this way by a senior staff member or even fear of staying employed at the company. Some have even gone as far as to describe Volkswagen as "North Korea without labor camps." (Ewing & Bowley, 2015)

FUTURE CHALLENGES

In the future as emissions standards are constantly being revised and made stricter and there is a push to move away from gasoline and diesel fuels there will be more scandals and issues trying to meet these standards. With hybrid vehicles growing the automobile market there is more stress on car manufacturers to build gasoline and diesel vehicles of the same caliber when it comes to being "green". There will also be a challenge for other major car companies to maintain their reputation due to the action of other car companies.

The main issue can be that Diesel fuel can have dangerous consequences on our health and our environment. Many results of the exhaust fumes are carcinogenic or cancer causing agents and many of these agents such as nitrous oxide exists at well above legal limits in some European cities. One problem is that "a lot of people remove these filters to improve fuel economy and performance." (Anderson, 2015) Technically it is not illegal to remove these filters but the vehicle will fail any future testing. It is suggested that such air pollution can cause thousands of deaths prematurely. In a recent study by the Department for Environment, Food & Rural Affairs up to 23,500 deaths in in the UK were attributed to nitrous oxide. (Anderson, 2015) The associated medical costs total in the UK to about $86bn in 2010.

There is also the issue of carbon dioxide emissions, it is claimed that Diesel engines produce less carbon dioxide and have better fuel economy and one can conclude that this would mean less emissions. However, "largely due to the fact that diesel cars tend to be bigger and heavier than petrol cars, so any advantages in efficiency are wiped out." (Anderson, 2015) In the United States not as many diesel engine cars are available as compared to Europe partly due to the stricter emissions standards the EPA has set for car manufacturers. In the United States the

cost of Gasoline and Diesel is much cheaper than Europe, which causes less of a need for non-gasoline powered vehicles.

A solution to this problem would be to find alternative fuel sources. According to Elon Musk in response to the Volkswagen scandal, "[w]hat Volkswagen is really showing is that we've reached the limit of what's possible with diesel and gasoline." (Kaufman, 2015) Elon Musk runs his own electric car company, Tesla which uses rechargeable Lithium-Ion batteries instead of gasoline or diesel. Vehicles like this obviously pose a greater effect on our health and environment than emission creating fossil fuels.

My Reflections

My attitudes up front toward this issue were of shock and surprise. I had trouble believing that Software Engineers voluntarily participated in a scheme that affected millions of car owners and the resulting environmental and health effect. I currently work in the medical manufacturing field where we have many rules set by not only the FDA but also foreign governmental medical bodies such as the TUV that oversee our devices and what standards we build them too. Since we ship our products internationally and they are for health purposes I make it a part of my job to ensure we comply with those rules and not participated in unethical activities.

However, as I did more reading into the corporate culture at Volkswagen and I can imagine the fear employees might have felt in trying to solve the issue of meeting American emissions standards I could understand if some engineers could have been persuaded to go along with this. Fear is a powerful motivator and so is unemployment. Volkswagen accounts for a large

number of employment in Germany so there is a far-reaching affect. My views softened a little as I can understand that type of fear despite not doing the right thing.

The corporate culture I am used to is nothing like the strict environment of Volkswagen and that would fall under one of my recommendations. Having an open environment that is not limited by fear can produce great results. Rules are important, however, but if an Engineer sees unethical behavior there should be no fear or shame in reporting it. I recommend a culture change and, if there aren't any, safeguards against the supposed "whistleblowers" in the company where they can report unethical activity (even anonymously) and not be at risk for losing their job. I do not know the process of which such firmware is validated to be installed on so many vehicles, but if the process did in fact miss the actions of a few "rogue" engineers, then there should be a restructuring of how that quality system works.

Quality systems are the backbone at which our products are declared reliable and safe for use whether it be for medial and human use or determining the lasting environmental impacts. Profits are important for a business to succeed and prosper but while money will be made up front it can cost more in the end and that is price of deception. In all my reading I saw a lot of pointing fingers, so it is still a little unclear on who the real culprit or culprits are and which that knowledge it can be better determined how to improve and move forward. To start, I recommend a change to the culture of the company and a review of the Quality Systems used to validate the software and firmware and other aspects of the vehicles as well. I did read an article on Germany making their emissions standards stricter, which would have been one of my recommendations as well.

Overall, I highly disagree with the actions taken by Volkswagen and their software development teams in this case and that better care should be taken in the future to comply the rules set by Government agencies despite the time and cost it might take over what profits can be made now.

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