

An Inquiry into How Company Culture Influenced the Volkswagen 2015 Emissions Scandal

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Introduction

Volkswagen is renowned as a global powerhouse in the automobile industry. The automaker commanded 12% of global market share in 2017, touting internationally recognized brands including Audi, Lamborghini, and Porsche (Volkswagen Group deliveries, 2017). Its success has been in part due to an ambitious strategy called “Strategy 2018”. Launched by then-CEO Martin Winterkorn in 2007, Strategy 2018 focused on three aspects: increasing annual unit sales, improving quality and customer satisfaction, and strengthening VW’s position as a top employer. To distinguish itself, Volkswagen leveraged its “attractive and environmentally friendly” automobiles, advertising “clean diesel” technology and other innovations (Blackwelder, “The Volkswagen Scandal”, 2018, p. 5).

In 2013, the International Council on Clean Transportation (ICCT) contracted scientists from West Virginia University to conduct a routine emission test on three diesel vehicles, including the Volkswagen Jetta and Passat. While conducting emission measurements on the road, the scientists discovered that the Volkswagen vehicles emitted 35 times more NO_x than U.S. regulations (Schiermeier, “The science behind the Volkswagen emissions scandal.”, 2015).

This anomalous result prompted international scrutiny into Volkswagen’s practices, revealing that Volkswagen was using sophisticated software to deceive regulators of the amount of nitrogen oxides (NO_x) emitted by its diesel vehicles. NO_x emissions are a major issue, linked to lung damage and diseases such as lung cancer or bronchitis. Furthermore, the pollutant can aggravate existing heart disease, leading to fatalities from cardiac arrest (Oldenkamp, “Valuing the human health damage [...]”, 2016).

This paper offers an ethical analysis of the actions of Volkswagen's employees and management in the Volkswagen emissions scandal. This case study is important because it illustrates how obsessively growth-minded company cultures may compromise important engineering design decisions, especially in the face of strong economic and political duress for the company. It also highlights the potential for powerhouse companies like Volkswagen to refuse acknowledging existing faults, jeopardizing the trust of consumers and government regulators in the process. Volkswagen's cultural environment condoned an attitude of unethical self-interest, encouraging the cheating of emissions regulations and the mischaracterization of Volkswagen vehicles as environmentally friendly. Although Volkswagen has since attempted to rectify this attitude, placing a greater emphasis on ethical conduct in the workplace, more needs to be done to enforce ethical decision making in the company.

We use the Institute of Electrical and Electronic Engineers Code of Ethics and the Volkswagen Group Code of Conduct to objectively evaluate Volkswagen's actions. We consider the former because the scandal revolves around software designed by electrical and computer engineers, and the latter in order to evaluate the change in conduct within Volkswagen post scandal. Tenets found in each code, such as Tenet Three in the IEEE Code of Ethics, "To be honest and realistic in stating claims or estimates based on the available data," are pertinent to the scandal and will prove consequential in developing a thorough case for or against Volkswagen's conduct ("IEEE Code of Ethics," n.d.).

This paper begins with the chronological development of the company during Strategy 2018. It describes the events that led to allegations of Volkswagen cheating on emissions testing, followed by an examination of the Volkswagen scandal's fallout, and the actions taken by

Volkswagen to improve corporate culture. Finally, the paper discusses the various ethical violations of the Code of Conduct committed by Volkswagen's engineers and management and outlines the extent of Volkswagen's ethical changes since the scandal.

Martin Winterkorn Outlines a New Plan, and a New Volkswagen

In 2007, Volkswagen's new CEO, Martin Winterkorn, laid out a new plan called "Strategy 2018". His vision was to make Volkswagen the number one automaker in the world, overtaking General Motors and Toyota. This plan would set the company culture and mindset in the years leading up to the scandal.

Volkswagen Launches Strategy 2018

Winterkorn highlighted several points on how to increase the sales on Volkswagen's brands in key areas such as the U.S., Russia, and China (Muller, "How Volkswagen Will Rule the World", 2013). Among them, his defining policy, "Strategy 2018," outlined a need to increase customer satisfaction through better innovation and quality, achieve a consistent profit, and become the top employer across all brands to recruit engineers for enhancing innovation (Blackwelder, 2018, p. 2).

Specifically, Winterkorn wanted to increase sales by more than 10 million vehicles per year through quality and customer satisfaction. Increasing sales would provide the company financial security during difficult times. Due to the decline in the European automobile market, Volkswagen needed to focus on increasing sales in profitable regions like the U.S., China, and Russia. Volkswagen also planned to become a top employer across all fields by attracting talented individuals who will help ensure the long term quality of Volkswagen's innovations and technology (Blackwelder, 2018, p. 2). Consequently, Volkswagen employees increased by almost 50% from 2008 to 2012. ("Volkswagen 2012 Annual Report", 2012).

Volkswagen Charms the Public to Expand and Gain Recognition Overseas

To achieve its sales goals, Volkswagen engaged in a large public campaign to improve its public image. In 2010, Volkswagen launched its “Think Blue” campaign in Europe, which was “intended to educate the masses about eco-friendly practices that can be applied in daily life” (Stoklosa, “Volkswagen Unveils ‘Think Blue’ [...]”, 2011). The following year, Volkswagen obtained the Leadership in Energy and Environmental Design (LEED) certification at their new factory in Chattanooga, Tennessee, signifying that the factory met environmental standards and was equipped to reduce waste. Additionally, Volkswagen partnered with the Museum of Modern Art to increase its involvement in social and cultural issues (Kurylko, “VW launches Think Blue [...]”, 2011).

Volkswagen also launched a series of commercials advocating for their new “clean diesel” technology. In 2009, Volkswagen launched a “Truth or Dare” initiative, debunking diesel myths on television. The company also aired advertisements to promote diesel vehicles (Pemberton, “VW’s Clean Diesel Ads [...]”, 2015). As a result, the Volkswagen Jetta received the “Green Car of the Year” award in 2009. Volkswagen’s diesel vehicles seemingly met the U.S. standards, providing an alternative to the pricey hybrids of its competitors. The growing popularity of Volkswagen “clean diesel” vehicles enabled Volkswagen to successfully establish a foothold in the American automarket (Groom & Krolicki, “Volkswagen diesel car wins ‘Green Car of the Year’”, 2008).

Implications on Corporate Culture

To meet the ambitious goals of Strategy 2018, the employees were forced to adapt to a new corporate culture. The executives and management became increasingly aggressive about

goals and deadlines, pressuring workers and engineers to produce results more efficiently. This attitude created an environment well known for “eschewing debate and dissent,” creating a cutthroat and autocratic work environment. It caused workers to remain quiet about questionable company decisions in “fear of being excluded from the company’s generous bonus system” (Rhodes, “Democratic Business Ethics [...]”, 2016, p. 1511).

Volkswagen Steers Itself into a Precarious Situation

In 2013, the International Council on Clean Transportation (ICCT) commissioned a study from West Virginia University (WVU) to measure three diesel cars’ emissions as part of a larger campaign to investigate on-road emissions compliance from a broad set of vehicles (Franco, Sánchez, German, and Mock, 2014, p. 2). WVU subsequently discovered emissions violations from two Volkswagen vehicles, prompting the California Air Resources Board (CARB) and the EPA to lead probes into Volkswagen and accuse them of evading regulations.

Volkswagen Discovered Cheating Emissions Regulations

The team at West Virginia University utilized portable emissions measurement systems (PEMS) in order to conduct on road testing of diesel vehicles. According to the researchers’ report, the use of PEMS allowed for the comparison of different emissions control systems in regards to nitrogen oxides against standards set by the EPA and CARB. The researchers investigated emissions output across a wide variety of road conditions, in contrast to the laboratory settings of compliance testing (Thompson, et al., "In-Use Emissions Testing of Light-Duty Diesel Vehicles [...]", 2014, p. ii).

The results of WVU’s study provided an unexpected conclusion: real-world testing of the vehicles produced NOx emissions exceeding the EPA Tier 2 Bin 5 standard of .07 grams per mile for full useful vehicle life, by up to 35 times for the Volkswagen Jetta, and up to 20 times for the Volkswagen Passat (Thompson, et al., p. 106). The report was deferred to the EPA and CARB, who then conducted independent tests to verify the anomalous data. The two institutions’ subsequent investigations discovered that the scope of emissions noncompliance consistently spanned a wide range of vehicles listed in Table 1 (Brooks, “Re: Notice of Violation”, 2015), suggesting that this issue was unlikely to be caused by ignorance.

Table 1: A listing of all affected vehicles identified to contain “defeat devices” (Taken from Brooks, p. 5).

Model Year	Make and Model(s)
2009	VW Jetta, VW Jetta Sportwagen
2009	VW Jetta, VW Jetta Sportwagen
2010	VW Golf, VW Jetta, VW Jetta Sportwagen, Audi A3
2011	VW Golf, VW Jetta, VW Jetta Sportwagen, Audi A3
2012	VW Beetle, VW Beetle Convertible, VW Golf, VW Jetta, VW Jetta Sportwagen, Audi A3
2012	VW Passat
2013	VW Beetle, VW Beetle Convertible, VW Golf, VW Jetta, VW Jetta Sportwagen, Audi A3
2013	VW Passat
2014	VW Beetle, VW Beetle Convertible, VW Golf, VW Jetta, VW Jetta Sportwagen, Audi A3
2014	VW Passat
2015	VW Beetle, VW Beetle Convertible, VW Golf, VW Golf Sportwagen, VW Jetta, VW Passat, Audi A3

In November 2015, the EPA issued a formal Notice of Violation (NOV) regarding the Clean Air Act of 1963 to Volkswagen. The EPA asserted that Volkswagen had knowingly and purposefully designed defeat devices to reduce NOx emissions during regulatory testing in order to bring vehicles to market (“EPA, California Notify Volkswagen of Clean Air Act Violations”,

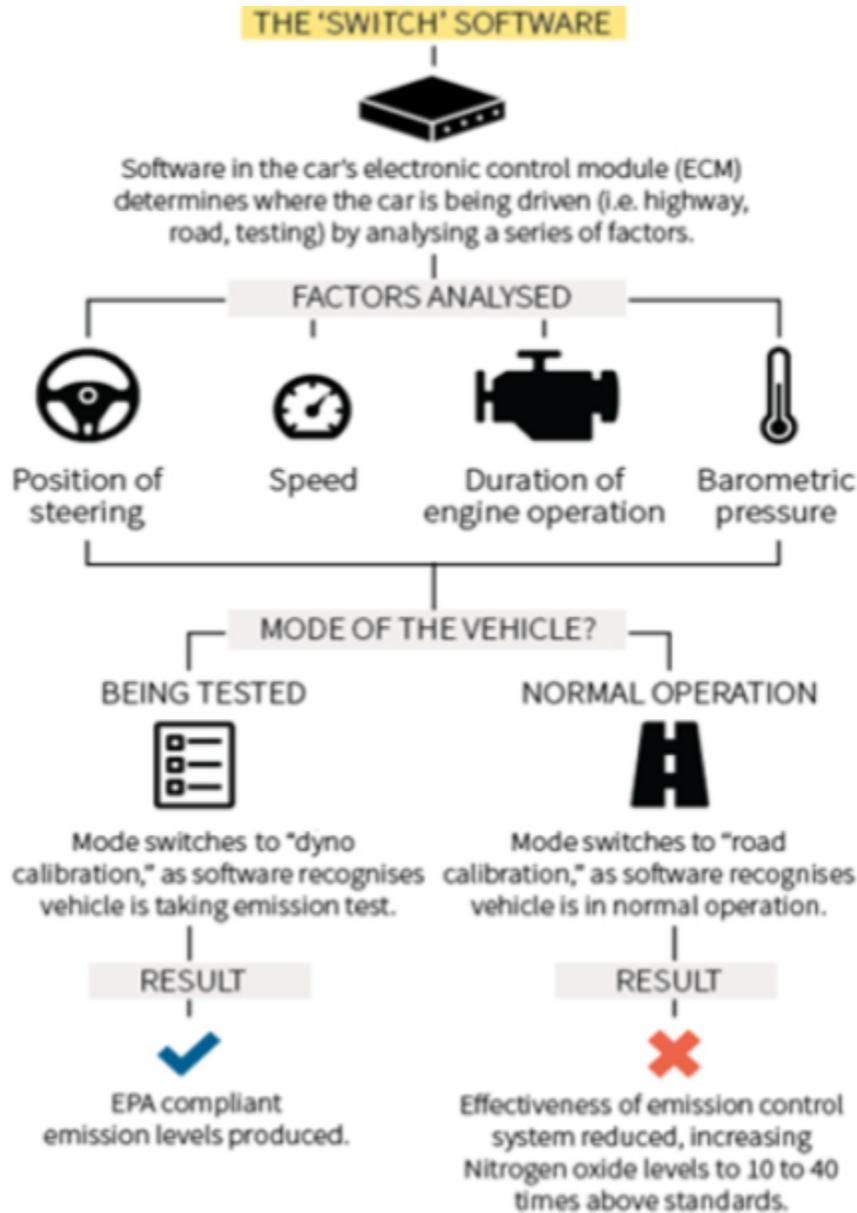
2015). Almost half a million cars were suspected to be affected, and both EPA and CARB determined that Volkswagen was violating federal and state law (Hebert, "Re: Admission of Defeat Device [...]", 2015, p. 3).

Defeat Devices explained. According to the 1963 Clean Air Act, section 203, *Prohibited acts*, a defeat device is a

component intended [...] to bypass, defeat, or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle engine in compliance with regulations[.] (Clean Air Act, 1963, sec. 203)

The defeat device in Volkswagen's case was software that allowed the car to detect whether it is in a lab environment or on the road. Figure 1 provides an illustration of how the software operates.

When the "switch" software detected that the car was in a laboratory setting using the factors shown in Figure 1, the car switched to what Volkswagen called "dyno-calibration". Dyno-calibration used a NO_x capture system, utilizing diesel fuel or urea to purge the NO_x from vehicle exhaust and significantly reducing emissions (see Appendix A for a further discussion on NO_x capture systems). However, when the software detected that the car was not being tested, it switched to "road-calibration", in which the vehicle stopped injecting fuel/urea into the NO_x capture system, rendering it useless (Brooks, p. 4). This decreased fuel consumption and promoted efficiency, but increased NO_x emissions (Gates, Ewing, Russell, & Watkins, 2017).



Source: U.S. Environmental Protection Agency

J. Wang, 22/09/2015

REUTERS

Figure 1. Diagram of How VW's Switch Software Worked (Qualsys, 2018).

Volkswagen Denies Allegations of Cheating

Volkswagen asserted that the emissions anomalies “could be attributed to various technical issues and unexpected in-use conditions” (Brooks, p. 4). However, given the comprehensive test results, Volkswagen’s excuses provided insufficient explanation for their

vehicular noncompliance. Volkswagen attempted to resolve the problem by providing a software fix; however, the fix failed to placate regulators and resulted in a full recall (Herbert, p. 2).

Additionally, well before the issuance of the Notice of Violation, it appears that Volkswagen had been consistently misrepresenting the state of its vehicles to regulators. According to a plea agreement for James Robert Liang, a key engineer of the defeat devices, Liang and other engineers lied to officials during certification meetings about the existence of defeat devices and the compliance of their vehicles (Department of Justice, "Volkswagen Engineer Pleads Guilty [...]", 2016).

After the admission of guilt, Volkswagen management attempted to distance themselves and the company from the scandal by blaming a handful of engineers. "When *Der Spiegel* reported that 'at least 30 people' were implicated in the scam, Volkswagen responded by saying that this assertion was 'completely without basis'" (Rhodes, p. 1511). In December of 2015, Chairman Hans Poetsch accused a "very limited group that acted irresponsibly", and denied involvement of upper management in the development of the defeat devices (Cremer, "VW Says Only Small Group to Blame [...]", 2015).

New Leadership Attempt to Chart a New Course for Volkswagen

After the scandal, Volkswagen was forced to recall and repair millions of vehicles globally. The scale of the scandal was massive: 11 million cars worldwide were found to have defeat devices installed, of which about 500 thousand were sold in the United States. Volkswagen was heavily impacted financially, and the public health and environment declined

from the vehicle pollution. Since the scandal, Volkswagen, under new leadership, has worked to reorient company ethics and policy, with mixed results.

Impacts of the Scandal on Both Volkswagen and the Public

In May 2019, VW CFO Frank Witter disclosed that the scandal has cost Volkswagen around \$30 billion in buybacks, legal settlements, and government reparations. This cost includes a \$4.3 billion penalty to the federal government (Department of Justice, "Volkswagen AG Agrees to Plead Guilty [...]", 2017) and a \$14.7 billion corporate settlement with the FTC and American consumers ("Volkswagen to Spend Up to \$14.7 Billion to Settle Allegations [...]", 2016).

However, these costs exclude the monetary impact caused by the dissolution of consumer trust. A study published in July 2019 by Ruediger Bachmann, et al. found that the German auto industry was impacted by the fallout, shedding \$5.2 billion in sales in 2016 ("Firms and Collective Reputation: a Study of the Volkswagen Emissions Scandal", 2019).

Additionally, Volkswagen's vehicles adversely affected public health and the environment. A study by Chossiere et al. determined that the fleet of cars with defeat devices will cause about 1200 premature deaths in Europe and cost 1.9 billion Euros ("Public Health Impacts [...]", 2017, p. 1). Diane Alexander and Hannes Schwandt demonstrated that a "10 percent cheating-induced increase in car exhaust increases rates of low birth weight and acute asthma attacks among children by 1.9 and 8.0 percent, respectively" ("The Impact of Car Pollution on Infant [...]", 2019). Tanaka et al. determined that the scandal will produce a proportionally larger impact to the climate in the short term compared to compliant vehicles ("Climate Effects [...]", 2018, pp. 5-6).

Volkswagen Changes Policy and Develops a More Sustainable Organization

In the immediate wake of the scandal, Volkswagen's new CEO, Matthias Muller, was brought in to replace Winterkorn and perform damage control. Muller sought to reorient the company by presenting his Strategy 2025. In the new plan, several key initiatives stand out: making Volkswagen's role for the environment and safety a top priority, focusing on electrifying its vehicles, and reorganizing the company's framework to encourage innovation, entrepreneurship, and change (Strategy TOGETHER 2025, 2019).

Accordingly, Volkswagen has pledged up to \$66.3 billion to facilitate electric and hybrid vehicle development within the next decade ("Volkswagen to spend €60 billion on switch to electric cars", 2019). Hiltrud Dorothea Werner was appointed to the management of integrity and legal affairs in 2017, where she has overseen the overhaul of the Volkswagen Group Code of Ethics. Volkswagen has introduced a whistleblower support program, revised its ethics training, and created an extensive integrity and compliance program Together4Integrity (T4I) (Strategy TOGETHER 2025, 2019).

Ethical Analysis of the Actions by the Engineers and Management at Fault

Since Liang's group developed the cheating software back in 2006, Volkswagen has violated numerous tenets of the IEEE Code of Ethics (Department of Justice, 2016). In particular, Volkswagen acted unethically by developing defeat devices, endangering the public and environment (Tenets 1 and 9) and by mischaracterizing the regulatory compliance of its vehicles to regulators, customers, and shareholders (Tenets 3 and 7). Consequently, Volkswagen

has needed to make a significant effort to turn around the corporate culture and make the workplace more transparent.

Violations of IEEE Code of Ethics Tenet 1 and 9

The eventual admission by Volkswagen to authorities that it had devised defeat devices to evade regulatory scrutiny shows that Volkswagen was complicit in a conspiracy to evade the law. In doing so, the engineers responsible for the defeat devices were also complicit in not upholding the IEEE Code of Ethics, in particular Tenet 1, shown in Table 2. As explored by Chossiere et al. and Tanaka et al., the Volkswagen scandal created a massive loss of life and property and contributed to the deterioration of the environment and the climate. These effects, which will be long lasting and widespread, violate Tenets 1 and 9.

Table 2: Tenets 1 and 9 of the IEEE Code of Ethics ("IEEE Code of Ethics," n.d.).

1	to hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices, and to disclose promptly factors that might endanger the public or the environment;
9	to avoid injuring others, their property, reputation, or employment by false or malicious action;

Although it is plausible that Liang and co. did not fully consider the repercussions of using a defeat device, it was evident that company culture coerced engineers to design said device despite rigorous evidence of the harmful effects of NOx emissions. The engineers and management were enabling unethical actions instead of delaying the entry of Volkswagen vehicles into the American market. In hindsight, the cost of said delay would be a pittance in comparison to the long term costs borne by the company as a result of the scandal today.

Violations of IEEE Code of Ethics Tenet 3 and 7

Through the denial of fault, shifting of blame, and misrepresentation of its cars, Volkswagen and its engineers, including the upper management, violated IEEE Code of Ethics Tenets 3 and 7, listed in Table 3. By violating these tenets, the engineers and management exposed themselves, Volkswagen, and the public to unnecessary risk had they valued safety over increased profitability. Despite the social and economic pressure Liang and co. were under, given that they “could not design a diesel engine that would meet the stricter U.S. emissions standards” (Department of Justice, 2016), their decisions should not be excused. By committing extensive fraud, the engineers failed to hold themselves to the highest ethical standards, and undermined the relationship between the public and the profession.

Table 3: Tenets 3 and 7 of the IEEE Code of Ethics (“IEEE Code of Ethics,” n.d.).

3	to be honest and realistic in stating claims or estimates based on available data;
7	to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;

Additionally, practical incentives exist for abiding by the Code of Ethics. Following Tenet 3 would have protected the engineers from legal trouble and prevented the Volkswagen scandal entirely if they did not misrepresent their vehicles. If management had abided by Tenet 7, most of the corporate directors, being engineers themselves, would have better prevented the resulting fallout if they were upfront about their shortcomings, instead of continuing to deny involvement until the issue was prolonged beyond repair.

Ethics at Volkswagen Post-Dieselgate

Since the scandal broke, it appears on the surface that Volkswagen has made substantial progress in improving its corporate culture. Alongside internal reforms, Volkswagen has worked

externally with the Independent Compliance Auditor (ICA) directed by Larry D. Thompson, who previously oversaw the federal investigation of the notorious Enron scandal (Thompson L. D., "First Annual Report [...]", 2018, p. 33), in order to address problem areas and emphasize proper conduct in the workplace. This is a step towards improving compliance with government regulations of customers, as stressed in their Code of Conduct.

Included in this new Group Code of Conduct are various principles, such as product safety, environmental protection, integrity, transparency, and others ("Volkswagen Group Code of Conduct", 2017). These principles attempt to guide Volkswagen employees in making decisions that minimize risk among stakeholders and promote an attitude that Volkswagen is making strong efforts to become a more upright company.

However, attitudes at Volkswagen have yet to recover. Only 25% of employees surveyed "agree that corporate culture has improved" in 2018, three years after the scandal (Menzel, 2018). While former top executives have been removed, others including CEO Herbert Diess and chairman Hans Dieter Potsch remain in power despite recently being charged by German authorities for market manipulation (Thompson, M., 2019). Recently, Diess made a faux pas using the phrase "earnings before interest and taxes set you free" in an earnings call, an unfortunate resemblance to the Nazi slogan "work sets you free" (Masters, 2019). These facts suggest that there exists a schism between the workers and upper management in terms of accountability and Volkswagen has not yet lived up to its tenets of transparency and integrity in the upper management. Volkswagen has not done enough to "hold executives accountable" (Ewing, "Volkswagen's Effort to Stop Scandals [...]", 2018), at a time when Volkswagen needs clear role models to direct the company.

Conclusion

The Volkswagen scandal is arguably the largest emissions scandal in recent history. The scandal led to a massive release of NO_x, contributing to the greenhouse gas effect, as well as increasing the chances of respiratory diseases and associated premature deaths. By engineering defeat devices to cheat the stricter emissions laws in the U.S., Volkswagen also jeopardized the trust of its consumers and regulators.

The primary motivating factor in the development of defeat devices was the internal corporate pressure to make Volkswagen the world's foremost automaker, an ambitious goal set during the "Strategy 2018" period by ex-CEO Martin Winterkorn. This plan led to management being increasingly willing to take shortcuts to increase profits in key markets like the U.S., forcing engineers to either find cheaper alternatives to address higher regulatory standards, or possibly lose their jobs.

This case study shows that companies need to incorporate and enforce an established code of ethics into their work culture. Companies should always consider the ethical responsibilities of their engineers when developing business strategies such as "Strategy 2018" to prevent the prioritization of profit at the expense of the public. By incorporating a Code of Ethics into their decision making, companies are more likely to avoid scandals by shaping a culture that values safety and good design. Additionally, putting a greater emphasis on ethics could reduce potential costs from recalls and lawsuits.

After observing the role of workers and management in the Volkswagen scandal, we ask: what should be the division of responsibilities between government, companies, and engineers to uphold ethical decision making? The Volkswagen scandal revealed a lack of accountability of

engineers and management to make ethical decisions. In contrast, the recent Boeing 737 MAX scandal revealed the failure of the Federal Aviation Administration (FAA) to properly certify Boeing's planes at the expense of safety. All three branches involved in developing and certifying new products can be culpable in endangering the public. Therefore, it may be up to the individual to be his/her own self-advocate and hold ethical decision making against each of these groups to a higher standard.

Word Count: 4000 (Including Appendix A)

List of Abbreviations

CARB	California Air Resources Board
CEO	Chief Executive Officer
CLD	Chemiluminescence Detector
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
ICCT	International Council on Clean Transportation
IEEE	Institute of Electrical and Electronic Engineers
LEED	Leadership in Energy and Environmental Design
LNT	Lean Nitrogen Oxide Trap
NOV	Notice of Violation
NO _x	Nitrogen Oxides
PEMS	Portable Emissions Measurement System
SCR	Selective Catalytic Reduction
T4I	Together4Integrity
VW	Volkswagen
WVU	West Virginia University

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Appendix A

Discussion of NO_x Capture Systems (LNT and SCR)

It appears that Volkswagen, along with other auto companies, have been developing NO_x capture systems such as LNT and SCR since at least 2006. Thompson et al. investigated two SCR systems and one LNT system (the BMW, Passat, and Jetta, respectively) during their study, in which both systems were complicit in the Volkswagen scandal (Thompson et al., p. ii).

Lean NO_x Traps, or NO_x-storage catalytic converters or LNTs, use oxygen-rich chemical reactions to deposit NO onto a substrate as NO_x. However, the substrate will eventually saturate, so it must be periodically purged using the reverse chemical reaction, which involves an abundance of fuel - in Volkswagen's case, diesel (ICCT, p. 8). As a result of using fuel to scrub the substrate, LNTs are less fuel efficient in their operation than SCRs.

Additionally, LNTs have another weakness: the substrates used are also very good absorbers of sulfur oxides, or SO_x, and relatively bad at desorption. Therefore, fuels that contain more sulphur and sulphur products tend to reduce LNTs efficiencies and lifespans as their combustion products take away vital absorption area for NO_x on the substrate ("LNT: SCR'S LITTLE BROTHER", 2017).

In contrast, SCR, or Selective Catalytic Reduction, uses a catalyst, usually urea, to decompose NO_x into N₂ (nitrogen gas) and water (ICCT, p. 7). Although the byproducts of this reaction seem harmless, SCR has disadvantages in the fact that there is a need for extra storage and relevant piping and design controls to dispense and regulate urea doping. In comparison, LNT just uses the fuel itself and provides more leeway to the capacity and design of the car.

Both of these capture systems have advantages and disadvantages (particularly in the small car segment, in which LNT becomes less efficient as the vehicle size increases), making their use in the market mixed. However, that representation does not belie the fact that both are susceptible to emissions cheating. Software can be made to create different driving profiles, like uphill driving or winter driving, to increase fuel efficiency or smoothness of driving. By extension, it is not improbable that automakers make profiles for regulatory driving tests as well.