

University of Wales Trinity Saint David

Wales Institute of Science and Art



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University of Wales

Trinity Saint David

Introduction to Automotive Engineering – Technical Report

Matthew Starke

2200996

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Chapter 1 – Introduction

My car of choice for this report is the Volkswagen Golf, my reason for this vehicle is because I believe I have always had a strong interest in this vehicle, and it is and has also been a very worldwide popular vehicle for the past 20-30 years of its production. During this report my aims will be to explore and find out the different factors that may have impacted the design and manufacture process of the VW Golf, and whether these factors helped for the better or the worse in the more modern models of this car. I will explore the powertrain options used during different production models, along with different the types of materials VW pursued during their manufacturing process. I will explore and discuss the impact modern day emissions laws have had on the production of the Golf and explore why the topic of emissions is quite a touchy subject for Volkswagen as a car manufacture, and why the Golf's sales figures may have been at stake because of it.

Chapter 2 – Impact of the topics

2.1 – Topic 1 – Materials

The different body materials used in the VW Golf production would have advanced over the past 30-40 years since the original Golf was released in 1974. The original Golf, along with many generations after it would have been made with steel bodies, although this would have made for a strong a stable chassis and frame, I would have suffered with weight compared to the modern-day use of aluminium of lighter weight steels. In fact, in 2013, VW released a statement which said, “Volkswagen AG is using new high-strength steel to make cars lighter and comply with strict emissions rules, confounding forecasts that aluminium would be the metal of choice for reducing weight. High tensile steel is up to six times stronger than conventional steel, and helped Volkswagen reduce the new Golf’s weight by about 100 kg, while also saving money. Aluminium is about a third of the weight of conventional steel but costs three times as much.” (Thetruthaboutcars.com, Bertel Schmitt, 2013). This statement shows how although aluminium would be the first go to material to use to make lighter car body’s, VW clearly didn’t want that approach in order to save more in production, and pass that saving onto the consumer, whilst still making a lighter car body through high tensile steels.

2.2 – Topic 2 – Engineering Interpretation – FMEA

FMEA – Failure modes and Effect analysis. This concept is defined as a systematic method to:

1. Recognize, evaluate, and prioritize (score) potential failures and their effects.
2. Identify actions which could eliminate or reduce the chance of potential failure occurring.
3. Document and share the process.

FMEA generates a *living* document that can be used to anticipate and prevent failures from occurring.

There are 2 types of FMEA’s such as Design FMEA and Process FMEA, both of which could have been used by VW when creating the Golf to identify any issues or failures with the production of each model as they came. VW could have created an FMEA when creating the Golf to identify any failure modes which results in the car not performing in its intended function and then therefore the failure effects of these and the outcome of such a failure would have on the product such as the Golf. Moving onto identify failure causes for potential reason the failure mode could occur. Then finally current controls, any mechanisms, or systems currently in place or could be implemented to prevent the failure mode from occurring. For example, a tyre pressure warning system on a Golf can prevent the failure of tyre blowout due to low pressure etc.

2.3 – Topic 3 – Emissions

The topic of 'Emissions' to VW and their Golf is quite a touchy subject. This is due the somewhat recent 'VW Diesel Emissions scandal' that erupted back in 2015. "The diesel gate scandal erupted in 2015 after Volkswagen was found to have installed illegal "defeat devices" to cheat emissions tests. It has become one of the costliest corporate scandals in history". (Jasper Jolly, The Guardian, 2022). The 'cheat' device was fitted to the VW TDI diesel engine, fitted in quite a few VWs, although the main focus was on the Golf due to a show car advertising the car as a 'Golf TDI Clean Diesel' which was in fact not true. The system was implemented to cheat emission laws particularly in the USA. When found out, "VW announced they would recall millions of cars worldwide" at the time that had the devices fitted, and they had "set aside £4.8bn to cover costs" and pay-outs they must make affected customers worldwide. (Russell Hotten, Business Reporter, BBC News, 2015)

Although this 'scandal' was focused on VW and their diesel cars, the topic of diesel cars/engines paired with high emissions has been an ongoing topic for some years. Although this scandal only reiterating the fact of how diesels can be in fact giving out high emissions, but the cars systems create a false output for the computers. Many car makers have spent lots of time and money trying to produce and safe and environmentally friendly diesel car, although many places around want to be diesel vehicles altogether before the general ICE ban and just sell petrol ICE cars for the next few years.

2.4. – Topic 4 – Hybrid Vehicles

A hybrid vehicle is a vehicle that uses 2 or more distinct types of power, e.g., an internal combustion engine paired with an electric motor. In the VW and more importantly Golf world, the main hybrid version they offer is the GTE. This branding follows on from the sporty petrol and diesel models in the form of the GTI and GTD. The GTE brings an electric motor into play, alongside a 1.4 litre turbocharged petrol engine to produce a combined power output figure of 242 BHP, (Steve Huntingford, WhatCar magazine, 2022). Although VW do also offer a Golf eHybrid which is a hybrid version of the more standard everyday golf for everyday people, as an alternative option to the sportier GTE variant.

Some people who enjoy the automotive industry may say "hybrids are boring", although some of the most high-end super/hyper cars on the road such as the McLaren P1 and LaFerrari both have heavily incorporated hybrid powertrain systems. Even modern-day Formula One pairs a rather small, in Formula One terms, ICE engine with a hybrid powertrain.

2.5 – Topic 5 – Manufacturing

Pretty much all modern-day car assembly lines are automated, with cars slowly rolling through on a conveyor to each section of the production process, with a mixture of robotic automation and human skill and detail to manufacture each car. VW and the production of the Golf bears no exception to this at their 'State-of-the-art' car plant facility in Wolfsburg. 'The Wolfsburg plant in North Germany, HQ of the Volkswagen group, is, at 5 sq kms, one of the largest and most advanced car factories in the world. It has the largest state-of-the-art paint shop in Europe, the first to use eco-friendly water-based paints.' (Volkswagen.co.uk, 2023). This therefore resulting in the use of high-end equipment and materials in the production of the Golf to give the consumer piece of mind that their car has been made to a good quality standard, and a standard to reflect the price they have paid for their Golf. With Golf's starting at around '£26,000' in the UK, (Carwow.co.uk, Reviews, Mat Watson, 2022), the manufacturing process is something the Golf needs to strive in to have better build quality etc over competitors to justify the more premium price tag it offers over other cars in the same market. (Carwow.co.uk, Reviews, Mat Watson, 2022)

2.6 - Topic 6 – Aerodynamics/Rolling Resistance

Aerodynamics are major part of a cars final design and production. In order to help optimise performance and speed with less air resistance, whilst also helping improve fuel economy and make a car more environmentally friendly for the planet. In the case of the VW Golf, 'Volkswagen was able to lower the air drag of the Golf by developing very specific measures such as reducing the volume of cooling air (via a radiator shutter and partially closed-off radiator grille), new underbody panelling, rear body modifications with a rear spoiler and C-pillar air guides, and by developing new aerodynamic wheels (essentially closing off gaps, making the wheels flush with the car's exterior), air drag was reduced by 10 per cent.' (Volkswagen Newsroom, aerodynamics and rolling resistance, 2014)

Similarly, 'Volkswagen was able to achieve another positive effect on energy consumption and range by optimising the tyres (205/55 R16 91 Q). Reducing the rolling resistance coefficient from 7.2 per 1,000 (Golf BlueMotion) to 6.5 per 1,000 for the e-Golf (likewise an improvement of 10 per cent) also improves the range.' (Volkswagen Newsroom, aerodynamics and rolling resistance, 2014). This point, in particular, explores how the topic of a car's aerodynamics doesn't just help with possibly same 'some' fuel in an ICE vehicle, but will also assist greatly in the design and production of the modern day EV's where battery range is key!

Chapter 3 – Current state of the automotive industry

I believe the current state of the automotive industry can be seen as positive and negative depending on the type of person who is viewing it. On the one hand you have got the more environmentally friendly people in the world who believe the automotive industry is destroying our planet due to internal combustion engines and fossil fuels, and although we are currently going through a major change in the industry from internal combustion to electrically powered vehicles, this still doesn't seem to be enough to satisfy these people. The largest areas of contention and change over the past 30 years would be technological advances in vehicles themselves and the production of vehicles worldwide. The levels of tech you can get in everyday road cars these days is quite phenomenal when you look back and what cars were and what they came with 30 or so years ago. The self-driving capabilities of cars these days is getting stronger and has been a major development, particularly for certain car manufacturers such as Tesla, over the past 10-20 years. 100% fully self-driving cars aren't quite ready for today's roads yet, although based on the levels we have come in this department of the last few years, I can't see it being long before we are being driven around by fully 100% self-driving cars.

However, undoubtedly, as briefly mentioned above the biggest forced change that has come upon the automotive industry over the past 10-20 years has been the need for manufacturers and cars to become more environmentally friendly through the production of fully electric cars. This venture started off with manufacturers taking a hybrid approach to vehicles powertrains, mixing a normal internal combustion engine with an electric motor. This helped bring down CO₂ emission of the modern-day car, whilst retaining the more practical ICE powertrain due to the lack of infrastructure at the time worldwide for fully electric vehicles to be practical for the everyday consumer. Right now, in 2023, fully electric vehicles are more common on the roads and in dealerships than hybrid vehicles. This is due to the ever-looming 2030 deadline for the UK at least where all 'new cars sold' will have to be fully powered by electric motors only, no ICE!

Chapter 4 – Conclusion

To conclude, I believe that my chosen car (VW Golf) has fitted in well to the automotive industry over the past 40-50 years of its life, but more importantly over the past 30 years. The car has suffered ups and downs through recent years, due to the VW emissions scandal in 2015 affecting sales following on, 'Volkswagen saw its sales in the UK have fallen by 20% in the wake of the emissions scandal, according to industry figures.' (freshbusinessstinking.com, Purpose, 2015)

Although due to the Golf's high popularity in the automotive sector when it comes to either buying an everyday family hatch, or a sporty hot hatch in the GTI and R forms of the Golf, I believe the Golf's all-round package helped it to get back up from the emissions scandal and start selling back at the levels it should be at.

Overall, I believe the Volkswagen Golf is a good base car to base other cars off, in the design and manufacturing stage all the way through to the customer satisfaction stage. Along with trying to be as environmentally friendly as it can in hybrid and electric forms today, further developing into and remaining a good all-round package and solid choice for consumers to consider going into the electric era, as it has been for many, many years, in the internal combustion era.

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