

Ford: The Evolution of Automobiles, Components, and Design

Honors Project

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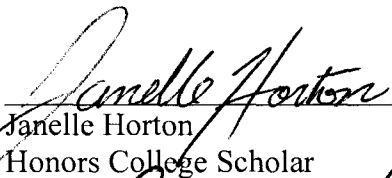
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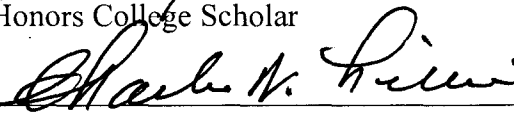
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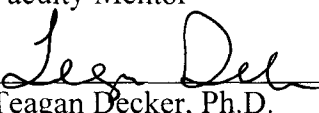
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ABSTRACT

Ford: The Evolution of Automobiles, Components, and Design:

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Due to interest in automobiles and the way the advancement in technology has brought the production of cars a long way, I decided to focus my research on the evolution of Ford. Knowing no previous history of Ford, I was always amazed at the design and gadgets within the cars of the 21st century that it sparked my interest to know how these cars, and how the company came about. Throughout the various articles and research I have come across during my time of research, I was impressed at the craftsmanship of the different components and their purpose within the various vehicles. I was able to find out Henry Ford's initial goal within the company, and how he continued to live by his message over the years, despite the growth in the economy and downfalls that the company endured. After graduating from my undergraduate institute, I am going to pursue a degree in Industrial and Systems Engineering, where my goal is to be a part of a motor company just as Henry Ford. Writing this paper helped me in seeing the production of cars from a different perspective that was quite informative.

Historically nothing has changed the everyday life of an American more than the productions of automobiles. Within the twentieth century there were select innovators that challenged their creativity in production of evolutionary advancements that transformed lives for years to come. Henry Ford of Ford Motor Company was an American multinational automaker appeared in the automobile industry on June 16, 1903. From the Ford Model T that was manufactured in the 1900s to the Ford GT crafted in the 21st century, Ford Motor Company has immensely transformed due to technical resources that are now available. In the beginning of his establishment, Ford introduced methods for large scale automobiles as well as large scale management of an industrial workforce by use of engineers manufacturing methods such as the assembly line which was a major asset for the company. The drastic growth of the automobile industry over the years has allowed the company to advance from their car components within the vehicles to the exterior designs of the models, therefore allowing Henry Ford and the Ford Motor Company to flourish for years to come.

Henry Ford was born July 30, 1863 on his family's farm in Dearborn, Michigan. At a young age Henry's father gave him a pocket watch which he took apart and reassembled, showing that he was handy when it came to gadgets. When news surfaced about Henry's skill, family and friends requested that he fix their broken watches as well. However, working on the farm bored Henry, and by the age of sixteen he had taken an apprenticeship as a machinist in Detroit (History, 2009). It was here that Henry learned the ins and outs of skillfully operating a service steam engine. In 1891 Ford was hired as an engineer for the Edison Illuminating Company, and by 1893 he was promoted to chief engineer. While at the company Ford developed plans for a horseless carriage and began the construction of his first model, the Ford Quadricycle in 1896. The Ford Quadricycle was a light weight metal framed that was fitted with four bicycle wheels that was powered by a two cylinder, four horsepower gasoline engine. During the same year,

Henry attended a meeting with the executives of Edison where he presented his plans of the automobile to Thomas Edison. Edison encouraged Henry to further his design plans which would conclude in producing a more efficient model.

After much trial and error on the production of cars and companies, in 1903 Henry Ford established the Ford Motor Company. Within a month of starting the company, Henry produced the first Ford car, the Model A which was a two cylinder eight horse power automobile (Gelderman, 2016). Due to the lack of an effective production system, only a few cars were assembled per day. Ford was devoted to creating a reliable and dynamic automobile that would be affordable for all classes, so he crafted the Model T that took four years to develop. It debuted in October 1908. The production of this model brought the company a large amount of profitable gains. Ford became well known for his profound vision simply because the team behind the manufacturing of the Model T were skilled workers who earned minimum wage. The Model T, which was also known as the “Tin Lizzie,” was a huge success that impacted the company with numerous amount of orders that was enormous for them to satisfy. As a result of this Henry put the techniques of mass production into a moving assembly line that would significantly change the American industry. The assembly line cut down the amount of time it took to produce an automobile that in return helped in keeping the costs low. By 1918 more than half of the cars in America were Model Ts.

The advancements within assembly line automobile manufacture helped in making the Model T the first affordable vehicle for Americans. The affordability, durability, low maintenance, and versatility made the car a prized possession for Americans. The assembly line production allowed the retail price for the automobile to be lowered from \$850 down to \$300 from 1908 to 1925, making up forty percent of the cars sold in the United States (History, 2010). More than fifteen million Model Ts were being driven, with mass production in Detroit and

Highland Park, Michigan. Thanks to Ford's improved production equipment, his company was able to make deliveries of around a hundred cars per day. Ford's Motor Company surpassed its competitors in manufacturing state of the art automobile designs while still keeping them at a moderate price.

The Model T came in several different body styles ranging from a two seat runabout, a five seat touring car, and a seven seat town car. All the cars produced were mounted on a uniform 100-inch framework and mass produced in black from 1913-1925. The engine was simple and well organized with all four of the cylinder casts in one block with a detachable cylinder head to ensure easy access and repair (History, 2010). The engine had a horse power of twenty and moved the car at speeds of 40-45 miles per hour. In the beginning of the Model T's production, the majority of the cars were started by manually cranking the vehicle. After the 1920s the standard models had battery powered starters. The transmission consisted of two front gears and one reverse that were controlled by foot pedals rather than the hand lever on the steering column. Since the reverse gear had more power than the front gear, the gas tank that held 10 gallons was located under the front seat, due to the gasoline being pumped to the engine by gravity. Weirdly enough, the Model T had to be driven up a steep hill backwards due to the lack of power in the front gears.

Pertaining to its drivetrain, piece by piece Ford improved the manufacturing behind the assembly of the car as well as its design. The drivetrain is the system within a motor vehicle that contains the transmissions to the drive axles. Mounted as a unit within the engine, Ford exhibited the two speed planetary transmission that was a feature within the car that made a smooth ride while driving. It took a lot to break down a Model T, but it was possible if the engine overheated. The vehicle's frame remained unchanged until the improved T in 1926, and even then, only underwent minor changes such as larger brakes, an improved cross member (a structural section

usually made out of steel), and new springs and spindles to drop the body of the car slightly lower to the ground (Adolphus, 2011). The brakes and low-speed pedals within the vehicle were widened and supplied with a lip to prevent the possibility of the driver's foot from slipping. Until wire wheels started to be the norm in vehicles, wood spokes were standard on the Model T.

No matter an individual's budget, there was a Model T for everyone. Individuals could expect to pay roughly anywhere from \$8,000 to \$9,000 for a mid- 1920s enclosed car, \$12,000 to \$14,000 for a touring car, and \$17,000 to \$20,000 for a truck or panel van (Adolphus, 2011). Depending on the prices and how an individual may want to customize, their car varied in the parts they were interested in. While keeping the cars at an affordable price range, Ford automobiles kept the aftermarket running smoothly and efficiently. Even though the Model T had its deficiencies that needed to be updated over the years, it remained a revolutionary automobile that became the traditional symbol of America.

Known as the king of the assembly line, the Model T made a huge impact in paving the way for future car manufacturers. In addition to making a vehicle that was cost efficient, Ford also looked out for their employees being that they were able to establish a minimum wage and the eight hour a day work schedule that helped in hiring the best workers. When it came to the personalized aspect of cars, Ford is the one to thank for the trend. From the Model T to the cars produced today, thousands of Model T accessories have been sold, making the aftermarket supplier a \$38 billion dollar industry (Siler, 2008). By 1921 the Model T stood out within the industry by being the first global car making up 57 percent of the world's production of automobiles. Ford is known in the industry for the creation of their tough and durable automobiles. In 1925 they built their first factory that produced a domestic pickup truck called the Ford Model T Runabout, which was equipped with a pickup body, and the Ford Model TT which was a heavier duty model. In addition to appearing in car dealer showrooms, the Model T

started making appearances in movies, songs, and became the modern language and culture within American society. According to Wes Siler in his article, “Ten Ways the Model T Changed the World,” the Model T was the best-selling vehicle up until 1971. In 1999 a panel of 126 automobile experts from 32 countries still considered Model T to be the most influential vehicle of the twentieth century.

Even though Ford was doing tremendously well in the automobile industry, the company had its share of competitors that were reaching for the same goal of being the top vehicle of the century. William C. Durant, the maker of Buick General Motors, was the top competitor alongside Ford in the early 1900’s. Under his leadership Durant was able to push the company forward from selling 4641 cars in 1907 to nearly double that amount in 1908. One of Durant’s concerns was whether or not the future of cars lay with big expensive cars, small affordable cars, or cars that featured the latest technology. Ford, on the other hand, had a different vision from Durant -his goal was to build a car that was simple, durable, efficient, and most importantly inexpensive.

Henry Ford did have his line of luxurious automobiles, but compared to the features of Buick’s Model 10, there were aspects that the Model T was lacking. The suspension within the Model 10 employed longitudinal leaf springs fore and aft, which is a spring that is mounted so it is parallel to the length of the car. Whereas the Model T had a traverse leaf spring which is a spring that is mounted so that it is at a right angle to the length of the car. This was kept on the Model T until 1949 (Swan, 2008). Both vehicles had the original crank start operant within the car, but the Model T had a reputation for bone-breaking backfires. Arguably the Buick’s Model 10 was a better car then the Ford’s Model T according to the article “1908 Buick Model 10 and 1909 Ford Model T” written by Tony Swan. However, in 1910 when Durant lost control of General Motors the new board of directors got rid of the losing aspects of the company he had

obtained, which led to the elimination of the Model 10 from Buick's portfolio (Swan, 2008). Miraculously Ford went on for another seventeen years with their Model T vehicle. Ford corrected prior glitches, expanded the range of body types, changed up the styles of the vehicles, and kept increasing the production while managing to keep the cost low. By the early 1920s half the cars on the planet were Model Ts, even after the production came to an end in May of 1927. Ford continued his vision in revolutionizing the way people saw cars with the Model A, which began production that October.

While the Model T was the dominant car of the automobile industry from 1908 to the early 1920's, the Model A appeared on the scene being a perfected version of the prior models. The Model A was the first to sport the iconic blue oval Ford logo and included top of the line features such as a safety glass windshield (Ford Motor Company, 2015). By 1931 Ford was able to sell over five million Model A cars despite the struggle of the Great Depression. The Model A was known as the new Ford car, with mechanical upgrades that included a new three speed transmission, hydraulic shock absorbers, and four wheel mechanical breaks (Riginos, 2013). The styling of this vehicle brought Ford up to date with the modernized aspects of automobiles such that the styles were starting to look more like cars rather than a horseless carriage. Ford continued to impress the industry with his innovative projects such as the flathead V8 engine that remained in production for more than 22 years. In addition, Ford was also the first to produce vehicles for the U.S army. When Henry Ford retired in 1946 from the company he built from the ground up, he passed over the empire to his grandson Henry Ford the 2nd. On April 7, 1947, Henry Ford passed away at the age of 83 near his estate in Fair Lane. The news was a big hit for the family and the company, but holding onto Henry Ford's initial dream the company continued keep Ford ahead of their competitors.

Throughout the rest of the 1900s Ford continued to impress the industry with their talents. In 1948 Ford took the automobile business by storm by introducing two new cars back to back: The F-Series line of trucks and the 1949 Ford, which was the first design to come out of Detroit after World War Two (Ford Motor Company, 2015). As far as design and durability, both cars showed the direction that Ford was planning to take the company. In 1954 Ford introduced the Thunderbird which emphasized comfort and convenience with its stylish exterior, a car that would be remembered as a classic. A few years later Ford introduced another vehicle, the Edsel, which unfortunately did not live up to the expectations that the company generated in the prior months (Hamer, 2014). On top of the poor quality workmanship, the automatic tele-touch transmission where the driver selected the different gears by pushing buttons, had complications due to the mechanics not knowing how to solve the technical issues that occurred. The car only sold 64,000 models within its first year which was far below the usual for the company. Ford wanted the vehicle to be in a separate division, therefore making sure the company did not have any ties with the Edsel by taking the logo off of the vehicles.

Nonetheless, Ford was able to jump back into the industry with an exceptional car in 1964, the Ford Mustang. Selling nearly 420,000 units within its first year, the Mustang established a new market segment, the pony car. The term post car was used to describe an affordable compact, stylish car that had a sporty image. With its long hood, short deck, customizable options and affordable prices, the Mustang was and continues to be a success within Ford's industry (Ford Motor Company, 2015). For the next couple of years Ford worked on extraordinary projects such as unveiling a mission control center that was used to put a man on the moon in 1965, to introducing a three point self-adjusting and retracting shoulder belt in 1970 (Ford Motor Company, 2015). It was in 1976 that the Ford Fiesta was launched, however it was the Ford of Europe who introduced the vehicle. This subcompact hatchback became the

company's first front wheel drive international model to become successful. Out of the previous cars Ford had developed, the Fiesta had an \$870 million dollar budget making it the largest in Ford's history, breaking the one year sale records of the Ford Mustang.

In the 1980s Ford revolutionized the automotive design by launching the Taurus in 1985. The car was an important shift in the motorized industry with its aerodynamic "jelly bean" shape, and it became one of Ford's most popular vehicles to date. The Taurus marked the shift in automobiles by increasing the quality standards and providing the buyers with front wheel drive designs. As if Ford was not stepping up their game enough, in 1986 they introduced the modular assembly line in St. Louis. The modular assembly line would involve the assembly of separate parts such as the chassis, interior, and the body of the model which would be done on their own line, thus joining all the needed pieces together the final assembly line (Leisner, E., Ost, S., Gmbh R. B, 1999). Ford Motor Company was at the top of their success, only leading towards more opportunities heading into the 90s.

Starting the year off in 1990, Ford introduced its Ford Explorer, which helped launch the domestic Sports Utility Vehicle (SUV) market. The Explorer was such a success within the Ford industry that Ford continued to make improvements in order to keep the vehicle relevant on the market. For instance, the V-6 engine was later switched out for a V8, which was a more modern six cylinder engine (Javlansky, 2010). In 1993, Ford introduced its new global sedan, the Ford Contour, which today is known as the Fusion. Three years later Ford produced a Ranger Electric vehicle that contained lead acid batteries, regenerative braking, and a 700 pound payload rating. The Ranger was the predecessor for current electric cars in the 21st century as well as hybrid energy systems. To conclude Ford's accomplishments overall within the 20th century, they were able to do what other companies could not. Staying true to their goal, Ford continued to manufacture vehicles that would grab the attention of probable customers worldwide.

Each step of a car's evolution represents the potential for remarkable moments among engineers and innovators within a team. Entering the 21st century, in 2003 Ford celebrated their 100th anniversary. Shortly after in 2004, Ford introduced its GT (Grand Touring) as its premium sports car. With its 550 horse power, mid-engine design, the GT was inspired by the GT40 race car (Ford Motor Company, 2015). Within the suspension of the GT, the front and rear contained independent double wishbones, coil springs, tube, shocks, and a stabilizer bar. Unlike the Model T, which was only produced in black, the 2005 GTs came in red, white, blue, black, silver, yellow, and 1 sonic blue. The Ford GT showcased the engineering genius of the Ford's special vehicle team which against other cars produced by Ford. The GT is most memorable to ever be produced within the company's 100 years in business.

Unfortunately, when Alan Mulally took over the company in 2006 Ford was losing billions of dollars. The company was \$12.7 billion dollars in debt and on the brink of bankruptcy, the biggest annual loss within its 103 years of operation. Seven years later Mulally was able to bring the company back on top, reshaping Ford to its initial purpose that Henry Ford envisioned the company to uphold. In an interview with Mulally and Rik Kirkland of Mckinsy Publishing, Kirkland asks Mulally about his leadership styles, pertaining to how the major changes within the company have affected the way he now leads the organization. Due to the way the world, and the automobile industry has changed, Kirkland asked Mulally if that factor had changed Ford's primary vision for the company. Mulally responded, "Henry Ford understood that the desire to move—to have freedom of mobility—is enduring and universal" (Kirkland, 2013). As the world around us changes it's the obligation of a company to adapt, so that they will not be left behind. Mulally understood that the Ford's vision will evolve over time, but the initial vision will remain constant.

The 21st century was an extraordinary beginning for Ford and their cars, being that technology was on the rise and the possibilities of what could be done were endless. In 2008 Ford began offering synchronization (SYNC) technology within vehicles that would be sold in 2008 (Ford Motor Company, 2015). The SYNC was created between a joint partnership with Ford and Microsoft. The device offered a hands free voice activated system with a cellular device, navigation and voice activated features that pertained to the entertainment features. The screen features are split into four quadrants that pertain to different functions within the car depending on the set up. SYNC is continuously being updated today, ensuring that the drivers of the car keep their hands on the wheel and their eyes on the road while still managing to connect to their technology.

The advancements within the company did not stop there, in 2009 Ford began to offer their turbocharged EcoBoost line of engines (Ford Motor Company, 2015). The EcoBoost is a combination of turbocharging and direct fuel injection. The engine uses a device that takes in more air than a regular engine would receive. The sole purpose of these engines was to deliver a better fuel economy in addition to providing the car with more power than their previous engines, while still being the same size. Ford continued to demonstrate why they were a strong business by showing their expansion and growth over the years, as well as what they had in store for the future.

By the year 2010, Ford had an extensive list of vehicles that met the requirements of different individuals depending on what they needed in a car. One car in particular that reached the top three on various car reports was the 2010 Ford Fusion. When the new model for the Ford Fusion debuted, the automotive press were so impressed that they decided to name the car the 2010 North American Car of the Year (Valdes-Depena, 2009). Compared to its 2006 model, the 2010 upgraded its five-speed transmission to a six speed unit. With its 175 horsepower and 172

pound twisting force that causes rotation, the four cylinder Fusion was hardly a sports sedan in comparison to the previous models. *Motor Trend* editor-in-chief Angus McKenzie in the article, *Ford Fusion: 2010 Motor Trend Car of the Year* argued, “While the 2010 Fusion shares much of its engineering with the previous version, the car looked and felt like a completely new car” (Valdes-Depeña, 2009). *Motor Trend* is one of the most prominent automobile enthusiast magazines in the United States- to be recognized *Motor Trend* their magazine and others demonstrates the positive direction Ford was heading.

For the next couple of years, Ford did not place in the top three category for car of the year, but did manage to obtain other tremendous achievements. Since 2010, Ford’s F-Series was labeled Americans best-selling truck for 32 consecutive years, and the best-selling vehicle overall for 27 years (Roth, 2009). The Ford Fusion was also named America’s most fuel efficient mid-size sedan for both hybrid and conventional gasoline models. In addition to all of Ford’s accomplishments, in 2014 they became the official car and truck of The National Hot Rod Association. Another one of Ford’s cars, the Mustang, which would be recognized globally years later, earned a 5-star safety rating for the driver and passenger in front and side crash tests, as well as in rollover performance. The Ford Mustang was going to be the car to keep an eye on due to the rate in which it was vastly advancing.

In 2015 Ford’s Mustang GT was recognized on various automobile articles as the car of the year. From *Esquire* to *Auto Blog*, as well as *Car and Driver*, all of these magazines plus others had nothing but good reviews on the 2015 model. After 50 years of progress with Ford’s Motor Company, the Mustang has been said to be functional, affordable, stylish, well built, and fast, and no other automobile in its class could compare (Smith, 2014). The adjustments that were made to the vehicle altered the development of the Mustang for the better. The new independent suspension brought refinement to a new level, and with its 5.0’s 435 horsepower

and 400 pound-feet of twisting rotation force, the GT isn't one to be underestimated. A lot of the cars that Ford is improving for the better will undergo phases of remarkable changes that will continue to hold the attention of loyal customers, while bringing in new customers who may have overlooked the ability Ford has to deliver satisfactory automobiles.

Ford envisions the future of their company to be filled with self-driven cars and drones. While Ford is known for their top of the line automobiles, they are focusing on becoming multipurpose company dealing with other aspects of technology in addition to an automaker industry. The word mobility has been buzzing around the auto industry a lot lately. Ford has been the forefront of integrating smart phones with cars, which is where the Smart Device Link platform comes into play. The software enables the driver to control their apps on their phone from the dashboard of the car which will allow them to make their own apps as well (Davies, 2016). Ford is also working alongside Amazon to integrate Echo, the Bluetooth speaker that listens to commands, and also joining a Chinese drone manufacturer in a challenging development of a drone-to-vehicle communication software. Ford isn't straying away from the enhancement of their vehicles by dealing with other companies that are solely based on technical gadgets. In fact there is a rumor surfacing that Ford may be partnering with Google in adding twenty new self-driving cars models to their previous line of ten (Davies, 2016). Ford has many ideas and projects they are working on to make sure their company thrives. With all the changes in technology it is inevitable that automobile industries will see more technical advancements in the next couple of years than they have in the past century.

With 2016 still underway Ford continues to perfect their craft while staying true to their initial vision. Pertaining to their previous models as well as their components and what they hope to achieve, the company is continuously moving forward with the advances in the world. Going into 2016 Ford has talked about its plans in making autonomous cars. To move forward with this

plan, the innovators of Ford believe that the smart software development and improved sensor capabilities in cars will be on the road in within five years (Lardinios F., Wihelm Alex ,2015). Ford makes sure to manufacture a car that is equipped for every lifestyle, customizable to the customers' standards, and most importantly safe and durable. With their phenomenal features that continue to amaze consumers on what an automobile industry can develop, the future will continue to look bright for Ford Motor Company.

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