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Disrupting the Automotive Industry: A Case Study of Tesla Motors

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Disrupting the Automotive Industry: A Case Study of Tesla Motors

by

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I hereby recognize and pledge to fulfill my responsibilities as defined in the Honor Code and to maintain the integrity of both myself and the College as a whole.

Your Signature:

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Abstract:

By standard economic models, profit-seeking firms will pursue technologies and innovation that is low risk and in line with consumer demands, sustaining innovation. Yet in practice, disruptive innovation, innovation that transforms existing technology and markets, is a recurring phenomenon. In the automobile industry, the effect of disruptive technology can be seen in the aftermath of the electric car. Tesla, an early entrant to the electric vehicle market, counters theoretical predictions by introducing products in a top-down fashion, yet succeeds in forcing incumbent firms to explore new technologies. While Tesla-created EV and AT technologies are only just entering mainstream markets, the pace of innovation hints that they will be a disruptor in the years to come.

Chapter 1

Introduction:

I predict technology driven trends could revolutionize how the automotive industry will respond to changing consumer preferences and drive transformational change within the industry. These sustainable and technological advances could have disruptive impacts on all companies involved in the automotive industry. As managers begin to develop strategies to prepare for these changes, what kind of response is already taking place? To answer these questions, I develop a framework to analyze Tesla's disruptive nature.

Christensen (1998) analyses how radical changes in technology such as the electric vehicles can disrupt incumbent firms. Christensen argues that disruptive technologies tend to emerge from outside the realm of the incumbent competencies (Christensen, 1998). Tesla defied this model while continuing to disrupt the automotive market by producing innovative vehicles that have established a new level of performance. Using a business strategy based on technology, user friendly, sustainable, and innovative practices Tesla has been extremely successful in its short life based on its revenue.

To determine the impact of disruptive innovation in the form of autonomous technology on the automotive industry, this paper examines Tesla, an early adopter and success story for autonomous technology. Beginning with a history and current state analysis of the automotive industry, I will introduce the theory of disruption and its relevance to this industry.

First, I discuss the history and current state of the automotive industry. I talk about the difference between disruptive and sustaining innovations. I review Tesla Motors as a company and give a brief view into its business strategy. I use an exploratory framework to help the reader understand why Tesla is on the path to disrupt and how it is planning for the future. Using journals, research, news publications, and other information I will look at the response to autonomous technology from other actors involved. Finally, a discussion on why Tesla's disruption could be positive and what role they may eventually hold in the automotive industry.

History and Current State of the Automotive Industry:

Henry Ford's development of the assembly line in 1913 set the stage for the automotive industry to grow into one of the leading and trendsetting industries in the world. Throughout the twentieth century, the automotive industry remained an innovator in manufacturing incorporating new technologies and business strategies. Yet as technology continues to advance, consumer preferences change and automotive companies need to adapt their strategies to reflect these preferences. These firms strive to provide better products than their competitors. The consumer has the final decision on whether they like the vehicle. What the consumer does not see is what the manufacturers do to make these vehicles innovative and competitive in the market place. As the world continues to shift from an industrial to an information-based economy, manufactures will have no option but to invest in state of the art equipment and technology to remain competitive in the global market.

This literature review objective is to inform the reader about the current state of the automobile industry. I look at the investment of technological innovation and what impact it has on a business's ability to stay competitive in the global market. For this project I choose specifically look at Tesla Motors to find out whether there manufacturing strategies have kept them competitive. Finally, I reflect on why this is an important subject to look at now and for the future.

The automobile industry was one of the major forces that drove America's industrial growth at the beginning of the 20th century. The invention of the assembly line inspired mass production techniques, which led the industry on a growth path that not only changed the American economy but also the global economy. Mass production techniques made automobiles affordable to society. The automotive industry not only directly created thousands of new American jobs but indirectly generated growth in commentary industries. Steel and tool suppliers grew just as fast, supplying parts to the major manufacturers (Lowry, 2014).

When World War II began, the American automotive manufacturers shifted there focus and ramped up production for military vehicles. The production of hundreds of thousands of vehicles allowed the manufacturers to perfect their craft. By the end of the war, demand for automobiles was high due to new infrastructure such as highways, which were paved all over America.

In the 1970s and 80s the American automakers became complacent, and foreign manufacturers from Japan and Germany took advantage by stealing market share from the US automotive manufacturers. The foreign manufacturers offered a product that offered superior build quality at an affordable cost. American

automakers had to be innovative; manufactures introduced power steering, disk braking, and power windows. Although these innovations helped the US auto manufacturers, the foreign market opened up and trade embargoes on oil, all led to efficient foreign vehicles to continue to outperform American automakers (Lowry, 2014).

Today the automotive industry represents 4% of global GDP. To put this number in perspective, food and agriculture make up 10% of global GDP (World Bank, 2016). This number seems relatively large when looking at total GDP (Lowry, 2014). If you look at the bigger picture of the global automotive market it plays an outsized role in the global economy due to the industry cyclicality and all other resources that pour into auto manufacturing. Other impacted industries such as steel, chemical, and electronics play a huge role in providing essential pieces to automakers.

What drives the global automotive market? The global automotive industry is classified as an oligopoly, which means there are few firms that control market share and all offer similar products but with differentiating factors such as makes and models. The global automotive market is impacted by global GDP, consumer confidence, employment, and price of fuel. Any economic statistic that increases disposable income will impact auto sales globally (Lowry, 2014). As the economy is able to produce more, additional people will be hired, and wages will increase. The economy then produces increased disposable income for consumers to spend on vehicles. Disposable income is an important factor for consumers when deciding on whether they need a new vehicle, but the deciding factor usually is consumer

confidence. Consumer confidence is an economic indicator that measures the overall degree of optimism consumers feel about the overall state of the economy and their personal financial situation (Lowry, 2014). If consumers do not feel good about their income and the economy, then consumers will probably not purchase new automobiles.

Another important factor in the global automotive market is the price of fossil fuels. Higher fuel prices reduce overall auto sales (Lowry, 2014). We will see that fuel prices play an important role in the type of innovation in the automotive industry.

There are a number of key success factors that specifically relate to the automotive industry. Manufactures must control employee wages, health care, and pensions to be able to stay flexible and competitive. Developing an export market for when domestic sales are down is crucial for global automotive manufacturers. Manufacturers must work efficiently with a motivated workforce. It is essential to have good relationships with suppliers and distributors to support the product and make production cost effective. The automotive industry is extremely competitive; investing in technological systems allows firms to stay on a competitive edge. Utilization of all features of an automotive manufacturing facility is essential (Nkamo, 2013). New technologies in vehicles such as autonomous driving software and fuel efficiently will drive the disruption in the automotive market in the coming years.

Disruptive Innovation vs. Sustaining Innovation:

Innovation is the process of implementing new ideas to create value and growth (Yale University, 2016). Companies innovate to respond to market trends and stay competitive within the market. Consumers often see innovation as something that adds value to a company. When a market is saturated with competition, an innovative product stands out from the rest.

A company can decide on a number of strategies for innovation depending on the risk they want to take. Generally manufacturing companies will pursue innovations that take into account current needs of customers in the existing market and developing solutions using new technologies or ideas to predict future needs. This type of innovation is called sustaining innovation.

Sustaining innovation is the most common form of innovation that takes place at companies today because it exposes companies to the least amount of risk. Sustaining innovation also includes incremental improvements to a product throughout its life cycle. Creating sustainable technologies is easy for companies because business strategies are often set up for sustainable practices. These sustainable practices are outlined by three efforts. First, a firm fixes or makes additions to a current product. Apple created the iPhone to improve smartphone technology. Each new model of iPhone comes with new features and fixes old bugs that consumers did not like. Second, there is a major cost reduction as the product's life cycle moves. The reduction in cost comes from an increase in sales volume. The company is able to buy larger quantities of resources at a reduced cost. Design enhances are cheaper since the product's flaws often work themselves out through

testing. The cost savings is then passed to the consumer. When new iPhones are released, older models become affordable. Finally, proliferation, which is when a product line expands to meet each end consumers, needs. Apple has created different levels of iPhone depending on what the consumer's values in their phone. This is seen in the automotive industry where each model has different trim levels, targeting a specific type of customer. Product lines typically grow throughout a product's lifecycle to meet consumer's needs. (Neilson, 2013)

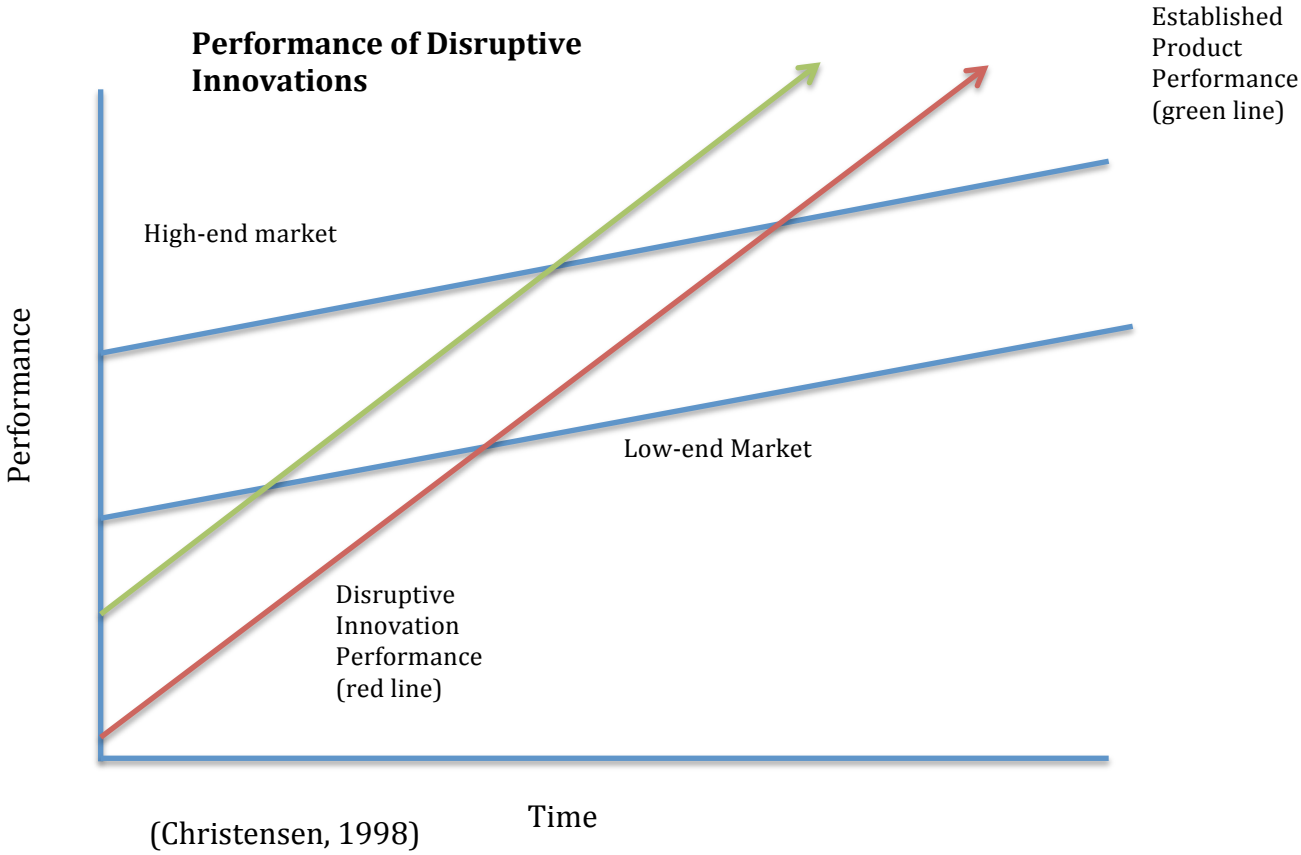
Disruption is defined as disturbance or problem that interrupts an event, activity, or process (Merriam Webster, 2016). Disruptive technologies are a new way of doing things. Disruptive technologies often disrupt the traditional business methods and practices. Compared to sustaining technologies, disruptive technologies rely on phenomenon and are not easily predictable. Sustaining technologies, solutions are known and the outcome is predictable.

Developed by Clayton Christensen, the theory of disruption explains why companies will sometimes pursue innovation that isn't necessarily aligned with current consumer needs (Christensen, 1998). Firms that harness new technologies but also develop new business models and improve old technologies are disruptive.

Christensen develops a framework to explain how disruptive technologies enter a market and eventually disrupt existing products. The framework is built upon understanding the differences between sustaining and disruptive technologies. One example is the divergence in product performance. Sustaining technologies consistently improve upon performance of existing products whereas disruptive technologies yield performance improvements in the long-term with

inconsistent short-term improvements. Second, disruptive technologies will outpace consumer needs while the fundamental driver of sustaining innovation is these needs. This means that performance develops faster than what consumers justify needing. Finally, sustaining innovation is associated with low risk and reliable profit. Companies that listen to their customers needs and create products based off of profitability usually are not willing to take the risk associated with disruptive technologies. (Christensen, 1998)

The automotive industry has established product performance that moves faster than consumer needs. This creates vehicles that overshoot what the market needs. Performance levels offered by disruptive technologies eventually meet or exceed the minimum levels that are demanded by established products. What is different about disruptive innovation is that it changes the bases of competition because they introduce a dimension of performance, which products did not compete previously (Danneels, 2004).



(Christensen, 1998)

Figure 1.1

These products are able to reach new markets, while developing rapidly, and are able to eat away at the incumbent market share. This means that at some point disruptive technology will intersect with low and high-end performance demand and consumers will be able to choose the product that meets their needs. The consumers will be quick to realize the disruptive innovation offers features that were not previously available. Once disruptive innovations are competing in the mainstream market, they have a better shot of wiping out established products.

Christensen believes that disruptive innovation exhibit poorer performance than established products. For example, in the automotive market, electric vehicles are considered to be a disruptive innovation, and assumed to be slower and have a

shorter driving range than combustion engine vehicles. Since performance may not meet consumer needs at first, it is essential firms pick the right market. They key to finding this market and harnessing disruptive innovation is finding a under performing product segment.

Disruptive innovation can succeed if companies are able to address one of the following weaknesses. If a competitor can create a product that simplifies the user experience that incumbent firms have been unable to simplify, then an entrant is able to undermine this product by creating a simpler more affordable product. Second, many incumbent firms try to create a number of innovative features all at once. The key is to focus on one feature, making it solve the problem as simply and cost effectively as possible. Finally, making a product accessible and affordable is vital to a disruptive product and creating new markets. People may think cutting costs comes from cheaper resources used to make the product. Cost cutting can also take the form of business strategy. Firms should use different channels to distribute and take full advantage of in-house capabilities. (Neilson, 2013)

An example of a disruption to the American automotive industry was the introduction of cheap and reliable vehicles from foreign manufacturers. General Motors, Chrysler, and Ford, Detroit's big three were a dominant powerhouse in the automotive industry. They made vehicles that were safe, comfortable, and fast. They continued to develop features that brought customers back. Christensen (1998, pg. 195) says, "This type of complacency creates a vacuum underneath these competitors" and "allows disruptive innovators to suck in customers with fewer features and cheaper prices." Foreign automotive makers, Toyota, Honda, and

Nissan were able to disrupt Detroit's big three by introducing smaller, cheaper, and comfortable cars. The key was these cars were much more reliable at a considerably lower price. The foreign auto manufacturers gained significant market share quickly. The introduction of foreign reliability created a whole new segment in the automotive market. American manufacturers had relied on sustaining innovation, little by little making improvements on past products. The dilemma here is that once consumers buy the improved product, they are less likely to come back and purchase again, at least not for a while. Disruption is creating a whole new market for growth, which will be explained in more detail when talking about non-consumption below.

In the business world disruption can be where a smaller company (entrepreneurial/ start-up) with fewer resources is able to successfully challenge successful incumbents in that industry (Christensen, et al., 2015). Incumbent firms will usually focus on improving existing technologies/products for their most demanding customers. They have to make trade-offs to decide what to focus their attention, often leaving out some segments that are not important to their business strategy. New entrants who provide something that is appropriate to gain a foothold in the market then target the overlooked segments. This suitability often comes with a low cost and accessible product. The incumbent usually will ignore the new entrant; focusing on their core products, in markets that are in high demand. Entrants will use this time to move up market and take advantage of high-end customers; they will use the success they had early on to propel them forward. Moving up market means that a firm is appealing to a larger audience that demands

more from them. When mainstream customers start adopting the entrant's offerings in volume, disruption has occurred (Christensen, et al., 2015).

Though Christensen's theory doesn't establish a definitive framework to determine whether or not a technology is considered disruptive, economists have applied his model to many industries. King and Baatartogokh (2015) applied Christensen's principles to 77 cases where they believed disruption took place. They found that the majority of cases did not fit the principles or conditions Christensen laid out in his theory. The primary principle that their findings contradicted is the idea that incumbents move along a linear trajectory of innovation. Incremental improvements allow incumbent firms to improve products in performance areas that are valued by consumers. For example, automotive manufacturers improve electric vehicles by increasing the range of travel. King and Baatartogokh (2015) also found that sustaining innovation was not always the driver behind linear improvements. They found that what might be interpreted as sustaining innovation was often outside circumstances such as policies that force certain industries to adapt their practices. For example, changing business conditions increase the economic advantage of scale and thereby limit the number of firms that can profit off of a market. (King and Baatartogokh, 2015)

Second, the pace of sustaining innovation overshoots customer needs. Christensen believes that if an incumbent firm continues to develop its sustaining innovation; it will usually overshoot what the customer values or uses in its product. In the automotive industry engines and horsepower have improved so much that consumers are not capable of using engines to their full potential. King and

Baatartogokh (2015) argue that not all incumbent companies overshoot customer needs. In the case of the animation industry, hand animation was replaced by digit animation because it was significantly cheaper. This is a case where innovation occurred not to overshoot the customer's needs but because it was financially better. This characteristic depends on the industry. Some industries move at a faster pace than others. (King and Baatartogokh, 2015)

Third, incumbents have the ability to respond to disruption but fail to. Christensen claims that incumbents hold the competencies to compete with new entrants and innovation but managers fail to effectively compete. Christensen believes that incumbent firms allocate all their resources toward sustaining innovations and don't want to take the risk that is associated with transitioning to a product that may be "not as good" as what is currently available. Again, King and Baatartogokh (2015) found that in the majority of cases this was not true. In many cases, incumbents are often legally, or incapable of responding to disruption. Christensen suggests that wood companies should have anticipated the threat of plastic companies and adapted to compete with them. This type of generalization is made to often between similar industries but different skill sets. It is hard to assume incumbent firms have the same capabilities to compete effectively with disrupting producers and this assumption can only be made on a case-by-case basis. (King and Baatartogokh, 2015)

What can be taken from King and Baatartogokh work? The assumptions that Christensen made can limit the ability of prediction the theory of disruption has. Sustaining innovation can be slow to keep up with consumer needs. For example,

battery technology is moving slower than electric vehicle technology and is holding back the cost effectiveness of electric transportation. Christensen (2003) believes that companies have the capabilities and resources to succeed in the face of disruption but lack the values and decision making to do so. Schumpeter (1942) on the other hand has said that waves of innovation are a vital part of the economy to wash away businesses that are obsolete. King and Baatartogokh (2015) found that technological shifts could be extremely treacherous for companies, because they involve different strategies, skills, designs, and infrastructure. To make the assumption that all incumbents have the capabilities to react to disruption is a stretch. Most assumptions Christensen makes could be argued but most rely on the situation and characteristics of the industry.

Christensen assumption that inferior performance by an entrant can disrupt incumbents lacks any theoretical drivers to prove the prediction. Adner (2002) focused attention on figuring out what demand conditions drive disruptive innovation. The structure of demand is characterized by performance overlap and performance symmetry, which make up market performance. Performance overlap refers to when characters are valued in more than one market segment. For instance battery performance is valued not only in electric vehicles but also consumer electronics. Performance symmetry refers to how the performance overlap allows each market segment to perform. With this understanding, Adner builds a model to show that technology improvements blur the line between market segments and lead to different competitive environments (Adner, 2002).

"As technology development progresses, consumers performance requirements are met, and then exceeded, by their home technology. As performance continues to surpass consumers' requirements, consumers' willingness to pay for improvements decreases, opening the door for lower priced, lower performance (disruptive) offers to capture these consumers. As the overlap between market segments preferences increases, firms have greater incentives to enter firms market. When performance overlap is asymmetric, the firm whose technology casts a larger performance shadow on its rivals market therefore has a larger relevant consumer base, have a larger incentive to invade. The invaded firm, confronting a smaller set of consumers, chooses to exploit existing opportunities in the uncontested portion of the market rather than engage in competition with its rival." (Adner, 2002)

Adners analysis of demand side market disruption highlights that the relationship between consumer preferences and consumers willingness to pay as a key factor in disruptive technology. Adner also acknowledges the importance price has on consumer's willingness to accept disruptive technologies. Price trajectories can be a useful alternative to performance trajectories to identify disruptive technologies. (Adner, 2002)

Christensen (1998, pg. 198) stated that "disruptive technologies are typically simpler, cheaper, and more reliable and convenient than established technologies". It is important to ask what the essential characteristics of a disruptive innovation are? Christensen characteristics of disruptive technology may be normal in some cases but they do not make up all disruptive technologies. Digital

cameras entered the market being an expensive technology compared to traditional film cameras but offered a much less expensive user experience. The same argument can be made for electric vehicles. Electric vehicles entered the automotive market at much higher price compared to combustion engines vehicles but there is minimal expense using an EV compared to gasoline-powered vehicle.

In Christensen most recent update of his disruptive framework he has replaced the term disruptive technology with disruptive innovation. This allows the theory to be applied on a broader scale. He also makes the distinction between low-end market disruptions and new-market disruptions. Low-end market disruptions are products that enter an existing value network at the low-end. New-market disruptions are an innovation that allows a wider audience to access a product. (Christensen and Raynor, 2003)

There has been a lot of interest on how to develop Christensen framework further given the open-ended questions. Erwin Danneels, a professor of marketing at Worcester Polytechnic Institute has highlighted a number of questions that may help clear some confusion when answering what makes an innovation disruptive. Is a technology inherently disruptive or is it "disruptiveness" a function of the perspective of the companies subject to it? At what point in time does a technology become disruptive? Does it occur once it displaces an existing product or service? Is a technology disruptive only once it displaces incumbents that built their business on the prior prominent technology? All these questions highlight some of the

pitfalls associated with clearly defining whether an innovation is actually disruptive. (Danneels, 2004)

Innovation and Competition:

It is important to understand the relationship between innovation and competition. Joseph Schumpeter is famous for his work on business cycle theories and ideas about innovation. Schumpeter (1943) defines innovation as "doing things differently in the realm of economic life", Schumpeter sought to provide an answer to show that innovation creates originated market power for firms that provides better results than price competition. Although this may be true in some situations, what might be more important to look at is the relationship between innovation and product market competition. Industrial organization is important to understand this relationship. Industrial Organization or IO is the theory of the firm that explores the structure (management practices) and market of the firm. Standard IO theory predicts that innovation should decline as competition in the market increases, because competition will lower the profit made by the innovator thus taking the reward away from innovating (an inverted relationship). This seems logical but other studies such as Geroski (1995) *Innovation and Competition* proved that firms in a competitive environment seem more likely to engage in innovative activity than in non- competitive and non-innovative businesses**.**

Aghion, Vickers, and Harris (1997) introduced an interesting approach that uses the Schumpeterian model and allows market share leaders to innovate. In the model, innovative incentives rely on the difference between post-innovation and

pre-innovation rents (Aghion et al., 1997). This is saying that competition may increase the incremental profits from innovating and therefore encourage investment in R&D (research and development) aimed to help the firm escape competition.

In "neck & neck" industry such as the automotive market, firms face similar production costs. The firm with the lower unit cost is considered the technological leader and when both firms have the same unit cost they are "neck and neck". This approach looks at innovation and growth as a "step by step" process. In order for automakers to reduce production costs, they must first reach the technological leader and operate at their level before making decisions about the future. In an oligopolistic industry like the automotive, escaping competition is most effective. Aghion et al. (1997) says "Finally, by increasing innovation incentives relatively more in "neck and neck" industries than in unleveled industries, increased product market competition will then reduce the "neck and neck" competitors thus proving the Schumpeterian effect and a negative correlation between product market competition and rate of innovation".

Aghion, Howitt, Bloom, Griffth, and Blundell (2002) found that innovation and competition have an inverted U-shaped relationship. The researchers developed Schumpeterian growth model in which firms innovate on a "step by step" process and both leaders and followers within the industry invest in R&D practices. They examined whether innovation would increase profits for leaders or reduce innovation for firms that lag behind. Testing different predictions, the authors found that the Escaping Competition Effect works when there are low levels of

competition and Schumpeterian Effect works when there are high levels of competition. Firms facing pressure for financial reasons are subject to stronger Escape Competition Effect and innovate more on average. Product market competition decreases the competitiveness between technological innovations. Finally, firms are likely to be more innovation if they are subject to high debts/pressure (Aghion et al., 2002).

Disruptive innovation also has the positive side effect of reaching consumers previously uninterested and unable to participate in the market. This forces incumbent firms to address and compete with a part of the market previously regarded as "non-consumers". This is one of the things that enable disruptive innovators (companies) to gain competitive advantage.

Christensen (1998) said, "The theory of disruptive innovation allows firms to predict whether a competitor will flee or fight." When automotive companies make similar vehicles such as pickup trucks, they're competing against the same customers. In the case of disruptive innovation, the incumbent firm leaves a market wide open for a new entrant and their innovation. The new entrant ("disruptor") is not competing against anyone; instead they are competing against non-consumption by the consumer. Non-consumption is the refusal to purchase or consume a product, resource, or service (Merriam Webster, 2016). The disruptor is creating new consumers by introducing a disruptive innovation. "The innovation transforms something that used to be costly, only the very rich had access to it", says Christensen (1998). "These innovations make it so affordable and simple that

normal people can do what was once only available to the rich and skilled people". (Christensen, 1998)

Right now, autonomous technology does not provide a better alternative to human drivers because of regulations and safety concerns. Through substantial research and development, the technology will eventually become better, but it is currently not convincing enough for consumers. For autonomous technology to gain traction in the market place, it must develop itself non-consumption market.

Innovation within the Automotive Industry:

Recently there has been increased pressure on traditional style of automotive manufacturing due to environmental factors and threat of sustainability of this traditional model (Zapata & Nieuwenhuius, 2010). Fundamentally it is important to look at what it takes to enter the global automotive market. Initial capital investments to manufacture are extremely high and usually result in sunk costs because of the specific nature of the equipment. This puts a lot of pressure on automakers to perform and sell automobiles year after year while staying competitive through innovative techniques.

Innovation has been incremental in the automotive industry for the last 100 years. Design and configuration of car, rely on the their predecessor for needed improvements. Car manufacturers will look at the user experience and customer's needs to make small modifications and adaptations as the car progresses through its life cycle. Using Dyerson and Pilkington (2005) explanation, automotive markets have been using and investing in the prevailing dominant design of vehicles, the internal combustion engine. Despite a number of other options for powering

vehicles such as electric, the existing dominant design has been incredibly stable and profitable for automotive manufacturers. Some argue that it has been the distribution, service, and fueling aspects that have kept the dominant design of combustion engines so stable throughout the years. Without an infrastructure to support a new technology like electric vehicles, combustion engines will remain the popular choice by consumers.

Finally, innovation in the form of regulation is the most common investment we see automakers use today. This type of innovation is when new practices are put in place because of new policy within the industry. In the late 1980s and early 1990s American automotive manufacturers were struggling to compete with foreign auto manufacturer. Toyota was famous for introducing "lean" manufacturing production and techniques, which began the Regulatory Innovation within the industry. During this time the European Automakers also were struggling to compete with foreign production. They developed an aid program to help bolster innovation within their own automotive industry. Cusumano (2013) defined this as "The operation, on an industrial basis, of a new system or process which, in whole or in part, represents a significant step forward for a particular industry in terms of product quality, cost savings, or safety in the workplace". This allowed such operations as "lean" manufacturing to be considered an innovation process instead of just modernization of production. (Zapata & Nieuwenhius, 2010)

Autonomous Driving Technology:

Autonomous driving technology has the potential to completely change the automotive industry as we know it. In the last decade there has been debate over

the pace of change, the current state of autonomous technology, and the forces between automakers on will establish this technology first. There is no longer a debate about whether autonomous driving will happen; it is just a matter of when. (Bernhart & Winterhoff, 2016)

Semi-Autonomous technology can already be seen in a number of manufacturer's vehicles. Tesla is leading the way with their autopilot system that was released in 2015. Equipping cars and trucks with autonomous technology could greatly reduce crashes, energy consumption, and greatly reduce the costs congestion seen today (Anderson, et al., 2014). To understand what this technology is and the benefits it could have on society, the National Highway Traffic Safety Administration (NHTSA, 2013) has put together a five-level scale.

Level 0: The human driver is in complete control of all functions of the car.

Level 1: One function is automated.

Level 2: More than one function is automated at the same time (i.e. steering and acceleration) but the driver must stay active and attentive during function.

Level 3: The driving functions are sufficiently automated that the driver can participate in other activities.

Level 4: The vehicle can drive itself without human intervention.

(NHTSA, 2013)

The Rand Corporation (2014), which is a non-profit research institution, recently put together a guide for policy makers regarding autonomous driving technology. They suggest some benefits that autonomous driving will have on society. Autonomous vehicles (AV) technology will greatly reduce crashes. The

Insurance Institute for Highway Safety (IIHS) estimated that if all vehicles had forward collision and lane departure warning systems, side view (blind spot) assist, and adaptive headlights, nearly a third of crashes and fatalities could be prevented (Anderson, et al., 2014). Driver error is responsible for a large portion of crashes. Once AV technology reaches level 4 (no human driver) crashes are likely to reduce even more. AV technology could reduce congestion and traffic in urban areas while also allowing the user to participate in other activates. AV technologies effect on energy consumption is unknown currently but it is assumed that fuel consumption will be improved due to autonomous acceleration that is much more efficient than a human driver. In the future, when AV reduces crashes, automakers can use less material for safety and the weight of AV will affect energy consumption (Anderson, et al., 2014). AV technology has the potential to reduce costs for the consumer. The costs of congestion and fuel economy will be reduced while increasing mobility for other consumers. Anderson et al. (2014) predict that the benefits of AV technology-including decreased crashes, increased mobility, and increases in fuel economy out weigh the costs and disadvantages that will be associated with AV when this technology is fully implemented. (Anderson, et al., 2014)

Autonomous vehicles are going offer a lot of benefits to society and change the way we move, but what factors is it going to take for society and auto manufacturers to develop AV? Bernhardt and Winterhoff (2016) offer five key factors that influencing autonomous driving today. Technological innovation for autonomous driving has increased in the last few years by both automakers and technology companies. Advanced Driver Assistance Programs (ADAP) such as

parking assist, adaptive cruise control, and lane assist are already available on higher end vehicles. Significant efforts are being made by all producers of autonomous technology to make it more cost effective. This effort will increase affordability and availability in the coming years. Since AV technology could change the automobile industry, it has become an incredibly competitive product. The consumer benefits pointed out above are a key factor for consumers to take interest in autonomous technology. The societal benefits to transportation could potential be huge. Decreased traffic congestion, improved road safety, and reduced carbon emissions are just a few. Finally, regulatory factors are helping develop AV by addressing legal frameworks and safety issues that need to be put in place before AV are on the road.

Importance of Competitive Advantage:

Michael Porter is famous for his competitive advantage work. He is a professor and leading authority regarding competitive strategies. Porter's argument is that: competitive advantage is a function of either providing comparable buyer value more efficiently than competitors, or performing activities at comparable cost but in unique ways that create more buyer value than competitors (Economist, 2008). So competitive advantage is when a supplier either has a lower cost regarding production or a differentiated product. Understanding competitive advantage on the firm level allows executives figure out what they are good at and why consumers buy their product.

Applying a competitive advantage framework to the automotive industry is important because it allows the manufactures to understand where they stand and

what they need to do to separate them from the competition. Consumers benefit by receiving low cost products and better quality that stems from competitive markets. Applying innovation to competitive advantage allows firms to take that next step, hopefully in the right direction to place them as the leader in the market.

Tesla Motors Company:

Tesla Motors is an automotive startup, originally formed to produce an electric sports car. Founded in 2003 by Martin Eberhard and Marc Tarpenning, Tesla has grown to be synonymous with technology and innovation within the automotive industry. Technology visionary Elon Musk was an early believer and backer for Tesla and now sits as CEO of the automotive manufacturer. (Baer, 2014)

Since its creation in the early 2000s, Tesla has strived to stand by its goal of creating affordable mass marketed electric automobiles. In 2008, Tesla struggled with funding but eventually was able to receive some cash flow from Daimler AG (Mercedes Benz) when they bought a 10% stake worth $50 million (Baer, 2014). By 2009 Tesla has delivered over 100 of their award winning all electric roadsters. In early 2009, Tesla received $500 million in interest bearing loan from the United States Department of Energy. The funding was a part of a program established by Congress worth $8 Billion going towards advanced technology vehicles. This loan was essential for Tesla to start developing what would be the Model S sedan as well as other innovative technologies used by the automotive market today such as commercial powertrain technology. In 2010, Tesla went public with an initial public offering price of $17 dollars per share. Taking Tesla public afforded the company a

large sum of cash to increase production and ramp up for the launch of the Model S. (Baer, 2014)

Tesla has used a unique corporate strategy to gain success within the automotive market. Tesla has been able to emulate a technology life cycle with its products and establish consumer base that is willing to pay for expensive, high end products. The technology life cycle refers to the strategy of creating and investing in a product through research and development and gaining financial return during "vital life". Technology of this cycle often moves quickly but affords its manufacturer's control over the price. As stated in its vision, Tesla hopes to eventual use this to create affordable technologically to establish its products in a more competitive market.

To create affordable automobiles, Tesla has established a three-step process to reach its goal. Tesla hopes to use the success of each previous model to help develop and pay for next model. This type of strategy is seen in the technology sector with cellphones and other electronic devices. Product prices start high and as the technology develops and becomes cheaper to produce, the price drops dramatically. Musk said, "New technology in any field takes a few versions to optimize before reaching the mass market, and in this market we are competing with 150 years and trillions of dollars spent on gasoline cars" (Tesla, 2015).

Tesla's goal of creating affordable electric vehicles is not only to benefit itself but the automotive industry as a whole. Tesla has already implemented a number of strategies never seen in the automotive industry. Tesla has become the first automotive company to sell and service its vehicles through company-owned show

rooms and online. Tesla vehicles are purchased through personal orders at one of the companies many show rooms. Once the Tesla is delivered to the customer, the customer is able to service the vehicle at anyone of Tesla's show rooms across the country for free. Tesla also aims to provide its technologically advanced batteries and powertrain components to other manufacturers interested in EV (electric vehicles). Finally, Tesla wants to serve as a positive catalyst to other automotive manufacturers. Tesla recently made all its patents and designs public for other companies to use to help create and innovate.

Tesla hopes to disrupt the automotive industry using complex coordination where many innovative pieces fit together all at once to give a firm a competitive advantage. (Baer, 2014).

Chapter 2

Case Study: Disrupting the Automotive Market

In the Innovator's Dilemma, Christensen establishes a framework to apply the theory of disruption to firms or innovations to determine whether they are disruptive.

This framework can be applied to Tesla and its investment in/interest in electric vehicles and autonomous technology. By identifying Tesla as a potential disruptive firm and outlining the steps to achieve that, other firms can benefit from establishing similar models.

It is difficult to directly answer whether these management strategies involving innovation will be successful or not since its success takes place in the

future. I can give a good suggestion on how Tesla is disrupting the status quo and how they look to gained a competitive advantage in the automotive market.

What is Tesla Doing to Become A Disruptive Innovator?

Some may suggest that Elon Musk, Tesla co-founder is creating a new strategy for disruption. Tesla is using a top down approach to attack the automotive market. Products start at the high-end and move their way down the market, the opposite of what Christensen suggested as the appropriate approach for a market disruptor. This top-down approach has been seen before when Apple introduced the iPhone and disrupted the mobile phone market. Musk's goal is to eventually create an affordable electric vehicle that could compete with or replace combustion engines. (Tesla, 2006) Tesla has the potential to disrupt the automotive market by disrupting the "status quo" of transportation.

Tesla is offering a differentiated product in a sophisticated luxury electric vehicle but still is selling to a saturated automotive market. Electric vehicles make up a small portion of a huge automotive market in the United States. According to Christensen, disruptors either target over served customers by offering a lower performance and lower value product or target a new market with an affordable product (Christensen, 1998). Although Tesla in sense is not serving either of these markets, it is being disruptive by creating another segment within the automotive market using brand loyalty and consumer focused connections (Rutter, 2014).

Christensen uses the term "asymmetric motivation" to describe whether an incumbent firm is going to be competitive when a new entrant enters a market segment. This means that while the disruptor is motivated to enter higher

performance segments over time, existing firms are not motivated to fight back to protect their market (Wessel & Christensen, 2012).

Tesla is relatively small compared to the automotive manufacturers it's competing with. Tesla has a huge incentive to take market share away from the incumbent automotive manufacturers in the electric market since that is the only market Tesla is serving. Large automotive manufacturers have nothing to gain from entering the small EV market and are hesitant to diverting resources to the small EV market fearing a loss of customer interest in combustion engine automobiles that return a stable and predictable profit. Companies like GM and Ford have invested billions of dollars into manufacturing and creating an infrastructure based on gasoline-powered vehicles. The reorganization associated with fully engaging in EV may put undue financial pressure on incumbent firms who can maintain and improve upon profit and growth without expanding to the new market.

One of Christensen's key principles to disruptive innovation is that small markets don't solve the growth needs of large companies. This means that many large companies will wait till the mainstream market has accepted the innovation before they invest in it. (Christensen, 1998) Contrary to Christensen principle, Tesla has grown to a company of more than 13,000, while establishing itself in a fairly small niche market.

Another attribute of a disruptive firm is keeping up with performance regarding customer expectations while retaining a low cost. While Tesla's price points do not currently fall into the low-cost threshold, over the past 4 years, as production has increased, prices have fallen. This trend is set to continue as Tesla

releases its affordable Model 3 (King, 2016). Tesla has continually updated and improved its products and compared to other automotive manufacturers it growth has been substantial. Economies of scale are also in the forecast to reduce the cost of manufacturing EV even more in the near future. Tesla has invested billions of dollars in creating a battery factory to supply not only its vehicles but also other segments of industry. This investment alone will allow them to create a supply for a technology that is on the cusp of being in demand, with low cost-long range electric vehicles coming soon (Baer, 2014). All these investments have led electric vehicles customers to demand a certain level of performance for all competitors.

Christensen main analytic tool for classifying disruptive innovation is a performance trajectory. Consumers demand a certain level of performance at the high and low end of the market. Two important performance metrics in the electric vehicle market are range and price. This table outlines Tesla vehicle average ranges compared to its competitors in the EV market.

Tesla Model	Kia Soul EV	Fiat 500e	Nissan Leaf	VW e-Golf	Chevy Spark
240 Miles	93 Miles	87 Miles	84 Miles	83 Miles	80 Miles

(Consumer Reports, 2015)

Table 2.1

Tesla has been able to maintain a significant advantage over its competitors because of the battery technology that it has developed.

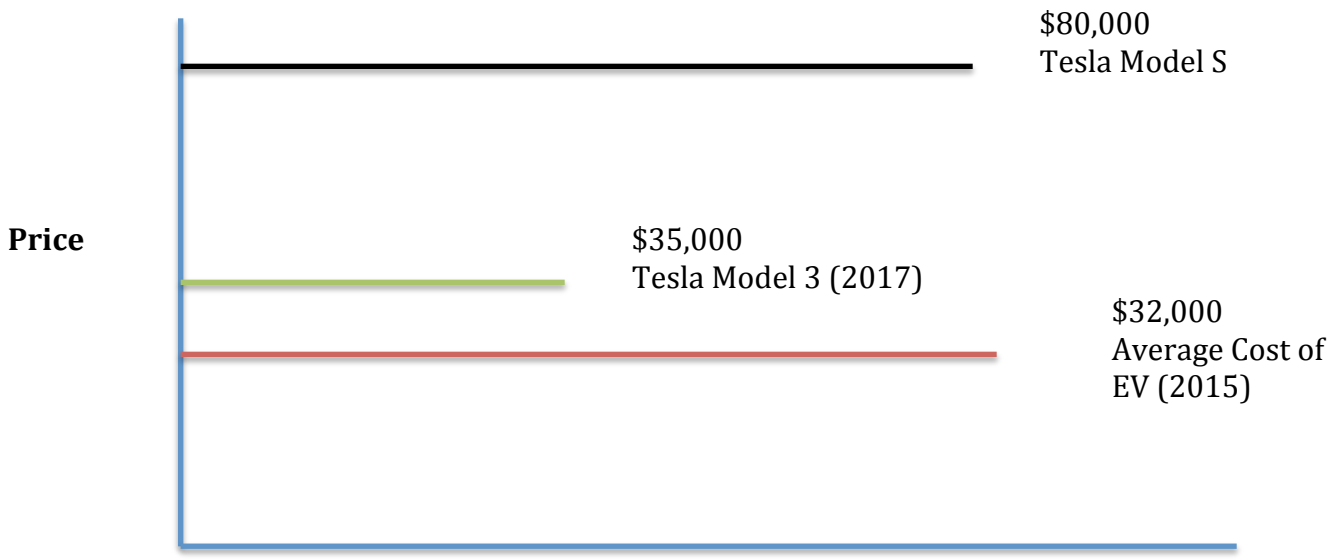


Figure 2.1 (Consumer Reports, 2015)

Tesla's price point is still relatively high compared to it competitors in the automotive market. Tesla has exceeded established demand for range within the price point, creating a performance trajectory that all other manufactures need to meet. Danneels (2004) said, "Disruptive innovation is when they change the bases of competition because they introduce a dimension of performance, which products did not compete previously". Tesla is motivated to offer high performance products that no other incumbent currently offers. Right now these come at a price but eventually once they are able to build value chains through battery production and economies of scale, Tesla will be able to cut cost, which will be seen in the Tesla Model 3.

Disruptors are good at creating new value networks and bringing new sales channels to an existing market (Wessel & Christensen, 2012). Tesla is creating new value networks and boosting the value network for electric vehicles. Tesla offers a

unique value proposition that is rare in the automotive industries. It is offering a vehicle that appeals to the environment, safety, and technology. For instance, the iPhone was able to create new value networks for mobile phones by making a phone that combines Internet, music, and a cellphone. Tesla has created this network through home charging and supercharger networks (free charging stations). An EV customer is no longer reliant on gasoline stations. (Musk, 2006) The supercharger network could be Tesla's most disruptive technology. Once the dedicated network is complete they will have a strong differentiation from the rest of the competitors in the electric car market. Every other competitor will have to build a charging infrastructure from scratch to support and compete with Tesla. This electric charging infrastructure undermines current gas stations and enters the market as an overlooked and underperforming product.

Tesla is pioneering new sales channels through its distribution and service of its vehicles. Unique from the rest of the automotive industry, Tesla is pursuing a company owned distribution and service model. In a traditional sales model, automotive dealers are not likely to undermine their best selling gasoline power vehicles for new technology like electric automobiles. This leaves EV an unfair opportunity for sales and growth compared to the incumbent gasoline powered vehicle. What Tesla sales channels are doing is creating a customer oriented, user-friendly experience. Disruption theory implies that disruptive technology is created by consumer needs and preferences. When buying and servicing vehicles consumers want an easy and affordable experience. Tesla's model of distribution and service

relies on maintain a positive customer experience, something that is often over looked by other automotive companies.

Yet Tesla faces challenges associated with being a new automotive company and entrant to the market. Most customers have already made up their mind prior to visiting a car dealership. Tesla's strategy to target consumers directly consists of building showrooms in densely populated areas where foot traffic is heavy. Product specialists are trained to inform customers on electric vehicles in general indirectly leading consumers to Tesla, the dominant firm in the EV market. Musk (2006) says, "our technology is different, our cars are different, and, as a result, our sales model is intentionally different".

Currently all major automotive incumbents rely on streams of income from internal combustion engines. To compete with Tesla, these companies not only need to produce an electric vehicle and charging network, but they need to make one that is better and cheaper than Tesla's product. Although Tesla's EV are not affordable to the mainstream market yet, they are well on their way.

In Barton's (2015) assessment of Tesla, he concludes that it is not a disruptor in the automotive market. He argues that Tesla is simply pursuing sustaining innovation by taking an electric vehicle and making it perform better and this sustaining technology is what is fostering improved product performance. Yet as explored above, Tesla's approach is outside of the norm and defined by radically different business strategies.

Currently, Tesla cannot be considered a disruptor in the automotive market because of economies of scale. The amount of vehicles Tesla has produced so far

does not impact the automobile market-at-large. For Tesla to truly displace combustion engines, they must produce at scale and make cost-effective vehicles that are available to a larger customer base.

Autonomous vehicles and technology have steadily grown in the last decade. Research by not only auto manufacturers but also software companies has spurred growth in the AI industry. The government has also played a role in the technological development by offering huge sums of cash for research. In terms of a disruptive technology that could change the course of the automotive industry, autonomous technology meets all requirements. A disruptive technology does not only change how value is created but also can change who will claim this value.

Autonomous driving systems are inevitable in the future of the automobile. Every automotive company has some form of autonomous driving program, whether it is in-house R&D or an alliance with a software company such as Google. In January of 2016, the United States government announced plans to invest 4 billion dollars into autonomous driving technologies (Spector & Ramsey, 2014). All these factors will allow autonomous technology to develop and enter the market quicker than expected. As an automotive company, a decision needs to be made to pursue this future technology or wait to see where the market develops. In an updated definition of disruptive technology by Erwin Danneels: disruptive technology is a technology that changes the basics of competition by changing the performance metrics along which firms compete. (Danneels, 2004) AV will change the landscape of travel and transportation for the automotive market.

Christensen's principle that technological innovation develops faster than what consumers need explains autonomous technology perfectly. Autonomous software is already being implemented in vehicles even though it may not be a consumer preference for many years.

In a recent study by the Victoria Transport Policy Institute, they found a number of implications that will occur with the implementation of AV. Automotive manufacturers will no longer look at rising fuel prices to develop a vehicle's performance. Driver preferences will change because autonomous technology will allow the driver to focus their attention somewhere else. People will start to share vehicles. The whole user process of driving will become efficient and user friendly (Litman, 2015).

Does Tesla have the potential to be a disruptor in the Automotive Market?

Being a disrupter in a 100-year-old industry means defying the establishment with new strategies, new markets, and new products. Although the auto industry has innovated in the past, Tesla has been able to push the boundaries for what is possible in the automotive world. The company's entrepreneurship attitude has allowed the company to grow faster, work more efficiently, and innovate new ideas around sustainability and technology (Boyadjis et. al., 2014).

Compared to larger automotive firms, Tesla is relatively small. The size of the company gives them flexibility in terms of where they want to focus time and money. Company size has also allowed Tesla to implement new strategies for manufacturing, development, and technology that have allowed them to become the disruptor they are today.

Tesla's manufacturing strategy relies on an electronic manufacturing services (EMS) model of production, which is seen in the electronics manufacturing industry but not the automotive. This involved Tesla, outsourcing its infotainment center and other electronic systems and gave them time to develop the software the systems will run. EMS production strategies are no longer unique to Tesla because other automotive companies have begun contracting out their electronic systems as well. This outsourcing gave Tesla an advantage when they were developing their Model S sedan. (Boyadjis et. al., 2014)

Tesla's development strategy stems from its founders as well as the location of Tesla in Silicon Valley, technology capital of the world. Every automobile manufacturer has research and development departments, but what separates Tesla is that they are pioneering software built vehicles. Tesla's vision of transforming mobility to sustainable practices has pushed them to innovate constantly. By Tesla establishing itself in the EV world, it has allowed them to develop battery and drivetrain technology that has never been seen before. Using an entrepreneurial strategy, Tesla invests all its profits back into development so they eventually can make affordable and cost effective vehicles. Tesla approach to disrupting mobility in general may be its biggest attribute. Recently, Tesla has released all its patents and innovations because it believes open-source information will allow the industry to advance faster. This is a perfect example how Tesla is disrupting the automotive market.

Tesla has already made a name for itself around technology adoption and innovation (Boyadjis et. al., 2014). Like all first movers in industry, competitors will

rise to challenge the competition. With the potential of a disruptive innovation like autonomous vehicles (AV), Tesla needs to move fast to establish itself and learn from its customers needs. Also working in competition with companies like Google could spur innovation to develop faster.

It is important to understand the current state of autonomous technology. Since legal regulations for transportation differ between states there are still a lot of questions regarding autonomous vehicles. This may deter potential consumers. This means the autonomous driving software will initially not enter the mainstream market; instead it will target a consumer as a luxury product. Tesla markets this technology as add-on to an existing product through over the Internet updates. When Tesla introduced its Model S sedan in 2013, it was planning and marketing for the future. They understood where their technology was heading. Tesla's core mission statement is about developing and refining technologies that enable self-driving cars (Tesla, 2015). Tesla understood technology implementation needed to be taken in incremental steps. Tesla was able to use an existing market that they created, the luxury electric vehicle; this allowed them, to "test the waters" for their autonomous software.

Currently there is no established market segment for autonomously driven vehicles. Many automotive managers focus on the mainstream market because of the type of resources it offers (Christensen, 1998). It is important to not force a new innovation on existing customers. Instead direct marketing to focus on uncovering a group of buyers who may have an undiscovered need for a vehicle that drives autonomous and is more fuel-efficient. General Motors has recently tried to uncover

this group by partnering with ridesharing company LYFT (Macmillan, 2016). The hope is to provide an on-demand taxi service/ride sharing using autonomous vehicles. An alliance between two companies that have different competencies could be extremely useful in taping a new market.

Christensen (1998) points out "the only useful information about the market will be what the firm creates through expeditions into the market, through testing and probing, trial and error, by selling real products to real people who pay real money". What he means by this is that, the innovation needs to be tested by real people who are willing to pay money for the product. It is essential for the consumer to learn how autonomous technology could be used in real life and discover all the unforeseen benefits it could provide. Tesla is pioneering the continuous deployment method of product development. In the past, firms will develop and refine a durable good till it is ready for consumers. Since Tesla's automobiles rely on software, Tesla is able to continuously deploy updates to fix and meet customer's demands. These factors are untestable and measureable.

Christensen also addresses the importance of having a plan to learn from while executing a strategy. Companies will not pick the right market for their product to enter at first, usually that market will pick itself. There is a high probability that a better direction will emerge as the business heads toward its initial target (Christensen, 1998). In the past successful managers have conserved resources to attack and find the right market on their second and third tries. (Christensen, 1998)

Potential Markets: Mobility

As a disruptor, it is important to find potential markets for who may use your product. Tesla was able to establish itself in the EV market by creating a differentiated product that appealed to an under supplied customer base. Autonomous driving technology has the potential to affect a lot of markets not only involved in the automotive industry.

A study done by Anderson et. al. (2014) suggested that AV technology could increase the mobility of people who are unwilling or unable to drive. At level 4, autonomous vehicle technology is able to drive itself without human intervention allowing people without mobility to access essential services of society. Although mass transit offers these services currently, Tesla marketing could consider the freedom it offers an individual consumer. Tesla should encourage its team to market this technology as a freedom to increase mobility to those who are currently disabled or unwilling to drive. Although this is a relatively small market, it is basically untapped by major automotive incumbents. This market seems like a viable approach especially when looking at how disruptive innovations have emerged in the past. (Anderson et. al., 2014)

Tesla & Disruption Theory:

Applying the case of Tesla to the theory of disruption raises some questions as to how Tesla fits the model. Typically, Christensen (1998) argues that low-end products enter before traveling up stream to disrupt the market. He characterizes

disruptive products as being cheap and affordable. Tesla entered the market at the high-end contradictory to Christensen's predictions, yet aligning with other characteristics associated with disruption that are also identified by Christensen. He writes, that disruptive innovations may outperform the established products and cost a premium price rather than a discount. High-end disruptors go after the least price-sensitive consumers, targeting incumbents' most profitable clients. An example of this type of high-end disruption took place when iPod's were released and immediately disrupted Sony's Walkman brand. Even though Tesla might not match Christensen characteristics of disruption it does align with characteristics that can be considered disruptive.

Adner (2002) focused on the demand side conditions that need to take place in order for a disruptive technology to succeed. Adner stressed the importance that price plays for consumer acceptance of disruptive technology. On April 1, 2016, Tesla started taking orders for its affordable and mass-produced electric vehicle, Model 3. Within 24 hours, orders exceeded 124,000 growing to more than 200,000 by day two. These orders exceed the total number of EV sold by all manufacturers in the United States in 2015 (King, 2016). As Tesla moves down market, consumers are strongly indicating the demand for this product

Chapter 3

Discussion:

What Tesla Needs to-do to Take Advantage of Autonomous Technology; How Other Firms Are Reacting/Embracing Autonomous Technology:

There are a number of major automotive and software companies developing forms of autonomous driving technology. Most automotive companies are not yet at the initial stage of making autonomous driving technology a major selling point to their consumers. Major automotive manufacturers like Audi, General Motors, Toyota, and Nissan all are developing AV but are still many years away from launching their systems into the market. Although these companies do offer Level 1 and 2 autonomous technologies such as parking aids and lane assist, they are far from where the AV drives itself. These companies are equipping current vehicles with semi-autonomous technology but are not using it as a marketing strategy to sell vehicles, yet. Software companies like Google and Delphi have been testing their autonomous software for a couple years, logging thousands of miles in unmanned vehicles. These companies aim to develop and distribute the technology to major automotive companies but don't plan introducing anything till at least 2020. (Gao et. al., 2016)

Tesla has been the first mover in the autonomous market with its semi autonomous autopilot software. In late 2015, they introduced the first step in self-driving technology through a software update for their Model S sedan. Tesla's released a statement regarding the technology and explains where they currently stand regarding AV.

"Tesla Autopilot relieves drivers of the most tedious and potentially dangerous aspects of road travel. We're building Autopilot to give you more confidence behind the wheel, increase your safety on the road, and make highway driving more enjoyable. While truly driverless cars are still a few years away, Tesla Autopilot

functions like the systems that airplane pilots use when conditions are clear. The driver is still responsible for, and ultimately in control of, the car. What's more, you always have intuitive access to the information your car is using to inform its actions." (Tesla, 2015)

Tesla has positioned itself perfectly in the market. By testing the software with existing customers that are able to develop and refine the software to a point where it can be released on a mainstream scale. As said in the market for EV, customer feedback from consumers who are paying for this technology is crucial in its development. In the past electric vehicles failed when placed in the mainstream market upon release. William Glaub (1995), Chrysler General Sales Manager in the 1990s once said, "Markets are developed with fine products that customers desire to own. No salesman can take marginal product into the marketplace and have any of establishing a sustainable consumer base. Consumers will not be forced into a purchase that they do not want." From a disruptive technology standpoint; Tesla is marketing this software as something that is simple, accessible (if you own a Tesla), and affordable because it is a free upgrade. Some could make the argument that it is expensive to own a Tesla and you are basically paying for the software through ownership. I make the argument that this is only the initial stage of development for Tesla's autopilot being disruptive in the automotive market.

The best move a company can do for disruptive technology is put itself in a position to benefit whatever the outcome may be. Although mainstream acceptance of EV's and AV's may be a decade away, Tesla has positioned itself for these coming disruptions. Tesla has been able to market itself as the leader in renewable

technology from batteries, software, and solar panel sensors. They will have to wait for the market to catch up before they will be able to be profitable. Tesla will be in position to exploit the upcoming disruptions before its competitors.

In the past, disruptive products often suffer from a similar challenge, customer feedback. It is hard to guide engineers and designers without a reliable source of customer input that addresses the needs of the consumer. Tesla's introduction of the autopilot software to existing customers solves this initial predicament. Tesla will be able to learn from its customers to develop and refine its system for the mainstream market. Using incremental develop stages and software that is fully aware of addressing and then fixing its own problems is unique and gives Tesla a competitive advantage.

Every major automotive maker is engaged in some sort of research involved autonomous technology as well as numerous outside suppliers. Christensen talks about the importance of functionality and reliability with disruptive products. Foreign automakers were able to disrupt Detroit's big three by developing a simple, accessible product. Tesla was able to disrupt the electric vehicle market by offering a technological yet simple product to an under established market. Tesla's product development strategy could take credit for this success. By the time Tesla's Model 3 is ready for consumers in 2017, it will have refined and developed autopilot. The Model 3 will be the catalyst for the software since it will Tesla's first affordable and accessible vehicle to date. For example, in the past customer's preferences have shifted when new technology enters the market. When Toyota and Nissan entered the U.S. Market with simple and reliable cars, they established a low-end position,

creating a market for people who wanted a vehicle but didn't need the features just the reliability. The foreign automakers than used this position to move up market and produce cars with more features leaving the door open at the low-end for other entrants (Christensen, 1998). Although Tesla has used a top-down approach, starting with high-end electric vehicles; they still were able to disrupt the market by serving a distinct product to an under consumed market. At this point Tesla will have first mover advantage, which will let them occupy a significant segment of the autonomous vehicle market.

One thing the autopilot system will need to improve before entering and being successful in the automotive market is the price point. Tesla's and other auto manufacturers are spending millions on researching and developing of autonomous technology. To regain some of this cash, automakers have to charge a premium for the technology. In the past there has been a long track record of customers paying price premiums for technology and convenience (Christensen, 1998). Although Tesla is investing millions of dollars in technology, the chance to receive real time feedback is worth the risk. As we will see in the next section, Tesla is playing a game by capitalizing on what they think is the next big break.

Compared to the human driver, autonomous technology is currently unconventional to the typical consumer because consumers do not know the benefits the technology offers. In Christensen's (1998), electric vehicle case study he called this the major downfall for EV's. Disruptive technologies are said to underperform in the mainstream market, and then eventually displace the existing technologies.

Autonomous technology is currently under performing because it has been introduced but not fully developed. Although Tesla has been the first mover in the autonomous driving technology segment, it doesn't mean they are the only automotive firm to tap the potential of this technology. As said before the majority automotive firms are researching and developing similar technology to use within their own automobiles. As much as I would like to classify autonomous technology Tesla's own disruptive innovation, it isn't. Autonomous vehicles will be a disruption to automobiles and transportation in general.

Schumpeter (1942) argues "small firms may have some comparative advantage in the earlier stages of inventive work and the less expensive but more radical innovations while large firms have an advantage in the later stages and in improvement and scaling up of early breakthrough." Tesla may benefit by working with a larger automotive manufacturer to develop and advance Autonomous technology even more. If Schumpeter's argument that large firms possess innovation advantages over smaller entrants than working together would be a win-win for both companies. Dyerson and Pilkington (2005) believe that having a strategy of alliance building between two firms allows them to introduce new technologies quickly and respond to market niches, which in the automobile industry usually takes time to develop.

In a recent study done by Gao et. al. (2016), they found that more consumers are willing to switch automotive manufacturers and pay more for connected car services. With almost a third of consumers willing to pay for technology, automotive companies need to move quickly to capture these opportunities. Tesla is positioning

itself to have the scale, speed, and agility to meet these consumer demands. (Gao et al, 2016)

Future strategies?

Steve Jobs (2008) once said "These waves of technology, you can see them before they happen, and you have to choose wisely which ones you're going to surf. If you choose unwisely, then you can waste a lot of energy, but if you choose wisely it actually unfolds fairly slowly. It takes years."

A technology "S" curve can help make sense of where Tesla stands regarding many of its technologies including autonomous software. The S curve is comprised of invent, commercialize, and harvest. Tesla is currently inventing and developing autonomous software and has dipped into the commercialization stage. The commercializing state involves Tesla communicating autonomous technologies existence to consumers. Innovation takes place in these first two phases. Autonomous driving technology as a whole is still in the invent stage. Tesla, as an automotive manufacturer can look at a curve like this and understand where the market stands and where they currently are.

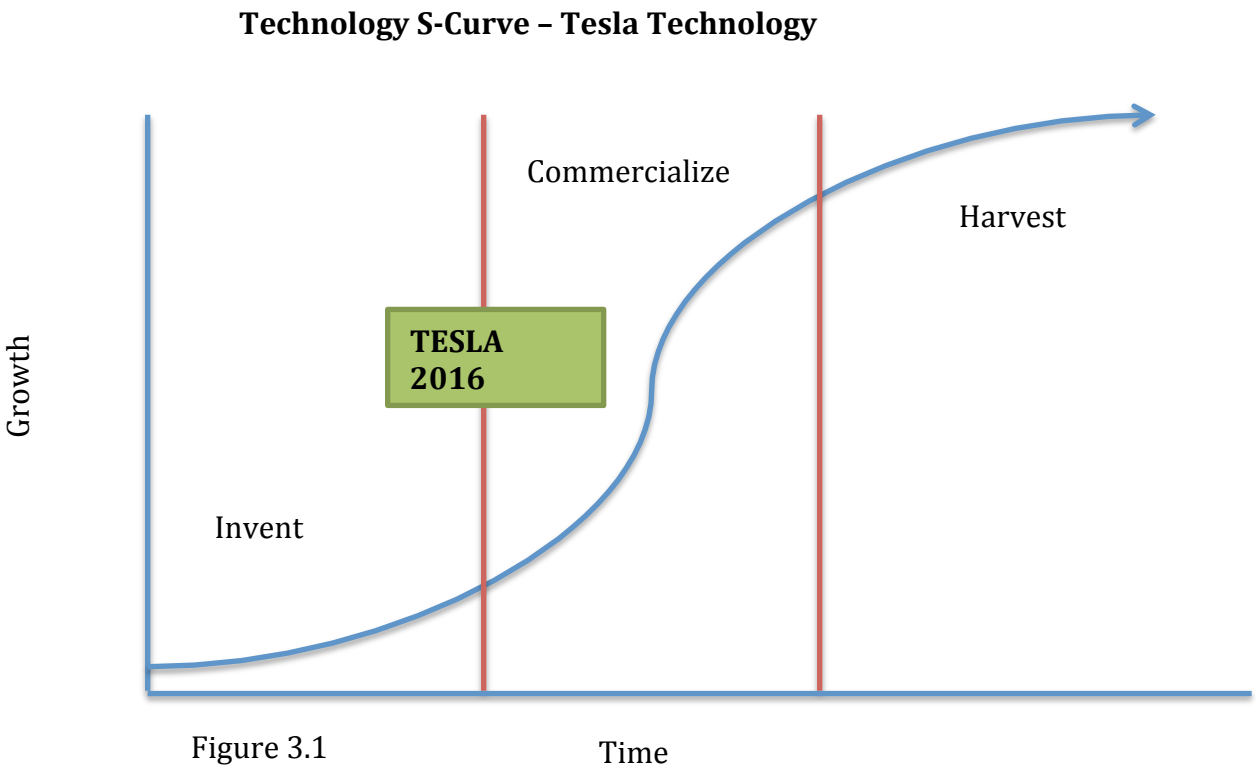


Figure 3.1

Tesla is transparent in official statements about its plans to radically upend existing market structure. The overarching goal of Tesla Motors is to help move the transportation industry from a mine and burn hydrocarbon economy towards a solar electric economy (Musk, 2006).

With regards to the technology curve, many of Tesla's budding technology such as the autonomous driving software are still in the invent stage. This means that Tesla is enabling itself for huge growth potential if their technology predictions come to fruition.

The first example of this challenge was Tesla's work with the electric vehicle. Now Tesla is working to make this vehicle affordable to the mainstream consumer. All new technology has a high unit cost before it can be reduced to an optimized

cost. Tesla being an R&D heavy company has placed all profits back into technology driven to develop more efficient vehicles and energy sources.

Technology trends are not the only way Tesla is predicting the automotive market. Tesla has been able to look at where the auto industry is and where it is heading to place them in a successful spot. Broadly speaking economists believe there are two types of products in an industry, modular and integrated. Integrated products are technology that works together to create one cohesive unit. Modular products are specifically made up of interdependent components that are assembled together.

In the 1990s and early 2000s, the consumer electronics industry saw Dell grow with a modular product because consumers were satisfied with performance but not the price of a PC. In the early 2000's and the introduction of Apple computer, the tide changed. Prices of computers were all relatively low and consumers demanded a better user experience. Apple continued its strong performance by becoming vertically integrated between all its products and has been a huge success to this day (Neilson, 2015).

In Tesla's case it is all about positioning itself to enable growth in either modular or integrated cycles. Neilson (2015) says, "During periods of integration, it is ideal to be integrated firm and to develop products that are benefit focused and user experience optimized". Tesla has created a beautifully integrated product with its electric vehicle. Inside, the user interface enables the customer to control features through their phone and a large user-friendly screen touchscreen. Tesla's supercharging stations around the country allow customers to quickly charge their

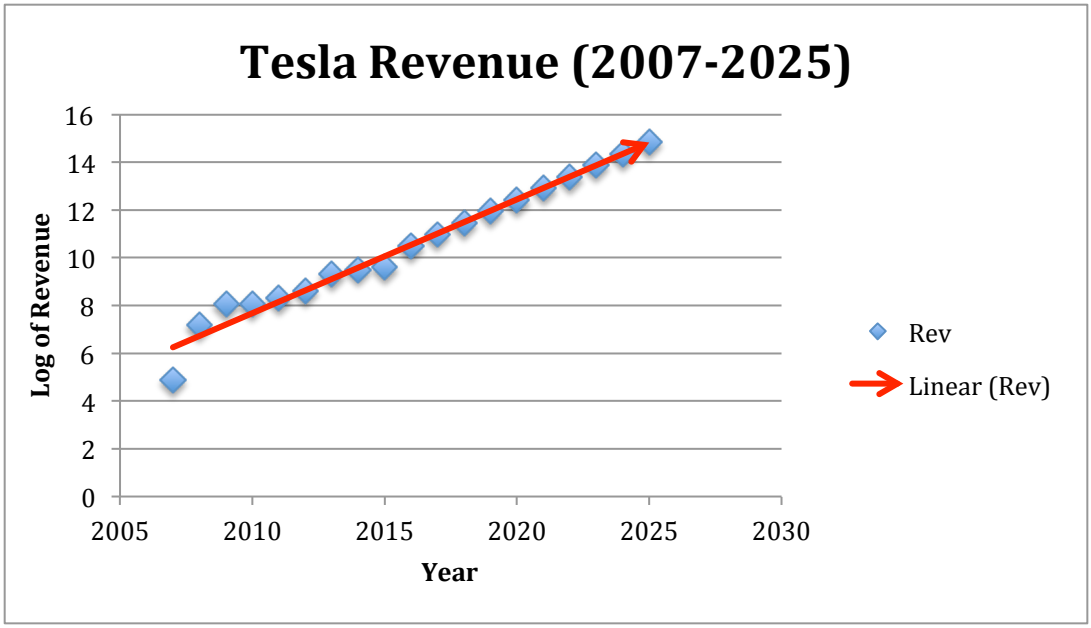
vehicles for free. Sales and service is streamlined to make the customer experience hassle free. Finally, software updates like the semi-autonomous software; update automatically and internally fixes itself as it learns the customer preferences. All these features Tesla offer make an incredibly integrated experience for customers while being disruptive to other automotive manufacturers.

Tesla has not limited itself to success solely in integrated products. Instead, Tesla has also pursued R&D or product development in other sustainable energy sources in order to stay dynamic. Tesla has created products that can be sold individually so it isn't only relying on its electric and autonomous technology. This is a competitive advantage by diversification. Tesla has made itself valuable also to other companies because it has the best of these technology already developed and now incumbent firms can choose to incorporate tesla developed components instead of making their own.

They sell drivetrains and software to other manufacturers as well. As electric and solar technology become more important for the automotive industry and other facets of life, Tesla will be able to supply sustainable sources of power. As Tesla continues to grow production of affordable EV's, their demand for lithium ion batteries will exceed the supply available around the globe. Tesla is currently producing a gigafactory, when done, will be the largest battery factory in the world. The factory alone will help boost electric vehicle sales because there will finally be a sufficient supply of batteries needed to produce electric vehicles at a low cost.

Finally, predictions can be made about Tesla's future growth based on their previous yearly revenue. These numbers are important to look at because they

show the potential Tesla could have in the future. The log of revenue was recorded because it is much easier to see the change between years compared to just using revenue.



(Tesla Motors Inc, 2016)

Figure 3.2

Using the data from the graph above I ran an ordinary least squares regression that gave me an r-squared value of 0.81196 and a coefficient of .484047104. The r-squared value shows how well the data fits to the linear regression line. In my regression the value was .81196 or 81%. This means 81% of the variation in the dependent variable (revenue) is explained by the independent variable (year). My regression coefficient says that for every one-year increase, revenue increases by $484,047,104. This information is important to understand because it gives a indication as to where Tesla's revenue growth is heading in the future.

Kay (1995) has argued “more efficient firms have created unique skills and strengths and will maximize their values by seeking other areas of activity where these special skills may also be of value.” Tesla and its partner company Solarcity have done just this. Tesla has predicted the need for sustainable electric energy and has developed the battery and solar technology to support not only the automotive market but other industries as well.

Conclusion:

The once stable incumbent automotive manufacturers are beginning to be threatened by new entrants bringing sustainable and technologically advanced systems to the market. This technological change is sparking a move towards new paths of development that encompass unproven and uncertain technologies. The electric car and advancements in autonomous software have sparked interest for cleaner more efficient automobiles (Dyerson & Pilkington, 2005). The incumbent automotive manufacturers have to make a decision on whether to invest in these innovations and position themselves where they are able to produce and be profitable when the mainstream market accepts these technologies. This could be risky because companies don’t know whether the market exists or whether tech valued by consumer will actually work.

Christensen's disruption theory framework is inherently flawed in the application of Tesla being a disruptor in the automotive market because it doesn’t acknowledge a top-down approach. The top-down approach seen in Tesla case is where they entered a significantly under served market (electric vehicles) by offering a performance and technologically advanced product at a high cost.

The case study of Tesla showed that their unique business strategy regarding technology, production, sales, and distribution have positioned themselves with the right core competencies to succeed when EV and autonomous technology enter the mainstream market. This position could allow them to grow from a new-entrant to competing with incumbent automotive manufacturers who may have overlooked their capabilities.

Being a first mover in an industry that has profitable potential has given Tesla a competitive advantage over the incumbents in the automotive industry. Automotive companies rely on their existing knowledge and competencies but when new and radical technologies enter the market it is risky to pursue them. Dyerson and Pilkington (2005) write, "established firms are doom by their timid and cautious approach to technological opportunities; more specifically, they are unwilling to consider technological opportunities that arise from outside of their conventional frames of reference[…]This creates opportunities for entrepreneurs to exploit." This is linked to Schumpeter's view on how innovation acts to mediate competition. Although this idea doesn't universally apply to the automobile sector, it does hold true to the Tesla case. Schumpeter (1942) said "now access to capital, resources and skills become important to the delivery of innovation rather than simple opportunity." Successful disruptors will capitalize on both access and opportunity.

Tesla has enabled itself the greatest possible access to research and development by reinvesting all its profits and seized an opportunity not fulfilled by other firms in the marketplace. Building a business model based on the optimal

balance of these two factors, Tesla has established itself on the path to become a successful disruptive innovator and a market force while setting itself up as a competitor alongside previously untouchable companies.

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