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How can the start-ups compete with the incumbents in the automotive market?

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How can the start-ups compete with the incumbents in the automotive market?

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by

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Abstract

This master thesis addresses how start-ups can become competitive in the actual EV-changing automotive market as well as what incumbents should do to adapt themselves. In fact, there are plenty of researches and published articles made towards the changing to EV's from the automotive industry. A lot of authors have approached the incentives for this change, the consumer's expectation, the penetration growth rates of EV's in the market, among other phenomena. Although, no one has ever approached the fact that this industry change can possibly allow start-ups to step in and take a position on the market, as well as what strategies should these companies take in such a competitive environment.

In order to study this matter, the author analyzed several strategies from market incumbents taken towards EV adoption, collected business paths of certain companies that were recent start-ups in the market and did an unprecedented empirical analysis of the automotive market through a linear regression that explains the financial success of an automotive company through nine explanatory variables related with EV adoption.

The research and the empirical analysis revealed that incumbent companies distinguish themselves between the ones that have adopted a first mover approach and the ones who took a laggard strategy towards the EV's. The first ones tend to spend more resources in R&D as well as with Capex expenses, but they benefit by being able to produce their own batteries and powertrain equipment which allow them to become independent from other companies, supply them with their assets and knowledge and produce native EV's who present financial advantages in relation to non-native ones. The second ones have such a market position that allows them to take a laggard approach, not investing

resources on R&D and Capex expenses as the first movers did. These companies tend to take advantage of the path left behind by the first movers and only invest in this market after making sure that there is enough demand to fulfill their supplies. Either ones or the others benefit from the formation of partnerships between each other and with with other companies from different complementary industries, as well as from incentives by the governments related to EV's consumption.

For start-ups it was made clear that they needed to find external help either by incentives of the government or other private investors through events like crowdfunding campaigns in order to support the first years of investment. It was also discovered that start-ups, like the incumbent companies, also benefit from partnerships and are almost obligated to do them if initially they don't have the necessary engineering knowledge or resources to develop own equipment. Dealing with start-ups is a very delicate process and the empirical cases from companies who were recent start-ups and become succeeded as well as the coefficients presented by the linear regression helped a lot drawing the author's perspective of the "ideal" market strategy approach to them.

Keywords: Electric Vehicle; Incumbents; Start-ups; Automotive Market; First Mover, Laggard

Resumo

Esta dissertação aborda a temática de como as *start-ups* podem tornar-se competitivas no atual mercado automóvel que se apresenta em mutação para os automóveis elétricos, assim como o que é que as empresas incumbentes devem fazer para se adaptarem a essa mudança. De facto, existem muitas pesquisas e artigos publicados sobre a mudança da indústria automóvel para os automóveis elétricos. Muitos autores abordaram os incentivos que levaram a essa mudança, a expectativa do lado dos consumidores, a taxa de crescimento da penetração dos automóveis elétricos no mercado, entre outros fenómenos. Contudo, ninguém ainda tinha abordado o facto de que esta mudança na indústria possivelmente poderia abrir portas para novas empresas (*start-ups*) entrarem e tomarem uma posição no mercado, assim como que estratégias é que estas empresas devem adotar num mercado tão competitivo.

De forma a estudar este assunto, o autor analisou diversas estratégias relacionadas com a adoção de automóveis elétricos que os incumbentes do mercado adotaram, colecionou dados de casos concretos de empresas que foram recentemente *start-ups* e fez uma inédita análise empírica do mercado automóvel através de uma regressão linear que explica o sucesso financeiro de uma empresa automóvel através de nove variáveis explicativas relacionadas com a adoção de automóveis elétricos.

A pesquisa e a análise empírica revelaram que as empresas incumbentes distinguem-se entre as que adotaram uma postura pioneira no mercado dos carros elétricos e as que decidiram atrasar essa entrada no mercado. As primeiras acabam por despender mais recursos em investigação e desenvolvimento assim como com despesas relacionadas com *Capex*, mas beneficiam por conseguirem produzir as suas próprias baterias e equipamentos de forma a tornarem-se

independentes das restantes, puderem fornecer o seu equipamento e conhecimento, e produzirem carros elétricos nativos (que promovem mais vantagens financeiras que os não-nativos). As segundas empresas possuem uma posição de mercado tal, que lhes permite darem-se ao luxo de entrar tarde no mercado, não despendendo tantos recursos no investimento necessário. Estas empresas acabam por se aproveitar do caminho deixado pelas pioneiras e apenas investem nos carros elétricos quando têm a certeza que o mercado possui a procura necessária para absorver a oferta. Tanto umas como as outras beneficiam da formação de parcerias entre elas e entre outras empresas de indústrias complementares assim como de incentivos pelo governo ao consumo de carros elétricos.

Para as *start-ups* (empresas novas) ficou claro que precisariam de encontrar ajuda externa, sejam incentivos governamentais ou outros investimentos privados através de eventos como campanhas de *crowdfunding* de forma a puder suportar os primeiros anos de investimento. Também foi descoberto que as *start-ups*, como as empresas incumbentes, também beneficiam de parcerias e são praticamente obrigadas a fazê-las se, inicialmente, não apresentarem o conhecimento de engenharia ou os recursos necessários para desenvolver o seu próprio equipamento. Lidar com *start-ups* é um processo muito delicado e os casos empíricos de empresas que foram recentemente *start-ups*, e se tornaram bem-sucedidas, assim como os coeficientes apresentados pela regressão linear ajudaram bastante a desenhar a perspetiva do autor da abordagem estratégica de mercado ideal para elas.

Palavras-Chave: Automóveis Elétricos; Incumbentes; Start-ups; Indústria Automóvel; Pioneiras

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Abreviations

ADAS – Advanced Driver-Assistance Systems

BEV – Battery Energy Vehicle

CapEx – Capital Expenditures

EV – Electric Vehicle

FCF – Free Cash Flow

ICE – Internal Combustion Engine

IEA – International Energy Agency

OECD - Organization for Economic Co-operation and Development

OLS – Ordinary Least Squares

PHEV – Plug-in Hybrid Vehicles

R&D – Research and Development

kWh - Kilowatt per hour

Chapter 1
1. Introduction

1.1. Purpose and Research Questions

This master thesis examines the actual changing environment of the automotive industry. With the growing number of Electric Vehicles on the roads in every developed city in the world it is important to ask if this is the proper time for start-ups and unusual players from different industries to step-in and make a statement against the old incumbents in the market.

The history has told us that in a free market the customer is in charge of the path of certain industry market. In fact, in this case, the change to Electric Vehicles is being motivated not only by customer demand but also by heavy political changes and environmental concerns.

By these means the following research questions are proposed on this master thesis:

1- What should the incumbent automotive companies do to maintain or regain their market position?

2- What can the start-ups do to be competitive in such an expensive and complex market with lots of players competing for ultimate innovation and customer attention?

1.2. Document Structure

This document is divided into seven chapters. The "Introduction" aims to contextualize and refer the proposed research questions. The "Literature Review" presents the concepts that will be necessary to approach during the study and the main theories and market evidences from recognizable authors that will help to understand and develop a way to answer the research questions. The "Methodology" describes the procedures used to make the third chapter: the "Development". This one gives us an understanding of the actual automotive market by the author's perspective, presents an interpretation of the business paths of six well succeeded automotive companies that were recent start-ups and formalizes a theoretical model through that information. In this chapter the author will also present a study of the recent Electric Vehicle related partnerships and merges done between the most recognizable brands of automotive companies and an empirical analysis through a linear regression that explains the financial success of an automotive companies through other nine explanatory variables. The fifth chapter is the "Discussion" where the author answers the research questions using the theory presented on the "Literature Review" and all the empirical studies made on the fourth chapter. The final chapter is the "Conclusion" where the author mentions the implications and limitations of this master thesis as well as possible future research suggestions on this matter.

Chapter 2
2. Literature Review

2.1. Actual situation of the automotive market

"Today there are approximately three quarters of a billion cars worldwide and if the industry continues to produce cars at the current rate, there will be two billion cars on the road by 2050" (Hong Paul, 2012).

In fact, the automotive industry has been growing and suffering a big transformation since the past 15 years.

Known as an industry fully dependent on fossil fuels, nowadays there is a real mass marketed alternative with the battery electric (BEV's) and the plug-in hybrid vehicles (PHEV's).

According to REVE, a Spanish Magazine that stands for environmentally friendly energies, in a recent published article with evidence from institutions as IEA (International Energy Agency) and OECD (Organization for Economic Co-operation and Development) it was argued that the penetration rate in the global market of EV's and PHEV's is not truly significant (2.2% in 2019). But despite of that, according to Hertz Patric (2018), EV's sales grew more than 2 million units compared to 2017 which meant an increase of 63% on a year-on-year basis (this rate increase has been slightly growing over the years. As a matter of fact, according to Amadeo Kimberly (2019), it was argued that the global EV market is growing, on average, 22% a year. In 2017 it represented $119 billions of the global economy and it is predicted to reach $567 billions by 2025. It was also

referred that by 2030 it is predicted to be 18,7 million EV's on the roads around the world.

In fact, all these facts make sense when we're analyzing consumer's EV preferences. According to Baik (2019), in the U.S., between 10-30% of the consumers indicated their preference to buy an EV instead of an ICE vehicle in their next car purchase (on national surveys). In Europe this percentage was slightly higher with 40-60% of the consumers showing the same interest. Finally, in China this percentage hits the target of 70%.

Actually, the automotive market didn't suffer any significant mutations for a long period and it is quite usual that incumbent companies like General Motors, Volkswagen, Toyota, among others, were strongly positioned and dominating the market. By this reality, there was no real interest for new companies to step in as the most competitive factor was the relationship between price/quality of the vehicles (the ICE vehicles' profit margins are already very low) and the recognition of the brand name by the customers. To achieve a competitive price/quality relation and a recognizable name it was necessary to have very low costs of production, a long presence in the market and great investments in R&D alongside with a very well-planned value chain.

2.2. What are the main contributors for the introduction of EV's?

According to Woodward (2019) there are two major factors driving the change to EV:

The **first factor** is due to policies and environmental regulations. It brings reasons as the fuel economy and emissions target, financial incentives and city access restrictions. These subjects encourage the growth of EV adoption.

For example, there are a lot of governments that impose emissions and fuel economy regulations. In order to meet these mandated targets, the EV market

will have to grow significantly. PHEVs and EV's market share will need to reach a combined 10% by 2025 and 22% in 2030.

To fulfill with these governments wishes there are some financial incentives like government subsidies, value-added tax (VAT) and vehicle registration tax exemptions. Also, the 20 major cities worldwide have announced plans to ban gasoline and diesel cars by 2030 or sooner.

Among all these policies, the International Energy Agency (IEA) – a global organization that works with countries in order to secure the energy sustainability of the world) set out a "Blue Map" scenario that aims to achieve a combined EV/PHEV share of a sales of 50% worldwide by 2050.

The **second factor** is the customer demand. Despite the incentives by the governments for the adoption of EVs, there are still a number of barriers to overcome before the majority of customers are comfortable with the switch, bringing the problem of the "**expectation gap**".

2.2.1. Expectation Gap

According to Woodward (2019), there are 4 most important customer concerns regarding EV's: driving range, cost premium (majority of EV's are more expensive than the average ICE vehicle), lack of infrastructure (rechargeable stations) and time required to charge.

As competition in the EV market grows, an "expectation gap" is emerging between manufacturer capacity projections and demand from customers. This "expectation gap" between capacity and demand has serious implications for the industry. To produce the capacity that is forecasted, investment in R&D is happening now. However, because of the expected "expectation gap", the overall industry capacity forecasts for 2030 approximately 14 million units above Deloitte's consultor Woodward (2019) projections for consumer demand.

This will create an excess of EV's supply, in relation to the predicted consumer demand. However, Deloitte estimates that the market will reach a tipping point in 2022 when the cost of ownership of an EV will be on par with its ICE counterparts. Maybe the customers will then change their minds and bet even more on EV's purchase.

2.3. Effect of the EV's on the automotive complementary industries

According to Meade (2006), "… electric vehicles will constitute a higher proportion of all new cars produced over time, so average input coefficients will change in the auto industry, thus affecting the demand for other industries that supply to the industry.".

There is a dependent economic and political connection between the automotive industry and other complementary industries such as the oil one. This interdependency has been a barrier along the time regarding the change from combustion vehicles to electric ones. Imagine a world with no gas stations, where people can recharge their cars at home or at a simple recharging stations that are much smaller and cheaper. This can be a great achievement for the society as a hole but for the oil industry it is a huge threat that is becoming a reality. (Orsato and Wells, 2007)

As we'll see further ahead on the study, there are several complementary industries that will have to change or adapt its business in order to survive and others are already making partnerships with some automakers as a way of integrating the industry.

2.4. Battery: The heart of EV's

According to Meade (2006): "… in the electric car, one battery is removed and perhaps twenty to thirty are put back in.". In fact, the theory says that despite of the huge number of batteries, the "heart" of an electric car is much simple, demanding lower operational costs because of the small number of moving and wearable parts.

Financially speaking, the batteries of EV's are the most interesting part for different reasons. Firstly, they are the most expensive part of the car, so the investment becomes higher either for the producer as for the consumer; secondly the batteries must be changed from 5 or 6 years, meaning that the companies must find a solution that protects the customer from spending 10,000 USD or more every 5 years.

There are different kinds of vehicle batteries in the market and according to Bossche (2006) we can identify the pros and the cons of the most used batteries in the automotive market.

The most common is the lead-acid battery that is the oldest and the most widely used for industrial electric vehicle sector, its cost is low but presents a very low specific energy of about 30 kWh (Kilowatt per hour). So, the lead-acid is less suitable for advanced high-performance EV's.

Then we have nickel-cadmium battery that has a specific energy nearly twice as high as the lead-acid batteries (50 kWh), availability of fast charging and a good life cycle. Its main downside is the purchase cost that is very high, so it is more uncommon.

Finally, we have the lithium-ion batteries, that have potential for high specific energy (up to 2000 kWh kg) and have been hailed as the promising battery for the future. They are safer, more stable and not as expensive as the nickel-cadmium ones. High performance EV's often use this kind of batteries like Model S from Tesla.

2.4.1. Falling costs of EV batteries

For a greater penetration of the EV in the market it is crucial that the battery prices become more accessible and cheaper.

According to Nykvist and Nilsson (2015), industry-wide cost estimates declined by approximately 14% annually between 2007 and 2014, from above $1000 to around $410 per kWh. And the cost of battery packs used by market-leading EV manufacturers are even lower at $300 per kWh, declining 8% annually.

These facts have significant implications for the modeling future energy and allows an optimistic outlook for EV's.

These authors believe that the cost of battery packs needs to fall below $150 per kWh in order to EV's become cost-competitive on par with internal combustion vehicles (according to Deloitte's studies this tipping point will happen in 2022).

2.4.2. Depreciation Rates of EV's

Another important financial aspect is the depreciation rate of the vehicles.

According to Faria (2012), the average depreciation rate of ICE vehicles is 0.2 while the electric ones have a depreciation rate of 0.15. These values can mean longer periods of customers rebuy of vehicles and that can hurt the automaker's sales.

2.5. What are the necessary tools for a company to invest in innovations?

According to Weaseling (2013), we're able to identify 4 different types of assets that are necessary for a company to invest on innovation and to be pioneer in a new marker segment:

1- Technological assets that are related to the knowledge itself of the components of an EV (Internal developments are transformed into **patents** and external ones are measured by **partnerships** with other firms);
2- Complementary assets - tools like production facilities and distribution channels that are essential for acquiring the final product, usually partnerships are made to get access to these complementary assets (essentially by start-ups);
3- Infrastructural assets – patent applications and partnerships focused on the combability of the charging infrastructures;
4- Reputational assets that is the customer's perception of the company alignment with existing norms and values, forming the "brand experience".

2.6. Incumbents position in the upcoming changing automotive market

With the social aware for environmental issues backed up by the media, social networking and strong incentives by the government, it opened a great window for start-ups to step in and present new environmentally friendly vehicle solutions that could differentiate themselves from the standard vehicle manufacture approach by the incumbents in the market. The price/quality and

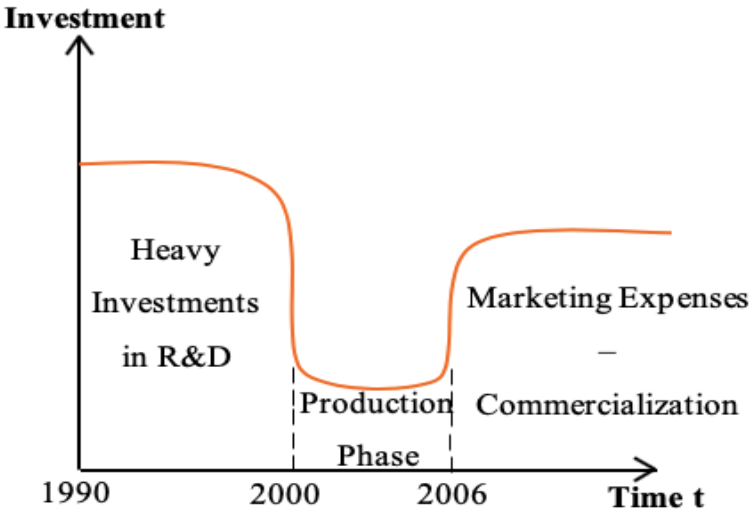
the brand name recognition of the same Internal Combustion Vehicles (ICE) were no longer the only one factor in the customer's choice. Now, the customer is concerned about the planned prohibition of circulation of ICE vehicles by some governments in some cities of developed countries around the globe, with the price of the fuel that is becoming higher over time in comparison to the price of electricity that is significantly lower, and with many other factors that influence his/her decision on the next vehicle to buy and will be mentioned throughout this article.

In such a changing automotive industry environment, it is important to analyze what is the strategy taken by the incumbent companies to maintain their market position and on the other hand **what can the start-ups do to be competitive in such an expensive market with lots of players competing for customer attention**. This second question presents to be the main concern of this dissertation.

According to Weaseling (2013) it is possible to analyze the initial approach of the incumbent automotive companies to this new market trend.

Overall, the incumbent companies have had a very similar approach to the EV in terms of patents and partnerships throughout time (between 1990 and 2011). In the first stage, they strongly invested in R&D, made partnerships and protected their innovations through patents. The partnerships appeared cause the risk and the level of uncertainty was too high in order to a single company bet alone on EV.

In 2000, the incumbent companies went through a period of apparent inactivity that was used to produce the EV's models. In 2006, the incumbents started to commercialize the vehicles now. (Graphic 1)



Graphic 1: Evolution of the Money invested by the Incumbents through the years.

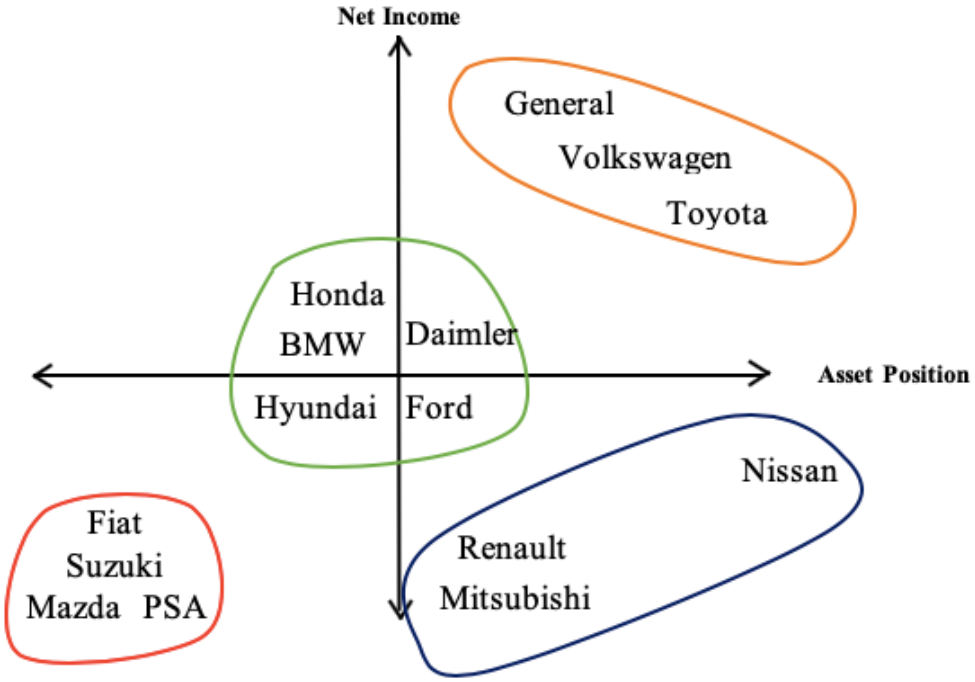
Y axis – Investment $; X axis – Time measured in years
Source: Weaseling Joeri, 2013

2.6.1. Incentive vs Opportunity to innovate for incumbent companies

"For a large car manufacturer to exploit an innovation such as the EV, it needs both an incentive and an opportunity to innovate." (Swann, 2009).

The incentive to innovate is related to the capability of a firm increase its market share by introducing new innovations. The opportunity to innovate is related to the investments a firm can make to support innovation.

According to these 2 variables, Weaseling was able to identify 3 groups of incumbent companies as we're able to observe in the graph 2: the first movers, the quick followers and the laggards (Freeman and Socte, 1997).



Graphic 2: Position of the Incumbents according to their annual net income results and asset position

Y axis – Average Annual Net Income $ (Incentive to Innovate); X axis – Asset Position (Opportunity to innovate);
Source: Weaseling, Niesten, Faber and Hekkert, December 2013

The blue cluster with Renault, Mitsubishi and Nissan constitutes the **first movers**. They have a strong asset position in the market and relatively low average annual net income. These firms have introduced a large number of EV's compared with any other car manufacturers. Mitsubishi quickly developed a strong asset position during the commercialization period (between 2006 and 2011) and that enabled the company to pioneer in the mass marketing (in this period PSA ordered one-hundred thousand of EV's from Mitsubishi). Renault and Nissan formed a partnership to commercially exploit the first purpose-built EV, selling approximately 32 000 units by the end of 2012. Renault had a more diversified strategy towards marketing EV's and launched 4 different models between 2012-2013.

The red cluster with Fiat, Suzuki, Mazda and PSA is considered a **laggard strategy** zone. None of these firms intended to commercialize EV's in the short term. In 2012, Suzuki had no plans about EV's, Mazda delayed EV exploitation until 2018 and Fiat had planned just a restricted market introduction of its EV's in California. PSA avoided its early investment in EV's by buying and reselling ready-made these cars from Mitsubishi and by using Venturi Automobiles (a French car-race manufacturer) capabilities to transform PSA existing Vans into EV's – this was a very lazy approach since a non-native EV will never by as functional as a native one.

The orange cluster also represents a **laggard strategy.** This group compounded by General Motors, Volkswagen and Toyota represents 3 companies that didn't provide much EV's during the commercialization period. Toyota argued that it preferred to wait till the electrification of the EV's was high enough so that Toyota can exploit it without any potential risk, taking advantage of the knowledge leaks of other companies between each step. Volkswagen initially was very kin on adopting a "slow follower EV strategy" and as Toyota, Volkswagen was waiting for others to take that initial step and play safer after that. General Motors wanted to mimic the success of the Toyota Prius using plug-in hybrid vehicles (PHEV).

The green cluster is compost by Honda, BMW, Daimler, Hyundai and Ford and represents the group of **quick-followers**. BMW, Ford, Honda and Daimler started by experimenting some EV's market introductions, while Hyundai was only focusing on the introduction of fuel cell vehicles, this is a type of EV that uses a fuel cell instead of a battery (the fuel cells generally use oxygen and compressed hydrogen to generate its power), there is an example of Hyundai EV's powered by fuel cells that is Hyundai Tucson.

2.6.2. Theoretical explanation of the 3 positions

Usually we can relate **high average annual net income** of the incumbents with **high incentive to innovate** in a changing market as the automotive one, and the **low annual net income** with the exact opposite. The **asset position** of the incumbents that represents if a company has plenty of production facilities with R&D departments ready to come up with new market solutions or fantastic human resources and high-tech production machines, usually is related to the **opportunity to invest** of the incumbents.

As we could observe in the graphic 2, for an incumbent to innovate firstly in the automotive market, it is not ideal that it has both a high incentive and a high opportunity. Cases such as General Motors, Volkswagen and Toyota can prove that. It is also not ideal that a company presents itself with low incentive and low opportunity to innovate, as it happens with companies like Fiat, Suzuki, Mazda and PSA. In fact, all these companies adopted laggard strategies.

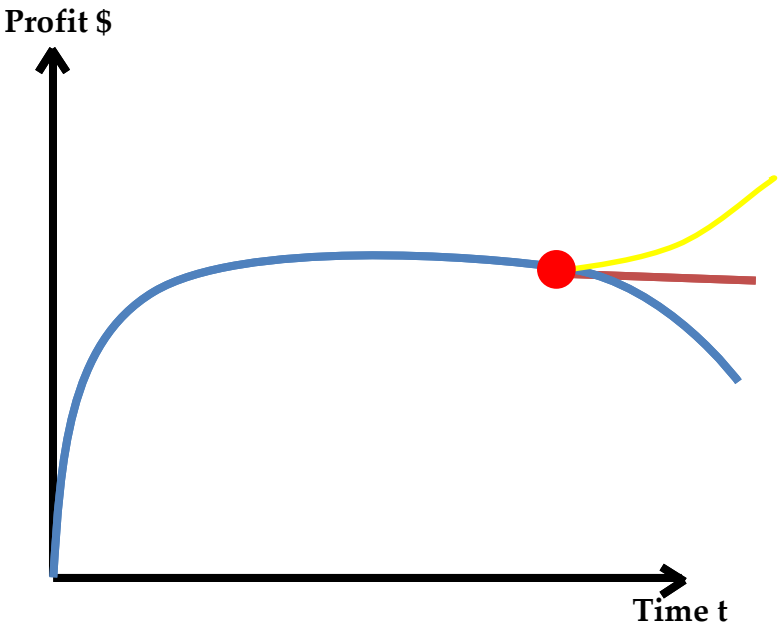
The first ones have a great asset position with very nice facilities that can provide everything a company needs, and also have a relatively high annual net income compared to their competitors. So, why don't these companies want to be first movers? Firstly, they represented a huge percentage of the automotive market at that time with a lot of vehicle owners using their own models so, they didn't need to be the first ones to come up with a different solution that could kill their own profit. They've invested a lot of resources in the ICE vehicles that people were still buying and financially speaking it didn't make sense trying to convince their clients to change their preferences. If something is making profit, it is not advisable to change that strategy, unless the profitability curve starts to fall (Graphic 3), in that case it is advisable to adopt innovation strategies to keep up with the competition and try to follow the yellow curve instead of the red or

blue. The second reason that justifies why these well positioned companies don't want to move first in the innovation phase is that in the first stages of any innovative product there is always some uncertainty, failed models and projects, difficulties in public education (in this case for EVs) and a lot of risky moves that could go wrong. A well-positioned company doesn't need to take all these risks and waste money on failed attempts, they have all the necessary resources and brand recognition to quickly come up with the innovative products (sometimes even more developed than the ones built by the first movers) that the first mover companies have developed once these products are launched in the market.

The companies with low incentive and low opportunity to innovate logically don't have reasons to move first.

So, statistically the companies with low incentive but high opportunity to innovate are the ones who move first (like Nissan, Renault and Mitsubishi). These ones have the facilities and the necessary resources to develop new technologies and new products but aren't currently the best positioned companies in the market, already starting to follow the red or even the blue curve in the Graphic 3. These companies prefer to take the risk of investing in some new products, trying to be rewarded with a better brand recognition or better public acceptance, building a disruptive market trend on an industry that hasn't suffered significant changes in a long time. Of course, these strategies can go wrong, so usually these companies work together with partnerships and cooperation strategies, allowing them to minimize the risks and maximize the future profits.

The other companies that have an average incentive and average opportunity to innovate usually adopt a quick-follower strategy, what makes sense because they are not in a position to risk a lot, investing before anyone else in new technologies, and they can't afford to be laggards as General Motors and Volkswagen can, so they stay in the middle quick following the first movers.



Graphic 3: Evolution of the profit curve through time

Y axis –Profit $; X axis – Time t.

Chapter 3
3. Methodology

In order to properly understand the current automotive industry, it was necessary to go through a deep analysis of the 5 strengths of Porter.

As the main concern of this dissertation is to study how can the start-ups* compete with the incumbent companies in the automotive market, there was a necessity to complement this information presented on the literature review about the incumbents' EV market approach with some theoretical model that could show us the start-up's perspective of the market.

To do that, there was analyzed the case of 6 automotive companies (Tesla, BYD, Chery, ElectraMeccanica, Sono Motors and NIO) that had recently started their automotive businesses and focused on producing EV's as a factor of differentiation from the competition and as a way of projecting the future of the automotive market (this means that some of them are companies with more than 10 years and constitute now some of the big industry players, but the main goal is to study what was their strategy approach to this competitive market when they were just starting their business journey). These 6 companies have all been successful and the main concern was to find the key variables that have distinguished them in their respective business journeys as a way of constructing the theoretical model.

After analyzing every business journey of the 6 companies, the author realized that there were 6 variables that distinguished them from each other: self-made batteries vs Outsourcing; Capital-Intensive vs Labor Intensive and Government Help vs No External Incentives.

After positioning the companies in 3 different graphics the author was able to draw a theoretical diagram that simplifies the initial situation of every start-up in the automotive market.

Throughout the hole study of the upcoming changing to EV's, the author realized that whether a company presents itself as an incumbent or as a start-up, there was always incentives to make partnerships towards the development of new EV models with autonomous driving (ADAS) features. So, in terms of research it made sense to present some recent partnerships that were made between some of the most recognizable automotive companies (and between other complementary industries' companies). These partnerships help to demonstrate the R&D effort that all firms are making at the present moment.

After this theoretical approach, there was a lack of empirical evidence to prove the concepts that were analyzed such as: first mover strategies, incentives by the government, EV related partnerships, among others. So, a linear regression was made through Stata program, based on a cross-section data collected from 31 different automotive companies (information about the companies in the appendix). This data includes companies from different backgrounds, that have had different EV strategy approaches whose headquarters belong to different countries around the globe. I believe that I was able to build a diverse group in order to create a viable statistic study that presents trustworthy coefficients from the different variables analyzed.

This linear regression uses the OLS algorithm to explain the FCF (the author used the FCF as a measure of realistic financial success of the firms; the values that were used represent an average of the last 5 FCF presented by the annual reports of the companies at study) of the companies through other 9 explanatory variables.

The 9 explanatory variables include all the concepts that were theoretically studied through the dissertation such as: external incentives for the EV market,

first movers strategies taken by some companies (used as a dummy explanatory variable that took the value 1 whether a company uses that kind of business approach and took the value 0 otherwise), present global market share, EV related partnerships, own production of the batteries (used as a dummy variable that takes the value 1 whether a company produces its own batteries and took the value 0 if it outsources that equipment), percentage of native EV's compared with the total EV's produced, among other variables that weren't mentioned.

After getting all the coefficients of the explanatory variables through the OLS algorithm, it was possible to verify the empirical results with the actual theory stated in the study, making the best possible conclusions.

Chapter 4:
4. Development

4.1. Industry Analysis - Porter's 5 Forces

Is a model that identifies and analyses five competitive forces that shape every industry and helps determine an industry's weaknesses and strengths. Five Forces analysis is frequently used to identify and industry's structure to determine corporate strategy.

The car industry is characterized by a constantly changing environment. There are a lot of incumbent companies with large R&D centres that are competing with each other all the time. Inside the car industry there are plenty of distinct market segments and companies do their best to position themselves into the segments where they have the most competitive advantages.

Nowadays there are vehicles that are powered by a great variety of sources: gasoline, diesel, natural gas and electricity (with plenty of battery options like zinc or lithium for example). There are even vehicles that are powered by two different kind of sources, these are called Hybrid cars, usually powered by gasoline/diesel and electricity.

Inside these segments there are different kind of vehicles: city and micro cars, vans, jeeps, trucks, sports cars and many others.

Among this huge variety of vehicles, the car industry is still very competitive having multiple players always presenting different innovations to the market.

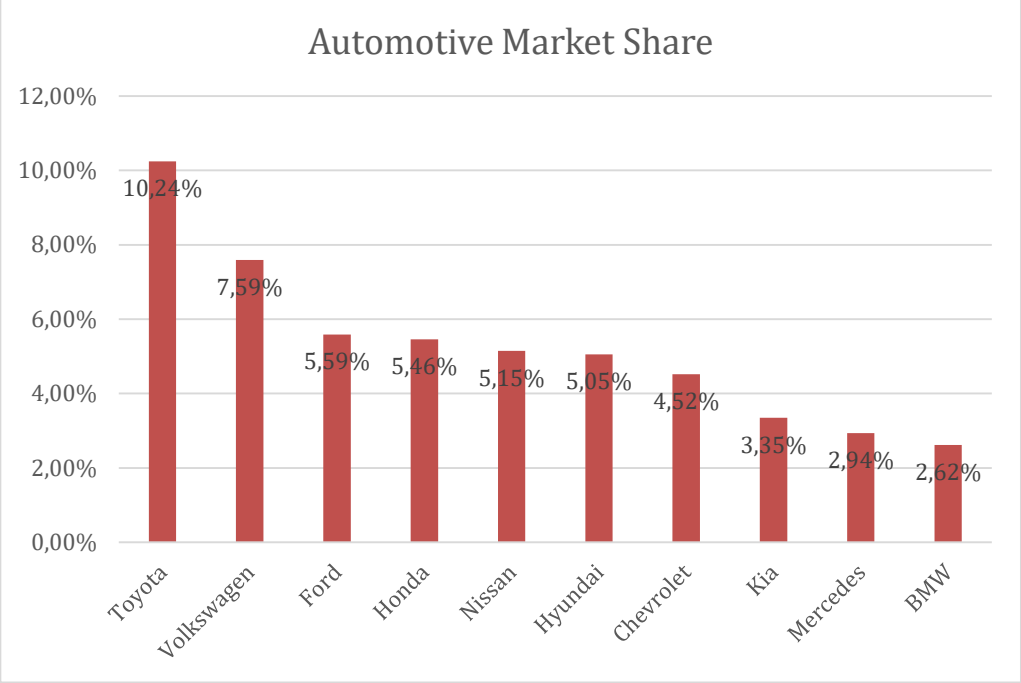
Recently we have been witnessing the change in the consumer preferences from ICE (Internal Combustion Engine) vehicles to BEV's (Battery Electric Vehicles). With the growing concerns about environmental issues such as global warming, the governments started to introduce new laws that impair the ICE's

owners and improve the conditions of BEV's owners. This obviously grows the demand for electric vehicles and incentives the companies to manufacture them.

The incumbents in the market like General Motors, Toyota and Volkswagen have to adopt a strategy to come up with environmentally friendly solutions and adapt their manufacture processes to these new kinds of vehicles. They have already invested a lot of resources in the ICE's vehicles and they can't just lose all the assets that took so long to accomplish. So, they need to go through a delicate process of managing the resources that can be reutilized from the ICE vehicles to the BEV's (people, machines, facilities, software, etc.), then implement the new components required by BEV's that are developed by their R&D centres (the companies that produce their own powertrain systems and batteries are called OBM (Original Brand Manufacturing) and take full responsibility for all the design, engineer and manufacture of the product) or simply outsource it from other companies (like Toyota and Daimler who buy already made vehicle batteries from Tesla).

4.1.1. Competition in the industry - High

According to I. Wagnerm (2019), Toyota was leading the market with a share of 10.24%, followed by Volkswagen (7.59%) and Ford (5.59%). (Graph 4)



Graphic 4: World market share of 10 most significative automotive companies.

Source: I. Wagner, Feb 2020.

As we can observe, Toyota and Volkswagen dominate the market, while Ford, Honda, Nissan, Hyundai and Chevrolet are quite similar in terms of market share with percentages varying between 4.52% to 5.59%.

While there is a lot of competition between companies, there is also space for coopetition what is known as an act of cooperation between competing companies. It is used to expansion the market, improve business relationships, reduce fixed costs, avoid high risks and heavy investments. Toyota, Daimler (from Mercedes) and Tesla form a good example of coopetition where Tesla provides batteries and other powertrain system components for them.

For Tesla the coopetition possibly allows it to: improve their bargaining power, influence the future sales of allied firms and outsiders such as GM and Ford, and predict how and when the **learning-by-doing effect** (without actually investing in R&D and producing their own batteries, Toyota and Daimler will

eventually learn how to produce it just by using Tesla's) will foreshorten and finally end temporary strategic partnerships. For Daimler and Toyota, this coopetition allows the companies to save some money that would be spent in R&D if the coopetition didn't exist. So, for companies that are late to the market, this should be a good business strategy. Although a coopetition may generate a mutual win-win outcome, the conflicts, in terms of the costly negotiation of cooperation payments and severe monitoring costs may also intangibly benefit outsiders.

Nowadays, as we're entering in a new era of the car industry, there is a point of turn where the companies aren't quite sure whether to move first or wait for others to take the first step. Until now we're able to identify 3 different types of business strategies: the first mover, the quick follower and the laggard strategy (Freeman and Socte, 1997). Late in this dissertation, these three types of companies will be used to characterize the incumbent's approach to EV's.

The first movers have the goal to become pioneers and to stay ahead of the competitors through lead-time (the time that a company takes to conclude all its production cycle). Usually, the first movers are firms with a strong incentive an opportunity to innovate because they are willing and able to bear the inherent costs and risks of new products or services, with the respective needed infrastructures.

The quick followers usually prefer to leave the decision to exploit a radical innovation to other players (**first movers**). They have the advantage to avoid the costly mistakes taken by the first movers and are able to quickly follow their path.

The laggards are less engaged in innovative activities and reduce their costs by minimizing R&D. Preferentially they enter the market last.

Based on Weaseling (2013), it is possibly to identify the incumbent companies that followed a first mover, quick follower or laggard strategy and that will be analysed later on this dissertation.

From a global Electric Vehicle market perspective, China is the leader with 1.1 Million units sold (51% of global sales in 2018), about 3 times the size of the European and US market each.

Despite this fact, the Chinese government doesn't give incentives at all, and has cut with all the help that it was giving for the production of high quality BEV's.

BYD and BAIC are the companies who dominate the EV's Chinese market (followed by Chery and NIO), and are the main responsible for the continually presentation of new models, both producing their own electric powertrain components.

In Europe, Norway is clearly the most advanced country, mostly because of the Norwegian EV Association that has been working for the successful introduction of electric vehicles for more than 20 years. The markets such as France, Germany and UK with Renault, Volkswagen, Citroen and other recognizable brand names are now gaining momentum but these countries still represent a low percentage of units sold when compared with Norway. The north of Europe with Sweden, Norway and Iceland dominate the percentage of units sold, but it is believed that with the government politics of CO2 reduction, the south and centre of Europe will follow.

In the US market we have Tesla that is probably the most representative and famous brand of Electric Vehicles in the world. Due to this fact for the first time in American history, an EV sold as much units as a comparable ICE vehicle. The Tesla Model 3 helped the US market to almost double the units sold. Tesla in fact represent 40% and 7% of the US and global market, respectively. The 2025 fuel-economy standards imposed by the government and the state authority under the Clean Air Act will most probably help to increase the EV market of US.

In Japan the EV penetration is only 1%, despite of Japanese companies being first movers with respect to the introduction of BEV's (with Nissan Leaf,

Mitsubishi i-MiEV and many other models). Nowadays there is a lack of a strong push for more aggressive adoption of EV's.

Graphic 5: Distribution of the major EV's world markets.

4.1.2. Potential of new entrants into the industry – High

In times of change as we are currently witnessing in the car industry, there are more opportunities for start-ups to gain position in the market. These **new opportunities** require investment in order to develop **a competitive advantage** in comparison to other players in the market. This advantage can be: a revolutionary business model that presents itself more efficient with new mobility value chains, better human and capital resources, acquisitions (like BYD did when it acquired Shaanxi Qinchuan Auto Company Limited) and partnerships with other companies (like Chery did with Delphi and Viston).

Graphic 6: Start-ups' development process in changing industries.

Investment in new technologies is becoming more expensive and its price tends to rise as the market gets more crowded and diverse with more **external players** coming in. In fact, **Start-up and Investment Landscape Analysis** (SILA), a tool made by McKinsey, affirms that more than 90% of investments in the mobility space in the past 10 years were made by players not traditionally seen as automotive companies (mainly technology, venture capitalists and private-equity companies). Presented with this fact, some incumbents have already started to form partnerships with tech companies (like BMW is doing, planning to integrate Amazon's Alexa technology relative to space voice-recognition in its vehicles), preventing to become obsolete in the market.

According to **SILA** it is known that there was nearly $111 billion spent in investment activities in new mobility technologies since 2010 (this amount of money is relative to more than 1000 companies across 10 technology clusters). Out of the $111 billion, more than 60% comes from large investments that tend to be industry-shaping moves made by established companies, but the other 40% is relative to small investments usually referring to **smaller companies with special capabilities or technology**. That is a good indicator that potential start-ups are stepping in.

Geographically, the investments are quite concentrated. The majority of investment activity was located in the U.S., then coming China and Israel. Investment in European companies is small and German companies account for the largest portion. For the same amount of companies, **China has had an investment 20 times higher than Germany**.

4.1.3. Power of suppliers - Increasing over time

As the car industry is getting more and more diverse, necessarily the suppliers are following this trend and becoming heavily diversified, with technological companies gaining a huge position in the market.

A car is a very complex product with a lot of small connected parts that work together for a correct functioning of the vehicle. So, there are tons of suppliers such as: Faurecia, Bosch, Continental, etc. that compete with each other to provide these components for automakers.

According to an article published in the Market Realist at February 6 of 2015 "Investing in the automotive industry" by Henry Kallstrom, the bargaining power of suppliers has been increasing over time (from 56% in 1985 to about 82% nowadays) because the automakers are becoming more assemblers and less manufactures. As a result, the suppliers grew and the automakers became more focused on marketing, sales functioning and dealer networks.

Despite the suppliers being the main producers of batteries and powertrain systems, among the automakers there are some that also produce them such as Tesla and BYD. That creates sort of an independency and empowers them among their competitors because they can supply these components to other automakers.

As it was said, nowadays automakers function more like assemblers, but they still have to design established parts and specifications which require a significant amount of investment. This investment difficult the company to switch suppliers with frequency. Besides, some components aren't compatible between different suppliers, so the company must choose determined supplier for specified group of components like the powertrain system for example.

The power of suppliers encompasses more than this, they have the ability to leverage their buyers to accept new engineering changes, set prices in line with their own profitability requirements and incentive the adoption of new technologies (as main suppliers have heavy investments in R&D).

4.1.4. Power of customers - High

The customers can be divided in two groups: the small individual buyers that buy single vehicles and the corporates or government agencies that buy fleets of vehicles. The last ones can moderately bargain for lower prices.

Unlike the automakers in relation to suppliers, the customers can easily switch to another automotive brand with no big costs involved. The majority of customers is very sensitive to price having a price elasticity of demand above 1, which means that from the customer point of view, vehicles are very elastic in relation to price. So, the customer would easily switch to another automaker brand that offers a better product at a lower price.

To overcome this issue, automakers try to conquer the loyalty of the customers throughout specific design, brand name recognition (like Ferrari, BMW or Mercedes that have a relatively high brand recognition), and other aspects that can distinguish them from the competition and lower the bargaining power of the customers.

4.1.5. Threat of substitute products - Moderate

The most threatening substitute products are the public transports like buses, trains, metropolitans, plains and taxis. In an increasingly developed world, the big cities are getting more and more overpopulated with an excess of traffic making it very costly and nearly impossible to travel by car. The solution adopted by most of the people is to use the public transports that are cheaper and getting more comfortable and accessible over time.

Back in the old days using public transport had a socially bad connotation, but nowadays even business man adopt this strategy and that bad connotation seems to have disappeared.

Another threat of the automotive industry isn't related with a substitute product but with a strategy already used by many that is known as the "carsharing solution". This consists in a fleet of cars that can be used only by members of determined organization or condominium. At a long range it is believed that this practice is cheaper than owning an actual car and this can be a threat for automakers because it reduces the demand and subsequently their vehicle sales.

4.2. Different Strategies of the Star-ups

For start-ups, the profitability is a great matter. The required initial investment needs to be paid through a good amount of sales, getting as soon as possible positive Cash Flows. According to Antoine Chatelain in "What a teardown of the last electric vehicles reveals about the future of mass-market EVs" there are four high-level commitments in order to design and develop an EV: architecture, integration, technology and cost.

In terms of **architecture**, the start-ups are very kin on producing native EV's – a car built with the main purpose of being electric. Nowadays, some incumbents try to build EVs with the chassis and body structure of their old ICE models (non-native EVs). Despite of this strategy being more DtC (Designed-to-Cost), resulting in less expenses for the companies, it is also less efficient, resulting in less space to accommodate a bigger battery pack that is correlated with higher range, more power and faster charging.

The **integration** of an EV can be measured by the design of the electric cable connection between the main powertrain components (battery, e-motor, power electronics and thermal management modules). This integration becomes relatively higher with the reduction of the weight and components of the car. For example, the model S from Tesla in 2013 had 10.1 kg in weight of cables and its

powertrain was compound by 14 parts; the recent model 3 has 5.7 kg in weight of cables and the powertrain system is compound only by 4 parts.

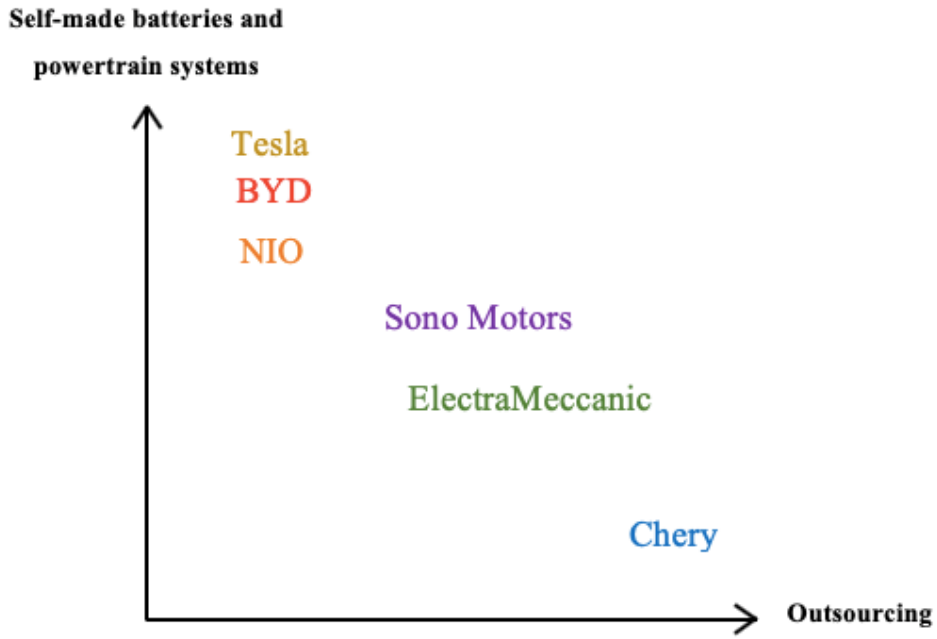
Technology wise, the upcoming start-ups feel almost obligated to provide the best tech equipment present in the market in order to be competitive relatively to incumbents. Usually there is a great bet on the highest levels of technology around Advanced Driver Assistance Systems (ADAS) – this system fully depends on the outside cameras of the vehicle and provides a safer drive experience with autonomous emergency brakes, parking aids, autonomous driving, warnings for traffic signals, among other features. Besides this factor, there are plenty of efforts being made to reduce the control buttons and substitute them for touch screens; this helps to build a centralized ECU (Engine Control Unit) of the car, making it more flexible and efficient.

The matter of the **cost** is a tricky one for start-ups. With great investments in the development of new and competitive technologies there are several strategies that companies can make to produce positive Cash Flows as soon as possible, for example: Tesla started by producing a performance car that had a high market price related to the power, range and technology of the Roadster model. This strategy enabled Tesla to have a high profit margin that could easily pay for the initial investments. Despite of this strategy, Tesla didn't show positive Cash Flows because the company was always investing in new facilities and technologies as we'll see ahead; in fact, many auditor specialists argue that if Tesla had invested more slowly through time it'd be probably showing much better Cash Flows now. The case of Tesla is just an example, the important idea is that a start-up will always have to present a strategy to quickly amortize its initial financing needs and survive to the first 5 years.

In this dissertation, there will be analyzed 6 cases of start-ups in 6 different variables: self-made batteries and powertrain systems vs Outsourcing partnerships made between companies; capital-intensive vs labor-intensive

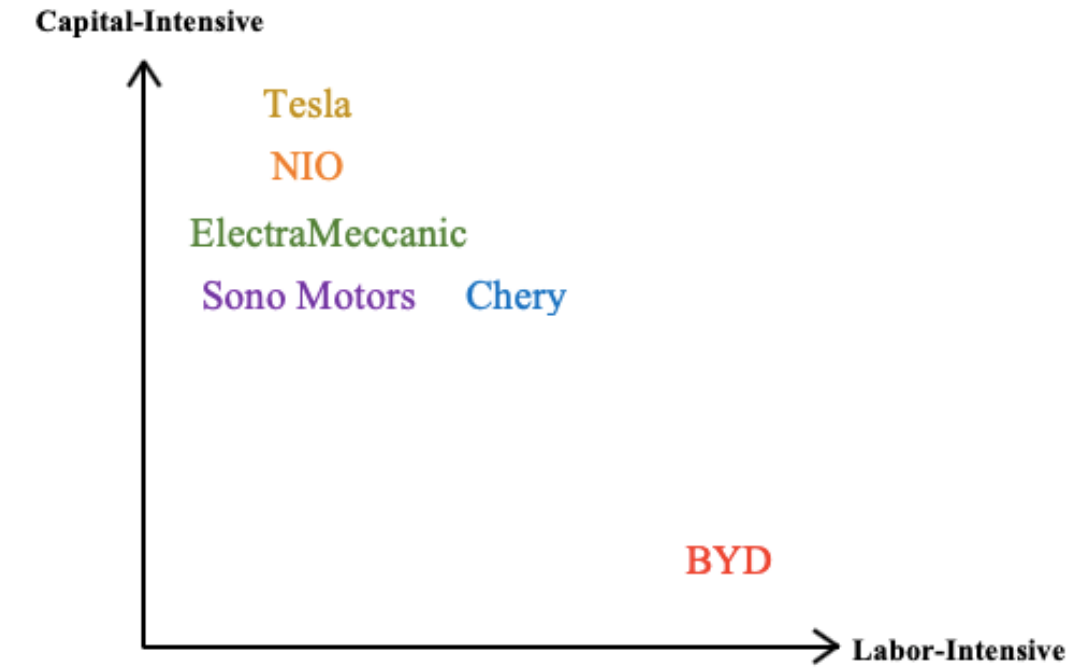
strategies and External Incentives vs no external help. These variables will help us to formalize a diagram that simplifies the start-up process of a company in the actual automotive industry.

The start-ups that will be analyzed are: BYD, Chery, Tesla, ElectraMeccanica Vehicles Corporation, NIO and Sono Motors.

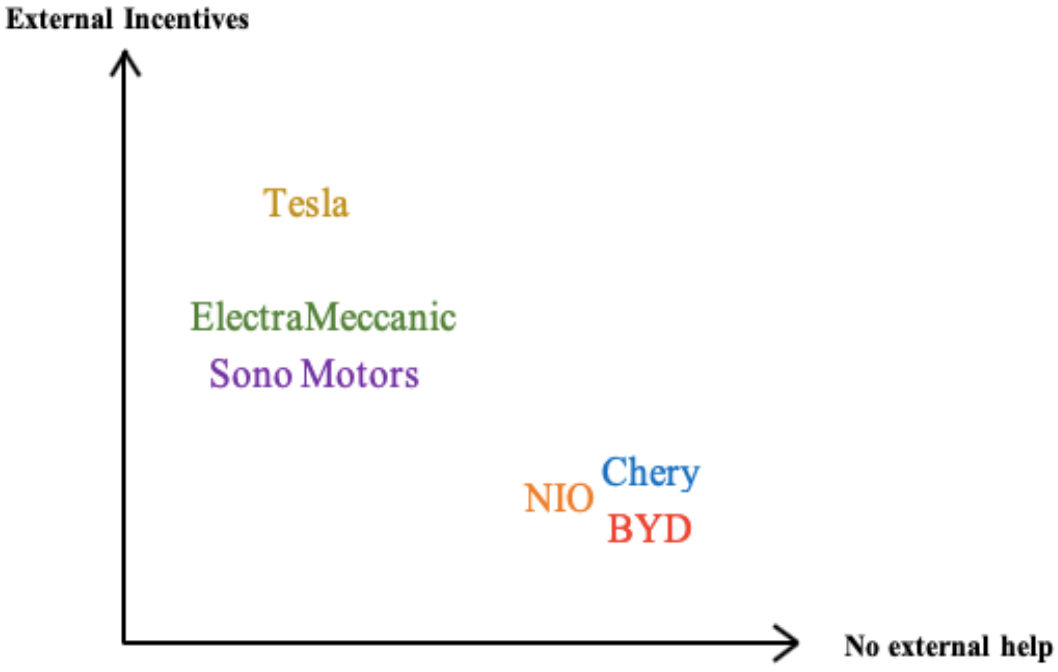


Graphic 7: Self-made batteries vs Outsourcing

Y axis –Self-made batteries and powertrain systems; X axis – Number of outsourcing partners.



Graphic 8: Capital-Intensive vs Labor Intensive



Graphic 9: External Incentives vs No External Help

4.2.1. Self-made batteries vs Outsourcing partnerships

When talking about self-made equipment or adoption of different strategies like outsourcing partners in order to produce or purchase batteries or components of powertrain systems, there are several different approaches.

The Chinese company **BYD** founded in 2003 by Wang Chuanfu (despite of already being old enough to be considered an incumbent company, BYD was considered a start-up because it was for a very long time an engine producer, only since 2008 the company started manufacturing EVs after acquiring Shaanxi Qinchuan Auto Company Limited) produced every single engine or powertrain system component inside the company. BYD used a strategy called reverse engineering and "creative imitation". This consisted on disassemble an already made equipment from another established company which already had a defined design, improving it to offer a better product and avoiding waste of money invested in own inventions that would probably fail at the majority of the times. This reverse engineering allowed BYD to create its own equipment through others' components. Besides this fact, BYD also produced some key machinery by itself rather than importing it from others, being able to reduce costs, becoming more independent from its suppliers. Lately, in 2019, BYD formed a strategic partnership with Toyota to develop battery-electric cars together, reuniting the resources of both companies for this purpose.

On the other hand, the Chinese company **Chery** adopted a very distinct approach and established a 3 to 5 years collaborative contract with the prestigious automotive engine-design company AVL. After making this contract, Chery collaborated with some western Automotive suppliers such as Delphi and Viston. These outsourcing partners were very useful because at the beginning of its business, Chery didn't have: a sufficient knowledge base followed up by a backward engine-design capability, external incentives like government help and a good investing strategy in R&D. By making these outsourcing

partnerships, Chery was able to build and manufacture its own EV's without properly developing an own battery and other key components, outsourcing it from its partners. This strategy showed up as a success and Chery was able to generate positive Cash Flows, starting to invest on average 10% of its annual sales in R&D. that resulted on the production of two EVs with high quality and fair price. These EVs already had some powertrain system components made by Chery that already had enough knowledge and experience to produce them by itself.

In the occidental world, **Tesla**, an American automotive manufacture founded in 2003 has been producing its own batteries and powertrain system components. As a result of own battery manufacturing, it formed a strategic partnership with Toyota and Daimler from Mercedes. This partnership consisted in selling batteries and powertrain system components to them, having the only inconvenient of monitoring the efficiency of the components. This allowed Tesla to gain some industry power since these 2 incumbents were depending on it for EVs manufacturing. By these partnerships Tesla also improved its Cash Flows results since they were negative due to the heavy investments of the company in R&D and new facilities like the Gigafactory (that Elon Musk ordered to build in order to achieve economies of scale in lithium-ion battery production and make EVs cheaper than gas powered vehicles). Even some auto-pilot features (ADAS) and many other tech innovations introduced in Tesla models are made by the company.

ElectraMeccanica, an automotive company established in Canada in 2015 by Henry Reisner has a different business journey from the three companies explained above. This company was built by the same CEO of another established company in the automotive market, called Intermeccanica. Hereby at the very beginning of constitution of ElectraMeccanica, the company already had the necessary market knowledge and a lot of understanding about car

engineering and financial limitations of automotive manufacturers (highly experienced management team with significant beneficial insider ownership). Despite having the necessary knowledge and intellectual assets, the company didn't have the necessary money to invest in R&D in order to develop its own batteries so ElectraMeccanica made a manufacture contract with a strategic partner called Zongshen Industrial Group (a multi-national company that is the China's largest manufacturer of motorcycle and three-wheeled vehicles, maintaining more than 50 joint ventures with recognizable global brands). This partner worked as an OEM (Original Equipment Manufacturer) producing all the engine components of ElectraMeccanica's EVs, including the battery and major powertrain system components. After receiving the already made equipment by Zongshen, ElectraMeccanica only needed to assemble them.

By this strategy, the company was able to mitigate the risk and lower its CapEx (funds used by a company to acquire, upgrade or maintain physical assets such as industrial plants or property buildings), hereby doesn't need to invest in production facilities, subcontracting this task to other company. The success of this strategy can be verified by the inexistence of long-term debt needed; the company works just fine without this kind of leverage.

NIO is a Chinese company founded in 2014 by William Li. It is recognized by many experts as the direct rival of Tesla. The company develops every battery, powertrain system or technological innovations by their own sources, but the CEO of NIO publicly admitted that their main goal wasn't to develop a new battery with an enormous range capacity or some super-efficient powertrain system. William Li believes that the battery technology that we have now is pretty reasonable and for that reason he invested some company's R&D resources in something called "swap stations". A "swap station" is a completely new technology where a NIO vehicle enter into a station available on the streets (nowadays only 18 stations available in China but planned to become spread

worldwide) and swap its empty battery for another fully powered in few minutes. For these "swap stations", NIO built a subsidiary company named "NIO Power" that also produces battery charges for mobile phones, homes and super-charge stations like the ones made by Tesla. Besides this, NIO also developed a 2 semi-autonomous system that offer ADAS (Advanced driver-assistant service) features, called "NIO Pilot". The only significant partnership has been made with Mobileye in November 2019 in order to develop an EV with Mobileye's complete level 4 of self-driving that will be available on the market by 2022.

Sono Motors is a Germany automotive manufacturer founded in 2016. This company invested a lot in R&D what made it come up with an EV that could be powered by solar system batteries (besides the ordinary electric battery that is also present on the powertrain system) incorporated on the outside skin of the car.

Sono Motors developed only one vehicle named Sion and with their marketing strategy allied to the awards they received due to their Sion prototype, Sono Motors was able to collect more than 2 million Euros from several crowdfunding campaigns, also getting funds by some medium-sized investors that have joined the company like: the founder of the German Energy Service Provider Juwi and the Bollinger Group.

This Sion model got more than 5 000 reservations and the mass production is predicted to start in 2021 in Trollhattan, Sweden, in a manufacturing facility that was previously owned by SAAB and is now property of the NEVS (National Electric Vehicle Sweden) which is in charge of the production of the new series of Sion Vehicles due to the result of the crowdfunding solar battery system campaign. This company could invest so much in R&D because it uses older and thus no longer legally protected powertrain system components including the main battery of the vehicle, saving a lot of money on this matter. Hereby, this

company doesn't produce its own engine-battery and major powertrain-system components, only manufacturing its own solar-system batteries.

By the intense R&D investment approach, Sono Motors also developed a better than the average artificial air filtration called BreSono that improves the air quality inside the car and a mobile phone app that incentives power-sharing (offer electric power to other Sion's owners), ridesharing (share a car ride) and car-sharing (rent out a car).

4.2.2. Capital-intensive vs Labor-Intensive strategies

Contrary from the majority of the companies in the automotive market, BYD adopted a very labor-intensive and low automated manufacturing process, with redesigned machines and more man power in the production of the engines and vehicles. This, allied to a high degree of vertical integration allowed BYD to be more flexible, reduce its costs, improve the quality control and allegedly reduce the TTM (time-to-market) – length of time that a product takes from being conceived until its being available for sale.

All the other companies analyzed used a more capital-intensive approach, mainly Tesla and NIO that are trying to develop a more horizontally integrated business model. Even BYD is now starting to realize that this labor-intensive and high degree vertical integration approach can't last forever, and has recently been changing its business model to a more capital-intensive oriented strategy.

4.2.3. External EV's Incentives vs No Incentives

Despite of China being the country with the majority of the consumers interested in buying an EV as the next vehicle choice (70%), the government doesn't provide any incentives and the automotive manufactures of EVs have to count only with external help from direct investors or partnerships made with western companies. In fact, the Chinese government as even limited the number

of automotive manufactures in the country, not allowing more than 28. If any Chinese company wants to enter in this market, it has to acquire another already established company as BYD did with the acquisition of Shaanxi Qinchuan Auto Company Limited.

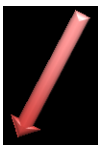
The other companies (ElectriaMeccanica, Tesla and Sono Motors have had incentives by the government and some continue to have it; whether it is by the form of universal recharging stations built by the governments for EVs users or by direct aids to the companies. For example, Tesla borrowed $465 million from the US Government and ElectraMeccanica had state tax credits of $750 in California and $2 500 in Oregon for EVs buyers. This help by the government is very important in the introduction of these vehicles in the market. Sono Motors was also financed by some crowdfunding events and private investment.

4.3. Theoretical framework for start-ups

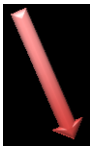
For an automotive start-up to rise and gain some kind of position in the market, at the beginning it has to have some kind of special asset that allows it to differentiate itself and grow in such a competitive market. It can be the necessary engineering know-how as ElectraMeccanica had, some liquidity in order to invest in R&D as Sono Motors had, or any other kind of asset that provides competitive advantage.

To simplify, I made a theoretical framework that shows how can a start-up evolve in the automotive market.

Does it have self-knowledge of the automotive engineering?

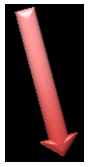


If **not**, the company should look for outsourcing partnerships with more experienced companies like **Chery** did.



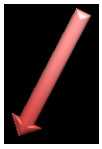
If **Yes**, can it produce its own **batteries and major powertrain-system components**?

If **not**, the company should follow a strategy quite similar to what **ElectraMeccanica** did, using **Zongshen** as an OEM outsourcing partner.

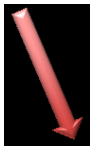


If **yes**, it should take advantage of that producing capability like Tesla did, forming partnerships with Toyota and Daimler who buy its EV batteries.

Does the company have external incentives?



If **not**, the company should look for external financing alternatives like crowdfunding campaigns as Sono Motors did, acquiring more than 2 M euros (despite of having some help by the government too).



If **yes**, like Tesla who borrowed $465 M from the US Government, it is easier to invest in R&D and come up with new technology inventions.

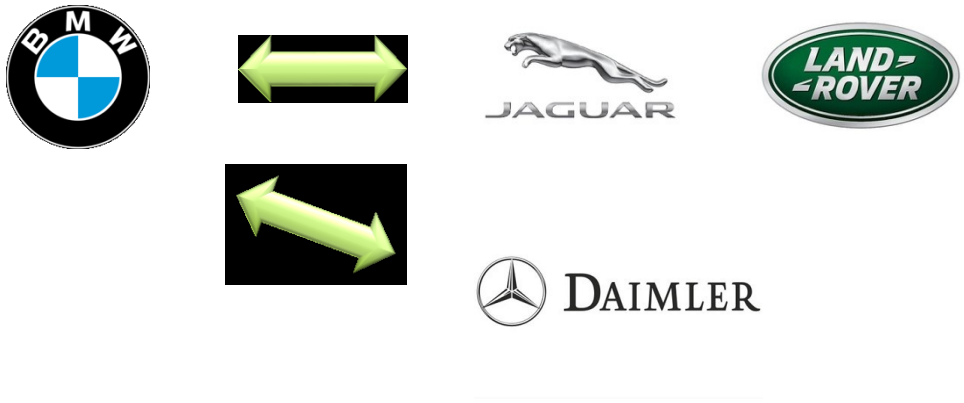
Does it have initial capital to invest?

The majority of the start-ups doesn't have much initial capital to invest in production facilities or R&D at the beginning of its constitution. Based on the empirical cases that were shown, the start-ups often need to find that point of differentiation from the competition through a good **marketing strategy**, evaluating the market trends and betting on what the customer wants.

Graphic 10: Theoretical Framework for Start-ups.

4.4. Recent partnerships and merges as a way of keep up with the changing industry

This is a time of uncertainty in the market. Some companies are working together as a way of mitigating the risk of investing alone in autonomous and electric vehicles, being able to build better economies of scale (presenting better consumer prices) and developing better final products as a result of more resources combined. Other companies are investing in complementary automotive industries in order to leverage themselves for the upcoming changes.

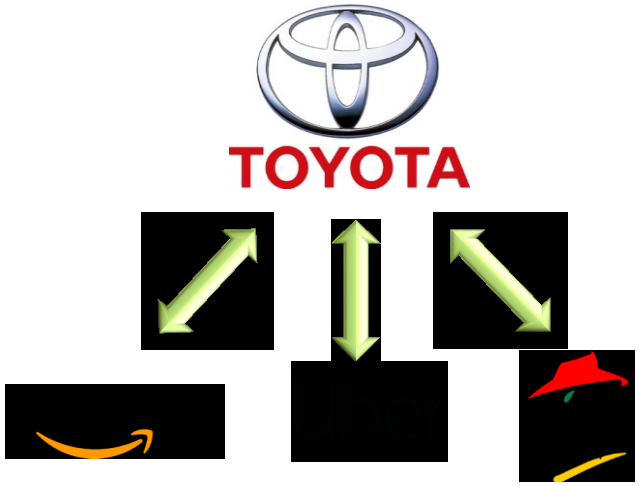


Graphic 11: Partnership between BMW, Jaguar Land Rover and Daimler.

BMW Group and Jaguar Land Rover formed a partnership to "help make next-level electrification technology more widely available to customers" by the start of 2020 (in PressClub Global Article of a Press Release by the BMW Group in 06/06/2019).

BMW Group also formed a huge joint venture with Daimler, publicly announcing intentions of spending together $1.13 billion. These companies were fearless rivals in several market segments for many years, but now intend to build this partnership through the constitution of 5 new separate companies with

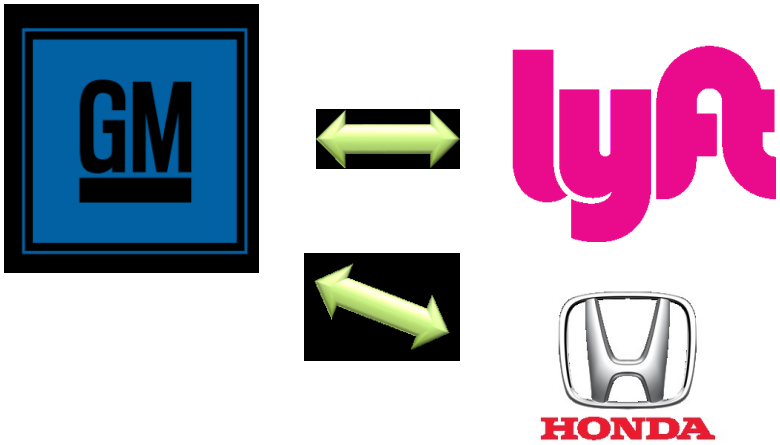
different purposes: Reach Now for multimodal services, Charge Now for EV charging, Free Now for taxi ride-hailing, Park Now for parking and Share Now for car-sharing.



Graphic 12: Partnership of Toyota with companies from other complementary industries.

In 2018, Toyota has made partnerships with several mobility companies that represent complementary automotive industries. This move was synchronized with the development of the e-Palette model (**Figure** 1), that is a fully autonomous and electric vehicle that is very uncommon from other models. This vehicle was made for car sharing and to provide mobility solutions to companies like Amazon, Uber and Pizza Hut whose businesses largely depends on products delivery.

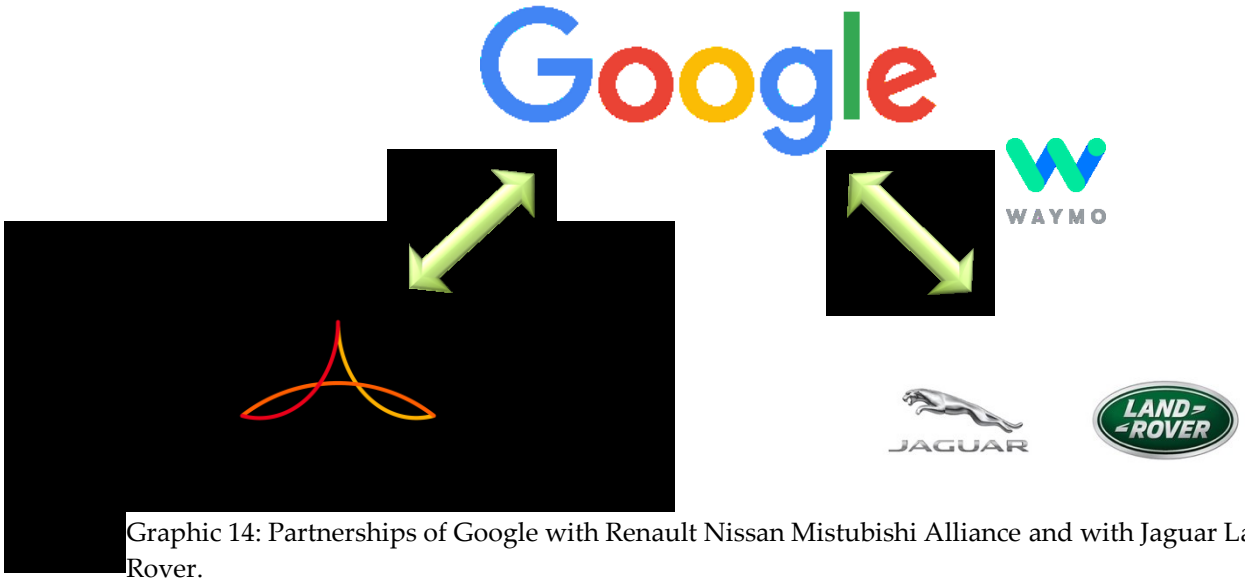
Figure 1: e-Palette model.



Graphic 13: Partnerships of GM with Lyft and Honda.

Nowadays, General Motors has a participation of around $1.27 billion in Lyft (having started with an investment of $500 million in January 2016), the main rival company of Uber. This investment was made in order to develop an autonomous taxi that could be used by Lyft, in return GM would provide insurance and maintenance of the vehicles.

Honda has also invested $2.75 billion in General Motors autonomous driving unit in order to build a fleet of unmanned taxis.



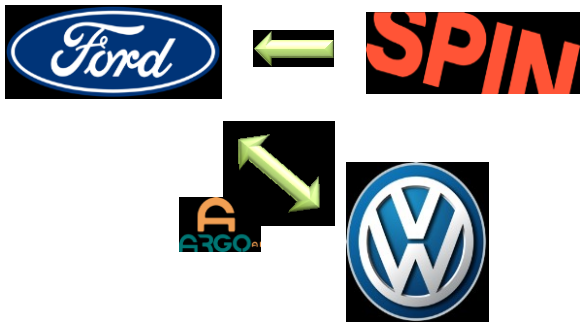
Graphic 14: Partnerships of Google with Renault Nissan Mistubishi Alliance and with Jaguar Land Rover.

Google and the alliance Renault-Nissan-Mitsubishi formed a partnership with the goal of developing infotainment systems and dashboard displays based on Android software. The vehicle owners of Nissan, Mitsubishi and Renault will be able to access Google features as app store, google maps, among others, in the vehicle's dashboards.

This Renault-Nissan-Mitsubishi alliance constitute itself a huge partnership between 3 huge automotive companies that is gaining power compared to big players like Toyota and Volkswagen.

Google has a self-driving car project named Waymo, and has made a long-term partnership with Jaguar Land Rover to develop autonomous driving cars. The first project is the Jaguar I-PACE (Figure 2) that has the necessary self-driving software from Waymo.

Figure 2: Jaguar I_PACE.



Graphic 15: Partnerships of Ford with Spin and VW.

Ford, started to realize that electric scooters are getting a big deal in the U.S. so it bought the start-up Spin for around $100 million.

Ford also made a partnership with Volkswagen having both invested in Argo Al, a company fully committed to develop self-driving systems. Volkswagen will provide its electric vehicle architecture knowledge so that Ford can build and design one high-volume fully electric vehicle in Europe.

Graphic 16: Partnership between Geely and Williams.

Geely, the company that owns Lotus formed a partnership with Williams from F1. This collaboration was made to develop and research advanced propulsion technologies to build an electric hypercar. The model that was presented by Lotus due to this partnership is Evija (Figure 3), a car with 2000 hp (hourse-power) that is believed to be the fastest electric model on the planet. There will be a limited production of 130 units and the car will cost around €1.9 millions to the public.

Figure 3: Electric hyper car developed by Lotus and Williams.

Graphic 17: Partnership between NIO and Razer.

NIO and Razer announced the beginning of a cross-platform partnership. The first project was the NIO ES6 Night Explorer Limited Edition Vehicle (Figure 4).

This model is made for gaming passion people since Razer is one of the biggest brands on this segment.

Figure 4: NIO ES6 Night Explorer.

4.5. Linear Regression

In order to get a more empirical view of the relationship between the financial success of an automotive company and its bet on the EV market, some of the subjects analyzed on this study were transformed into variables of a linear regression (number of EV-related partnerships, external help by the government, first mover strategies, present market share of the companies, among others). As a finance master's student, myself, I consider that the FCFs (Free Cash Flows) are the most reliable indicator of a company's actual financial success. They represent the profitability of a company, excluding non-cash expenses that are usually presented in the income statements, including capex (capital expenditures – investments on physical assets) and changes on working capital (a good measure of a company's liquidity).

So, for this linear regression it is used 10 variables along a cross-section data of 31 automotive companies (information about the companies will be presented in the appendix), and the **explained variable** (**fcf**) is the annual mean of the last 3 FCF values (in million $) of the companies. For economic variables it is used the average of the last three results as a way of obtaining a more realistic analysis,

since a company can present very different values of Capex or FCF, for example, from one year to another.

The median will be used as a unit of measure and analysis.

The linear regression is presented by:

$$fcf_i = \beta_0 + \beta_1 patent_i + \beta_2 partn_i + \beta_3 capex_i + \beta_4 repta_i + \beta_5 dgovern_i + \beta_7 dfirstm_i + \beta_{10} native_i + \beta_{11} dselfm_i + \beta_{12} presmkt_i + \varepsilon_i$$

The explanatory variables are:

Patent – Explanatory variable that indicates the number of EV related patents, a *company i* has published. These are considered as technological assets and are related with the internal knowledge of a company to manufacture EV's and autonomous driving vehicles;

Partn – Explanatory variable that indicates the number of business partnerships related with development of EV's that a *company i* has made. These partnerships usually are made to improve some expertise or to add new features such as ADAS (Advanced driver-assistance systems) technologies;

Capex – Explanatory variable that indicates the average of the amount of annual capital expenditures (in million $) a *company i* had in the last 3 years. These expenditures can be production facilities, improvement on physical distribution channels or any other kind of physical investment. In this dissertation, these expenses are known as complementary assets;

Repta – Explanatory variable that indicates the average of the vehicle's annual sales (in million $) of a *company i* in the last 3 years. This data is very much related with the popularity of a company and in this dissertation, it is known as reputational assets;

Dgovern – Explanatory dummy variable that takes the value 1 if the government of the country where a *company i* has its headquarters helps and incentives EV's production and consumption;

Dfirstm – Explanatory dummy variable that takes the value 1 if a *company i* has a strategy of a first mover in the EV's market;

Native – Explanatory variable that indicates the (Native EV's/Total EV's) ratio of a *company i*. It is very important in order to observe how many vehicles were adapted from ICE to EV's, and how many were built with the main goal of being EV's;

Dselfm – Explanatory dummy variable that takes the value 1 if a *company i* self-manufactures its batteries and powertrain systems, and takes the value 0 if it outsources them from other automakers or suppliers;

Presmkt – Explanatory variable that indicates the present market share of a *company i* in the automotive market on the last year of activity (2019).

4.5.1. Statistics analysis of the acquired data

Variable	N	mean	p50	sd	min	max
fcf	31	657.871	594.384	432.671	-1275	1540
patent	31	57.24	39.45	34.23	18	86
partn	31	4	3	2.266	1	9
capex	31	5479	4367	3286	389	9725
repta	31	1.748	1.547	1.327	0	8.7
dgovern	31	0.677	1	0.475	0	1
dfirstm	31	0.355	0	0.486	0	1
native	31	0.601	0.65	0.291	0,1	1
dselfm	31	0.571	1	0.802	0	1
presmkt	31	0.056	0.041	0.024	0.001	0.1024

Table 1: Table of Statistics.

The statistics presented are computed across 31 companies.

Analyzing the median, we can say that according to the explained variable **fcf**, the middle number of all the data observed for this variable is 594.384. This means that the middle *company i* of the list of observations has a FCF of $594.384 millions. This same logic can be applied to all the other explanatory variables presented in the table above.

4.5.2. Explanatory Dummy variables analysis

govern = 0						
variable	N	mean	p50	sd	min	max
fcf	10	-237.15	-375.13	236.28	-1275	276

govern = 1						
variable	N	mean	p50	sd	min	max
fcf	21	852.82	728.37	301.45	342	1540

Table 2: Explanatory Dummy variable Dgovern analysis.

Relation between the explained variable **fcf** and the explanatory dummy variable **govern** across 31 automotive companies.

Analyzing the tables above, we can state that the explanatory dummy variable **govern** has a significant impact on the **fcf** of a *company i* (this impact is concordant with the theory presented before). According to the values of the medians presented, if a government, where a company' i headquarters are settle, gives incentives to manufacture and consume EV's (the explanatory dummy variable takes the value 1), the median of the *company's i* **fcf** will be higher than the one whose government, where its headquarters are settled, doesn't incentive the manufacture and public consumption of EV's (according to the table values, 728.37 > - 375.13 million $), keeping all the other explanatory variables constant.

In terms of mean, this same logic is still viable. A *company i* whose headquarters are settled in a country which government gives incentives to

manufacture and consume EV's has a mean **fcf** of $852.82 millions while a *company i* who doesn't have help by the government usually has a **fcf** mean value of $ -237.15, keeping all the other explanatory variables constant.

firstm = 0						
variable	N	mean	p50	sd	min	max
fcf	20	839.12	753.48	415.36	203.45	1540

firstm = 1						
variable	N	mean	p50	sd	min	max
fcf	11	-275	-379	245.79	-1275	104.56

Table 3: Explanatory Dummy variable Dfirstm analysis.
Relation between the explained variable **fcf** and the explanatory dummy variable **firstm** across 31 automotive companies.

The tables above demonstrate how the explanatory dummy variable **firstm** can influence the results on the explained variable **fcf**. The first one takes the value 1 when a *company i* has a first mover strategy in the EV's market and takes the value 0 otherwise. In fact, from the values presented in the tables we can observe that the companies that use this first mover strategy, actually present a median **fcf** lower than the ones who don't move first on the EV market (-379 < 753.48 million $). That can be explained by the fact that first mover companies often make big investments (inversely related with a good FCF result) and according to the literature presented on this dissertation that means low annual net income and a bad asset position.

selfm = 0						
variable	N	mean	p50	sd	min	max
fcf	13	76.462	130	105.32	-1275	235.49

selfm = 1						
variable	N	mean	p50	sd	min	max
fcf	18	823.67	703.56	167.49	-156.35	1540

Table 4: Explanatory Dummy variable Dselfm analysis.

Relation between the explained variable **fcf** and the explanatory dummy variable **firstm** across 31 automotive companies.

For the explanatory dummy variable **selfm** that takes the value 1 if a *company i* self-manufactures its batteries and major powertrain system components, and takes the value 0 if it outsources them from other automakers or suppliers; we can state that if the variable takes the value 1 the median of the **fcf** will be higher than otherwise (703.56 > 103 million $). That also makes sense by the fact that companies who produce these components can sell them to other automakers and make profit from that. The ones who outsource this expensive equipment tend to be dependent from other companies' choices.

4.5.3. Analysis of the coefficients

Variables	Coefficients
Partn	24.197* (0.123)
Capex	-34.657* (0.216)
Repta	45.195** (0.354)
Dgovern	16.635* (0.095)
Native	3.471* (0.078)
Dselfm	8.238 (0.175)
Presmkt	37.25*** (0.237)
Dfirst	-16.724** (0.093)
Patent	-17.491* (0.248)

Table 5: Analysis of the coefficients.

Coefficients of the explanatory variables. *** denote p-values <0.01, ** denote p-values <0.05, and * denote p-values <0.10. Standard-errors in parentheis.

R-squared =	0.9341
Adj R-squared	0.8674

Table 6: Relevance of the linear regression.

According to the table 6, this linear regression has an Adjusted R Squared of 0.8674 which means that we can explain 86.74% of the model by this linear regression. The other part that we cannot explain is contained in the error term **ε**, that represents every variable that is not present in the model but still influences the explained variable **fcf**.

The Adjusted R Squared is a coefficient used to assess the fit of a linear regression equation by comparing it to the fit of a regression equation with no explanatory variables that uses the mean of the explained variable as the sole predictor. If the value was 0 the fit of the regression equation would be exactly equal with the fit of a regression equation that used the mean as the sole predictor.

Chapter 5
5. Discussion

The main objective of the author for this chapter is to analyze the theory studied on the second chapter "Literature Review" about the incumbents' strategy on the EV's matter and connect it with the partnerships analysis and the empirical study presented on the third chapter, mainly with the coefficient values from the explanatory variables of the linear regression. This will help us to answer to the first research question: "What should the incumbent automotive companies do to maintain or regain their market position?"

To answer to the second research question "What can the start-ups do to be competitive in such an expensive and complex market with lots of players competing for ultimate innovation and customer attention?", the author will analyze the theoretical model made in the third chapter and also correlate it with the coefficients of the explanatory variables from the linear regression.

1- What should the incumbent automotive companies do to maintain or regain their market position?

According to the Literature Review, incumbent companies that have low annual net income values and a good asset position are very kin on taking a first mover strategy. If we check on the table 5 the coefficient for the variable **dfirst** we can see that it is negative -16.724. This value means that if a *company i* takes a first mover strategy it will take the value 1 in the linear regression and its **fcf** will lower in $ -16,724 millions, holding all other explanatory variables constant. This coefficient makes sense in a way that if a company invests earlier than its competitors in an uncertain market like EV's, it is very likely that this strategy

will lower the company's FCF in the short-term. Also, if we check the coefficient value for the explanatory variables: **capex** (-34.657) and **patent** (-17.491), it is easy to understand why early investments might lower the FCF values of companies.

But an incumbent that takes a first mover strategy is also a company who might be able to develop its own powertrain system and consequent engine-battery, which means that it will probably take the value 1 on the other explanatory dummy variable called **dselfm**. This one is used to distinguish the companies who produce their own batteries from the ones that outsource it from other automakers. Based on the table 5, if a *company i* manufactures its own batteries, it will improve its **fcf** in $8.238 millions, holding all other explanatory variables constant. In fact, if a company is independent from others in terms of battery development and production, that represents a huge asset, having also the possibility to sell them to other automakers and make profit from that.

Also, a company that is producing EV's from zero, will likely make native EV's which means having a small advantage relative to other automakers that are making non-native ones. Despite of the coefficient of the explanatory variable **native** being low (3.471), the author believes that it might take higher values in the future.

According to the Literature Review, an incumbent with a high annual net income and a good asset position, will have no incentive to move first on the market. This company enjoys from a good coefficient of the explanatory variable **repta** (45.195) and usually has a significant value of present market share, taking also advantage of a good coefficient from the explanatory variable **presmkt** (37.25). As this type of companies have so many initial advantages, they can have the luxury of taking a laggard strategy and entering late in the market, meaning that they'll probably outsource their EV batteries from other automakers and will be dependent from their technologies till they invest own resources to develop their own powertrain-systems.

As we've seen from the Chapter 4, both first movers and laggards are very kin on making partnerships with each other and with other companies from different complementary industries. Actually, according to table 5, the explanatory variable **partn** has a coefficient of 24,197 which means that for one additional EV-related partnership made, a *company i* should improve its annual **fcf** in $24,197 millions, holding all other explanatory variables constant. If an automaker shares its knowledge and resources with other entities, it will lower its costs and improve the probabilities of developing better technologies and producing efficient final products.

Finally, as it would be expected, if a company has incentives from the government it will improve if FCF results. Actually, according to table 5, for the explanatory variable **dgovern**, we have a coefficient of 16.635 which means that if a *company i* has incentives and help by the government, its **fcf** would improve in $16.635 millions, holding all other explanatory variables constant.

2- What can the start-ups do to be competitive in such an expensive and complex market with lots of players competing for ultimate innovation and customer attention?

Based on the theoretical model for start-ups presented on the fourth chapter "Development" as well as on the linear regression, we can take some important conclusions.

For a start-up to survive in the actual automotive market, first of all, it has to have a financial structure that can be able to support negative **FCF's** for the first years of existence. Usually, in the constitution of an automotive company there are several **CapEx** expenses that will damage the financial results. Alongside these **Capex** expenses (the explanatory variable **capex** presents a negative coefficient of -34.657 in the linear regression), the company doesn't have any

recognizable sales numbers (represented by **repta** in the linear regression) neither a significant present market share (**presmkt)** to compensate these red flags. So, for a start-up to survive in the market it must initially have some **external hep or incentives** from entities like the government (**dgovern)** or direct investors in possible crowdfunding events. To ensure its survival, a start-up should also make strategic **partnerships** with already established automotive companies that share the same desire to bet on EV's, the first movers. These partnerships would facilitate the access to better technologies and equipment in order to develop their own **native** EV's. This conjuncture of strategies is the best bet for a start-up to survive to the first years of existence. If the company can't find any good strategic partnerships, it should follow **Sono Motors** steps and utilize equipment developed by other automakers that is no longer protected by any patent property right, in order to avoid spending a lot of money on buying that equipment from companies who already produce it and are trying to take some control of the market.

When the company has already conquered some market share and presents better financial results, it should look at the market with an incumbent point of view, managing the expenses in **R&D** and new **patents** with the return it is receiving from the market (**repta**). It is also important to have in mind that the start-ups who have invested to develop their own batteries and power-train systems (**dselfm**) are the ones who nowadays present better financial results and have a better present market share (Tesla and NIO). So, if a start-up is well succeeded on the first stage of its existence, it might consider investing on this matter.

Chapter 6
6. Conclusion

6.1. Theoretical Implications and limitations of the study

The research developed on this master thesis allowed the author to make well-grounded assumptions about incumbent and start-ups business strategies related to the automotive market change from ICE vehicles to EV's. But these assumptions require a great implication that holds on the maxim that big organizations like IEA, OECD and governments from developed countries in the world will not change their mind on environmental matters and EV-related projects for the future years, otherwise that would compromise all the growing penetration rates of EV's in the automotive market and the whole purpose of this study. Other implication lies on the truth of the annual reports of the companies that were consulted in order to get the necessary data to build the linear regression on the fourth chapter. This master thesis also relies on fundamental economic laws like the free trading market, and transparency of transactions.

The major limitation of this study lies on the fact that the linear regression presented has a small sample of thirty-one companies and only explains 86.74% of the data (according to the adjusted r-squared). Adding to this limitation, the author made some quizzes to get more information about the incumbents, start-ups, companies from complementary industries and opinions from market experts, but since the covid-19 was spread worldwide at the beginning of the year, that compromised the normal function of the companies and it was getting really difficult to obtain some answers from that entities.

6.2. Future Research

To complement this master thesis, it would be really interesting to amplify the study to companies from complementary industries. Since we got an overview of what strategies incumbents and start-ups should engage in the actual automotive market, it would be pertinent to analyze the strategies taken by companies like Samsung, Google, among other players that are stepping in the market and already have a strong brand recognition by the general public.

In the appendix there will be four quiz forms that the author planned to use for research purposes but because of the covid-19 situation it got really difficult to manage. For future research it would be interesting to use these forms in order to get more evidence from the companies a to get even more grounded assumptions about their business strategies.

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Appendix

Quiz for incumbents:

1. As an incumbent in the market, do you feel pressure to develop new EV models and electric powertrain system technologies to maintain your market position?
6. How expensive it is to come up with a brand new EV?
7. Is it sustainable to keep up with the necessary level of R&D to present new EV models?
8. Do you believe in a future market fully constituted by EVs (20 years from now)?
9. Do you prefer to move first in the market, presenting new solutions or follow the others, taking less risks?
10. Do you feel threaten by companies like NIO, Tesla and BYD?
11. Is it more advantageous to subcontract the production of the vehicles to other company (working as an OEM) or do your own production with own facilities?
12. Toyota and Daimler buy the majority of their batteries and powertrain system components from Tesla, do you find that advantageous, or as an incumbent do you prefer to develop these components by your own?
13. Do you think the automotive industry is slowing down?
14. Do you feel more cooperation between companies than before?

Quiz for start-ups:

1. Do you find it difficult as an automotive start-up to collect external investment to fulfill the company's financial needs?
2. How much does the government incentive the development of Electric Vehicles and do you find that help crucial as a recent company in the market?
3. Is the competition between start-ups intensive or is it only intensive with the incumbent companies in the market?
4. How much investment do you need to come up with new technological solutions for batteries or powertrain system components?
5. Is it better to produce your own powertrain system components or simply outsource them by buying it from another company and assemble it all in your own facilities?
6. Do you feel pressure as an automotive start-up to come up with new technologies as new ADAS features or auto-pilot innovations?
7. Do you find this transition time of the market attractive for many companies to step in? Including companies from complementary industries like Samsung or any battery producer?
8. Do you feel like Tesla, BYD and NIO will take over the market in the future or the incumbent companies like General Motors, Toyota and Volkswagen will overcome the first ones?
9. Is this a time of cooperation between companies?
10. Do you feel that suppliers are gaining more and more bargaining power over the last years?

Quiz for Complementary Industries:

1. As an automotive complementary industry do you feel incentive to step in this market as a new competitor or just as a cooperative entity? Working as a supplier?
2. Do you feel threaten by the upcoming change to EVs in the automotive market? Do you feel that some complementary industries need to suffer some mutations in order to keep up with the market?
3. Do you feel that the bargaining power of complementary industries will increase with this market change?
4. Is it easier (in terms of bargaining power) to work with start-ups or with market incumbents?
5. Do you feel the necessity to invest a lot in R&D to keep up with your competition?

Quiz for Market Experts:

1. As a market expert do you think that this is the right time for start-ups to rise against the incumbents?
2. Do you think that cooperation between the incumbents is rising to develop new technologies? And do you find that beneficial for the market?
3. The battery technology has evolved a lot in the last years, what do you think will be the next big differentiating feature in a good EV? (ADAS features, recharging speed, etc.)
4. Do you think that the companies that are producing the batteries and all the powertrain system (supplying the market like Tesla), are the ones that will domain it in the future?
5. Do you think that the government will provide recharge stations free of charge for all EV users in the future?

Companies analyzed on the linear regression of the fourth chapter

TOYOTA
VOLKSWAGEN
HYUNDAI/KIA
GENERAL MOTORS
FORD
NISSAN
HONDA
FCA
RENAULT
PSA GROUP
SUZUKI
SAIC
MERCEDES
BMW
GEELY
CHONGQUING CHANGAN AUTOMOBILE
MAZDA
DONGFENG MOTOR
BAIC
MITSUBISHI
TESLA
SONO MOTORS
ELECTRA MECCANICA
BYD

CHERY
NIO
TATA GROUP
FAW GROUP
VOLVO
SUBARU
GAC GROUP