



**Universitat de les
Illes Balears**

Facultat d'Economia i Empresa

Memòria del Treball de Fi de Grau

Tesla Motors and Lean Manufacturing

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Any acadèmic 2017-18

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Paraules clau del treball:

Musk, Tesla, lean, manufacturing, management, thinking, technology

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1. SUMMARY

1.1 Tesla Motors revolutionized the car industry through lean management, making possible the arrival of the electric car with characteristics never seen before: a large range of kilometres without the necessity of recharge, higher speed than combustion cars and reduced economical maintenance.

The young company, now is struggling to produce the model 3, BEV (Battery Electric Vehicle), an affordable car for the masses, which fabricating process relays on lean management. Despite Tesla achievement of manufacturing leading sales luxury car, with model X and model S, model 3 has been awakening many critics of high prestige and the firm face the most hazardous problems of his existence: at engineering level with automation problems and financially on the verge of bankruptcy.

Elon Musk, Tesla CEO and major owner, remains confident in the future of electric vehicles industry and his organization besides opposition from Wall Street and traditional car companies, which have tried to produce affordable electric cars unsuccessfully.

The project will explore how Tesla Motors arrived at this point, which bifurcates in the end of Tesla or the long waited arrival of the electric car for the masses.

1.2 Catalan version

Tesla Motors ha revolucionat l'indústria del automòbil mitjançant el lean management, el qual ha fet possible l'arribada del cotxe elèctric amb prestacions mai vistes abans: un ampli rang de quilòmetres sense la necessitat de càrrega, major rapidesa que els cotxes de combustió i un manteniment econòmic.

La jove companyia actualment tracta de produir el que s'anomena BEV (vehicle elèctric de bateria) el model 3, un cotxe elèctric pel consum de masses, fabricació on el lean management resulta fonamental. A pesar de ser capaç de manufacturar el model X i model S, liderant en vendes el segment de cotxes de luxe, el model 3 està despertant les crítiques de persones de gran prestigi i l'empresa està fent front els problemes més complexos des de la seva existència: en enginyeria amb problemes d'automatització i financerament a prop de fer fallida.

Elon Musk, director i accionista majoritari, confia en el futur del cotxe elèctric i la seva empresa tot i l'oposició Wall Street i la indústria del automòbil de combustió, la qual va intentar de produir vehicles elèctrics insatisfactoriament.

El treball explorarà com Tesla hi ha arribat a aquest punt que bifurca en el fi de Tesla o l'arribada del cotxe elèctric de masses.

2. INTRODUCTION

The project chosen is due to the relevance to society and environment. Electric vehicles reduce carbon footprint and have higher technological capabilities like autopilot although, the company is troubled to bring the electric car to the masses, occurring at the moment (2018), therefore may be difficulties in the information.

Production of model 3 is being compared to the famous model T of Ford, which revolutionized car sector and spread the process to other industries, and was the root for the lean management concept.

At the present, Tesla is trying to bring the lean management to a higher level by increasing its automated production for the model 3 and as Elon Musk said *“We realized that the true problem, the true difficulty, and where the greatest potential is – is building the machine that makes the machine. In other words, it’s building the factory. I’m really thinking of the factory like a product.”*

The interest on Tesla Motors development and his charismatic CEO. How his commitment and persistence may accomplish the affordable electric car arrival outperforming traditional car makers such as General Motors, Daimler, BMW, Toyota or Volkswagen, which besides having larger resources may fall behind a young car company that overcame the high barriers of the car industry.

3. OBJECTIVE OF THE PROJECT

To support lean management concept and how Tesla applied it successfully, and demonstrate the positive effects of lean management approach make corporations more competitive.

Furthermore, to enhance an optimism and hard work in entrepreneurs displaying that through diligence and efficiency one’s dreams can become everybody reality.

From one of my favourite’s quotes from T.E Lawrance *“All men dream, but not equally. Those who dream by night in the dusty recesses of their minds, wake in the day to find that it was vanity: but the dreamers of the day are dangerous men, for they may act on their dreams with open eyes, to make them possible.”*

4. Description of methodology used

The project relates to an ongoing issue now 2018. Tesla model 3 begun production in July 2017, which it is said to be the most automated plant in the car industry, due that fact majority of the information from the manufacture comes from newspapers, Tesla Motors statements, Elon Musk, critics, legal statements, academic articles and literature there may be some lack of information or extensive use of forecasts.

The methodology intends to bring an objective view in the matter based in facts besides the big debate, trying to avoid misinformation that Tesla defenders and critics spread.

5. Project

5.1 Elon Musk.

Elon Reeve Musk June 28, 1971 born in Pretoria, South Africa holds three citizenships: South Africa, Canada and United States, studied physics in Queen's University in Kingston, Ontario, Canada and University of Pennsylvania also received a degree in economics at Wharton School of business. Later he moved to California to continue his physics studies pursuing a PhD in applied physics and material science at Stanford University.

His entrepreneur career commenced by starting a software company with his brother Kimbal Musk in 1995 Zip2. The company provided and licensed online city guide software to newspapers having clients such as The new York Times and The Chicago Tribune, by 1998 the corporation had 160 clients and by 1999 Compaq acquired the company for 307\$million.

In 1999, Elon with the money from the deal cofounded X.com an online financial services company that through different merges transformed to PayPal, company used for millions by people's daily helping to make money transfer online and safe. EBay buyout the firm from which Musk received 165\$ million.

SpaceX was the next project in Musk mind. The idea behind was to regain the public interest in space exploration to achieve that purpose he and Adeo Ressim, his college partner, travelled to Russia trying to buy rockets and rocket companies at low cost. After several meetings Musk with almost reaching a deal with Kosmotras by buying a rocket for 8\$ million dollars.

From the trip, Elon realized that rocket industry was too expensive, with high margins and that he could produce lower cost products through vertical integration. His early calculations the company could cut the launch price by ten while having a 70-percent gross margin hence.

He founded Space Exploration Technologies- SpaceX- where he held and holds the CEO (chief executive officer) and CTO (chief technology officer) positions.

The company after overcoming initial hazards rapidly became successful: in 2008 Falcon 1 (SpaceX first rocket) was the first privately developed liquid fuel rocket reach Earth Orbit and NASA awarded a contract amounting to 1.6B \$ for commercial resupply services. In 2012, the Dragon was the first private spacecraft to visit the space station. The organization continued to gain important NASA contracts during the years, in 2017 SpaceX Dragon achieved a milestone realized the first reflight of a commercial spacecraft to an and from the International Space Station, this milestones reduces the cost for the rocket industry due the fact that the spacecraft is reusable.

“SpaceX designs, manufactures and launches advanced rockets and spacecraft. The company was founded in 2002 to revolutionize space technology, with the ultimate goal of enabling people to live on other planets.” From SpaceX website, as Elon Musk said in many interviews he wants humans to become interplanetary species and believes that humans need to colonize other planets in order to avoid extinction. The CEO expressed that he wants to die in Mars.

CAPABILITIES & SERVICES

SpaceX offers competitive pricing for its Falcon 9 and Falcon Heavy launch services. Modest discounts are available for contractually committed, multi-launch purchases. SpaceX can also offer crew transportation services to commercial customers seeking to transport astronauts to alternate LEO destinations.

PRICE	FALCON 9	FALCON HEAVY
STANDARD PAYMENT PLAN (2018 LAUNCH)	\$62M Up to 5.5 mT to GTO	\$90M Up to 8.0 mT to GTO
DESTINATION	PERFORMANCE*	PERFORMANCE*
LOW EARTH ORBIT (LEO)	22,800 kg 50,269 lbs	63,800 kg 140,460 lbs
GEOSYNCHRONOUS TRANSFER ORBIT (GTO)	8,300 kg 18,300 lbs	26,700 kg 58,860 lbs
PAYLOAD TO MARS	4,020 kg 8,860 lbs	16,800 kg 37,040 lbs

*Performance represents max capability on fully expendable vehicle

Inclination: LEO = 28.5°, GTO = 27°

Picture from SpaceX products displaying prices and capabilities.

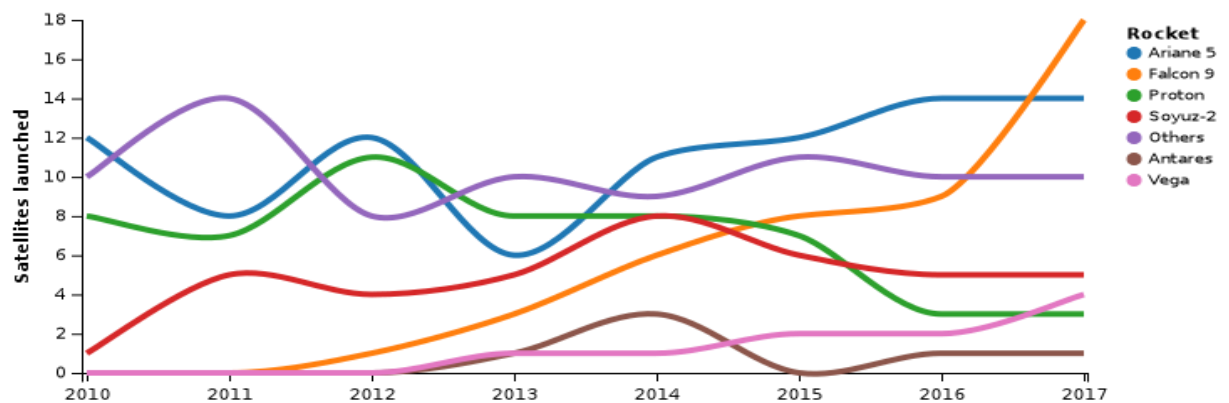
“ROAD TO THE RED PLANET

SpaceX was founded under the belief that a future where humanity is out exploring the stars is fundamentally more exciting than one where we are not.

Today SpaceX is actively developing the technologies to make this possible, with the ultimate goal of enabling human life on Mars.” Text from SpaceX website.

During his existence the company competed with giant companies such as Lockheed Martin, Boeing, EADS and powerful nations like China and Russia that didn't stop Elon from success.

As an example, the company is said to be the best option for launches. NASA relayed on the organization multiple times and is leading in number of launches.



Actually, Musk runs multiples enterprises, dedicating more time to Tesla and SpaceX, also is chairman of The Boring Company with the objective of reducing traffic congestion by making tunnels, Neuralink a brain-computer interface company and Solar City, one of the largest solar panel producers in the world. Purchased by Tesla for 2\$bn in November 2016.

Elon figure broadened the science and management, followed closely by the media, the reasons behind: being the manager of spacecraft and electric car companies, dating Hollywood actresses, appearing in some films, having conversations with president of USA Donald Trump.

Media describe him as the real Iron Man. For many is considered one of the most charismatics CEOs of the twenty one Century, many claim him as better entrepreneur than Steve Jobs and some regard him as an inventor and compare him to Tomas Edison.

5.2 Management Style

His management style is recognized by setting overly aggressive forecasts for very complex products that he generally misses. For example, Tesla model X, an electric SUV produced by Tesla, first deliveries were expected to take place in 2013. Instead, arrived to the public in late 2015, two years late. Same it is occurring at the present with Model 3 production rate estimations, which have been reduced twice in a year, not only in Tesla but also in SpaceX, the Falcon Heavy from SpaceX had suffered multiples delays.

Employees find this characteristic of Musk shocking. He always assumes that every element of the organizations can be pushed harder in order to obtain overly stretched deadlines.

Borgan BamBrogan, founder and CEO of Arrivo, who worked as a top engineer for SpaceX, who closely worked with Musk in interviewed, said: "He is an optimistic by nature.

He makes his calculations for how long it will take do something based on the idea that all things will progress without a flaw at every step and that all the members of his team will have Muskian abilities and work ethics." He described Musk as somebody who does everything rapid –"He is authentically in a hurry".

Asked about this approach, Musk said that does not try to impossible goals, finds them demotivating and if he did it in the past was unintentionally, and it is trying to recalibrate to be more realistic.

What is more interesting is the strong power in Elon human resources. For example, recruits the most talented workers despite overworking employees. He expects them his same output in the task required. Even though they are not able to meet the overly accelerated deadlines has mastered the art of getting most out of them.

Recruiting power and ability to attract best talented workers comes mainly from three sources: the figure of Elon Musk, who appears frequently in the media producing admiration by many, most importantly the ethical missions his companies try to accomplish. Thirdly, the opportunity to be part of leading companies, which are shaping the future.

Glassdoor, a website dedicated to provide information for futures employees about companies with data inputted by peoples, who have been working or work for the firm. An 85% approve the CEO and almost 60% would recommend a friend to engage a job in Tesla and an overall rating of 3.4 over 5 which falls for over a point to Google (4.7) and Facebook(4.6) and Apple (4.0) despite that many employees have left their job of those companies to join Tesla or SpaceX.

Despite Elon Musk covering many recent academic papers about business management, he refers himself as technologist rather businessperson in an interview in CNBC.

It is famous for solving problem with first principles rather than analogy, which is what most people, applies. First principles is about reducing facts to a fundamental truths and then deduct the best answer. Whereas, analogy thinking is applying similar responses to similar problems that already happened.

Moreover, Musk recommends focusing on signal over noise, that is, finding where the problem does comes from. Instead of, trying to repair matters that may be just symptoms from the real trouble.

Tesla CEO suggests seeking criticism this helps in finding problems and avoiding errors. Companies should always know and like to know what can possibly be or go wrong, in order to improve.

Summarizing, Elon Musk has been awarded as the most admired tech founder by CB insight, a firm that analyses tech trends. The results are justified through a survey beating figures such as: Apple co-founder Steve Jobs, Microsoft Bill Gates, Netflix Red Hastings, Zappos founder Tony Hsieh, Yahoo CEO Marissa Meyer and Amazon's Jeff Bezos.

5.3 Tesla Motors

Tesla Motors is not a usual car company, headquarters in Silicon Valley where produces electric vehicles and solar panels, which electric cars head in performance possessing superior specifications, especially in technology, to its peers. For example, range, acceleration and others features as autopilot control outcompete their counterparts, and meliorate at impressive rates. For these reasons, some regard Tesla as a tech company rather than automaker, supporting that statement: business analysts acknowledged the company potential of as supplier especially, in batteries or autopilot systems.

Company objective is defined in their website "Tesla's mission is to accelerate the world's transition to sustainable energy." and continues "Tesla builds not only all-electric vehicles but also infinitely scalable clean energy generation and storage products. Tesla believes the faster the world stops relying on fossil fuels and moves towards a zero-emission future, the better."

At the present 2018(April), the organization counts with revenues of 12 billion \$ for 2017, is expected to reach 20 billion \$ figure for 2018. Since inception has been growing the size of operations besides, having just two profitable quarters.

Martin Eberhard and Marc Tarpenning founded Tesla Motors, contrarian as what public generally thinks: Elon Musk did not found the company but joined at its early stages and rapidly became the CEO, product architect and through different funding phases became the major owner, positions which holds at the present.

The name honours Nikola Tesla; Serbian inventor and engineer, who created the induction motor. Well known for inventing alternating-current (AC) power transmission, with it won the war of currents in 10th Century against Direct Current system power of Thomas Edison. Musk donated 1 million to new Tesla Museum. The construction will take place on the ground of the inventor's laboratory in New York.

Tesla first product, the Roadster counted with high performance features but was an expensive electric car, sold from 2008 to 2012. The car appeared in Time 2006 as the recipient of better inventions.

The idea behind the Roadster was to revert the bad image public had about electric cars. They though, and many still thinking that electric cars are unreliable, unsustainable with lower performance. In other words, trying to attract the public showing that electric cars can be faster than combustion cars and compel customers with great designs. To sum up, producing electric cars always meant and today still mean synonym of losses.

The public bad conception emerged from multiples failures by automakers, which tried to bring electric cars to the masses unsuccessfully. The main reason for the outcome was that companies, sold electric cars with weak specifications or unaffordable.

As an example, in 1996 General Motors only produced the 1.117 units of its EV (electric vehicle), with range of 100miles from a full charge and able to reach high speeds, but its price made unable to get enough demand to get scale economies (cost reduction through high volumes) therefore consumers no responded well enough and the firm decided ending production due to constant losses.

In 2010, the Nissan Leaf with a range of 100 miles per charge had a more budget-conscious price of \$30000 but failed when benchmarked to gas competitors, still on production but has a minor role on the company. In 2012, the Renault Twizy besides having a lowered price tag around 12000\$ without tax incentives (Tax incentives are: helps that many Governments give to promote electric cars because do not harm environment) fell too short for customers: it had to be charged every 60 miles and could only fit one person.

The existence of the latter two probably were consequence of Tesla. Some companies after the unsuccessful intends opted for hybrid cars. In order to satisfy environment-concerned clients. As a consequence, Toyota offered the Prius and resulted a total success.

5.4 The Tesla Roadster



The Roadster was a key element for Elon Musk business plan “The Secret Tesla Motors master plan” which revealed once he introduced the model 3, at an investors conference.

To consider how sizeable the achievement was, the roadster was the first car from the company. In an industry with big entry barriers due to this fact, the firm outsourced many components of the product.

The Roadster is a Lotus chassis married to a lithium-ion battery pack and an electric motor, a total of 2450 Roadster were sold between 2008 and 2012, priced at 98000\$ in 2008, number that raised to 109000\$ a year later, and in 2018, Elon announced the second version but delivery still pending.

The success comes from solving many of the problems electric cars had in the at the past: the vehicle featured two seaters convertible sports car, attracting customer by his design and outperformed in velocity many combustion vehicles, able to accelerate from 0 to 60mph in 3.9 seconds.

As Elon Musk described in the Master Plan, which defines the long term strategic plan followed to accomplish the organization sustainable transport.

“Critical to making that happen is an electric car without compromises, which is why the Tesla Roadster is designed to beat a gasoline sports car like a Porsche or Ferrari in a head to head showdown.

Then, over and above that fact, it has twice the energy efficiency of a Prius. Even so, some may question whether this actually does any good for the world. Are we really in need of another high performance sports car? Will it actually make a difference to global carbon emissions?

Well, the answers are no and not much. However, that misses the point, unless you understand the secret master plan alluded to above. Almost any new technology initially has high unit cost before it optimization, and this is no less true for electric cars. The strategy of Tesla is to enter at the high end of the market, where customers are prepared to pay a premium, and then drive down market as fast as possible to higher unit volume and lower prices with each successive model.”

What Musk is explaining here is that the Roadster, was essential for advancing electric car technology, innovation is expensive at first and with time expertise evolves: reducing costs while achieving and higher performance would impact future models, and indeed happened. With that in mind, targeted wealthy early adopters (defined as persons who are likely to buy innovative products as soon as get into market) regarding the step key for BEV (battery electric vehicle) advance.

The next step, used the earned money and experience to develop a luxury car targeting a larger segment, The Model S. The changes from the Roadster were challenging, the Roadster as explained before was a car made mostly in hand and relied highly on outsourcing outputting low volume. Now, Tesla embarked to an increasing requirements for manufacturing.

The company acquired an automobile closed factory, known as Nummi (New United Manufacturing Inc) for just 42million\$. From a joint venture between Toyota and General Motors, a 5.5 million square foot facility located in Southern California, which at the present keeps producing all Tesla models.

The production relays is based on automotive high–tech robots, including more than 160 specialist robots requiring thousands of high-end jobs in the process. Started production with 1000 workers, by 2013 incremented to 3000 and in June 2016 duplicated to 6000. Actually, the automotive plant has the highest vehicles output and is considered the most advanced and regarded as an innovative production system, which differs substantially from others automakers.

The major costs incurred in the plant came from the equipment rather than the building itself required to make the Models S.

Launched in 2012, seven seats luxury sedan, with a range from 160 miles (260 km), the economic version to 265 miles (426km) catalogued by EPA (The US environmental Protection Agency) official range was the electric car with greatest range available in the market. In addition, the model S safety scored a perfect rating of 5 NHTSA (National Highway Traffic Safety Administration). Tesla decreased the price dramatically to just 57.400\$ (without tax credits) compared from the 100.000\$ Roadster cost.

CEO Elon Musk said, “That an electric car can in fact be the best car in the world.” Once the production was about to start. The chief wanted to demonstrate that BEVs could outperform any petrol car.

Model S besides missing delivery and production deadlines set, ended becoming the company largest success, became the largest sales plug in car in 2015 and 2016, actually ranks as second BEV sold car of history after the Nissan Leaf, if measured in dollars Model S would largely lead because has a twice expensive average price tag.

Tesla Motors was obtaining the resources necessary to produce the dire electric car for the masses. However, Elon wanted to create a SUV before commencing that, the product was not a bad idea because at that time SUVs sales were growing un-stoppable. As prove Micelle Krebs an autotrader analyst exposed that “Luxury SUVs are really hot right now, and the Model X should have been a big hit and broadened Tesla’s audience”.

Despite seemingly a low risk bet, Musk committed a mistake designing the product, as he reportedly admitted years after by twitter “Early next year. To start with, we're making the simplest Model 3 first, like we did with S. Didn't do it with X, because I was an idiot.”

The CEO architected an overly complex car, very ahead of any other by technology, and still is the highest tech vehicle (April 2018). Although the product was designed to be tech marvel but not designed to be manufactured.

In industries, usually appears the trade-off between complex products or designed for manufacturing, which facilitate production while complex products difficulting the production thus higher costs. As a consequence, Tesla delayed deliveries for near two years after facing multiples hazards at the manufacturing process. Among the reasons, the falcon wings doors suffering from oil leakage and overheating, the supplier Hoerbiger went to court but the settlement was not released.

Conclusively, as chief of product design Elon Musk affirmed, he stubbornly rejected the warnings his executive’s warnings.

5.5 Model 3



The dire mass-market electric vehicle, with which the company wants to generate a disruption in the industry and supposes that will make BEV a real option for new car buyers. As explained the previous models had a high price tag only accessible by high budgets but with model 3, the company expects to bring electric car sales to the next level.

At the present (2018), sales of BEVs in USA represent just nearly 200,000 from the 17 million total vehicles sold. The Model S crowns BEV market with 27,060 figure besides starting at 74,500\$.

In March 2016, Tesla showed the Model 3 prototype and announced first deliveries in late 2017, the company elaborated a scheme to reserve the car for 10,000\$ and in one week the reservation reached 325,000 most importantly reported that 93% came from new buyers.

Model 3 lowest cost configuration is just 35,000\$. Before any tax incentives, competing with comparably priced offerings from BMW, Mercedes, Audi, Lexus, Toyota, Acura, Jaguar, the Volt from General Motors and the Nissan Leaf, the two latter are the only BEVs, all the others are gas powered cars. Actually (May 2018) Model 3 are outperforming competitors and the gap is expected to increase as Tesla production rate improves. However, many firms intend to enter the BEV market with giants like Volkswagen or Toyota.

Despite that Tesla is likely to retain first mover's advantage from 2-3 years minimum. This statement comes that besides others automakers are mature and have more experience addressing mass market, and what implies: standardisation of products, ability to deal with geopolitical risk or lobbying power, lower cost per unit due to economies of scale (Scale economies is the benefit from producing larger volumes) and more financial power.

All of those advantages will take place once the manufacturers already produce their models, and many of them are reluctant to enter the market. As an example, BMW announced its Tesla Model 3 competitor iNext with 435-mile range will enter the market in 2021, Mercedes parent company Daimler postponed their date to 2022 and like them majority of producers just designed and presented the prototype they may delay it if face difficulties in production. As Tesla had and electric would still mean a different thing for big automakers.

The reasons why Tesla does not get more direct competition: Tesla only had two quarters presenting net income after fourteen years of business and had multiple capital injections. Entering a market with that history of loss making products and after failures in the past, it is logical for CEOs being reluctant and postponing their decision. In addition, automakers are safe executing the actual process, which they have been doing for decades and profiting from it in an industry which had little but no advances, therefore are more prone to be risk adverse.

Furthermore, there are many theories about the outcome in competition between combustion and electric vehicles. Some say ICEs (internal combustion engine) cars will keep dominating due to the charging infrastructure electric cars need and how electric generators will adapt to it.

The most sceptical say that electric cars will never be able to outcompete the gas powered car considering electric cars inferior products and not economically possible. Whereas, the electric defender forecast a change in consumers opinions, and that once they have the effective opportunity to switch to electric cars, even with the same specs, under the perception that's is the future. And as result, many firms will have no option but enter the electric market and leave combustion cars, which will slowly disappear.

In addition, Apple the largest company in the world, in a report by New York Times, has been trying to make his own electric car. Induced by the self-driving technology and success of companies like Uber, scaled the project "Titan" or what press called "iCar" or "Apple Car" and the article reflected that ultimately abandoned the electric car and focused on self-driving driving technology.

At the present, Tesla is facing hazards with model 3 production. What many call a break or do it point, this is, bankruptcy or expansion. The problems emerge from the difficulty in scaling manufacture. The company delayed target production rates twice, lack of experience and a history of missing its own estimation, weighted in. Some analyst doubt of Tesla capabilities, never faced mass production. And what is more preoccupying the organization is increasing production which augment cost while having a small liquidity.

In addition, the company is perceived as not profitable. As evidence, Tesla Motors is the top shorted USA corporation, that is Wall Street betting against success.

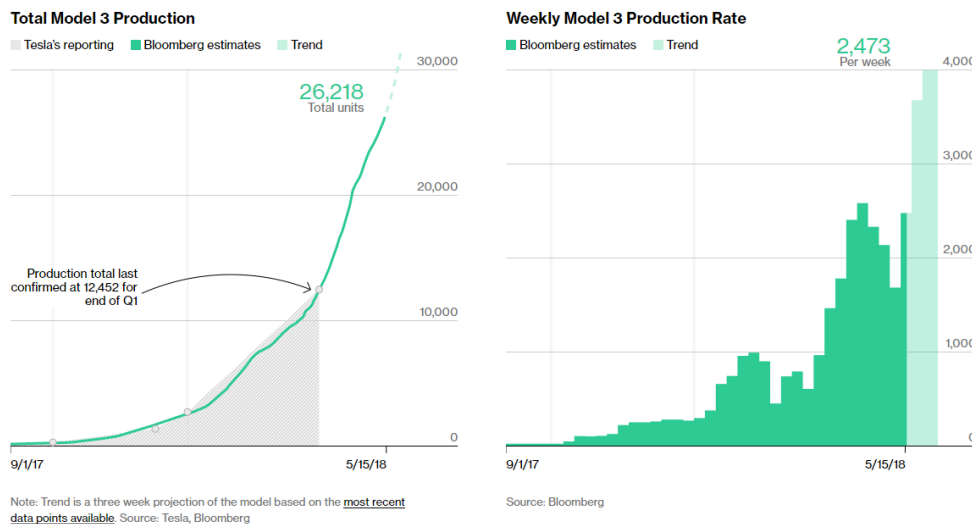
However, Elon Musk stated multiple times that will not need to raise capital and stated that once achieve 5000 cars per week production rate will surpass the financial breakeven.

Currently, the situation is an absolute drama, some high end to executives exited the company such as Matthew Schwall the company main technical contact with USA safety regulators left for Waymo, a corporation owned by Google. Tesla Chief accounting officer also left the company for "personal reasons" and Doug Field senior vice president of engineering is taking some time off. Moreover, the press that once praised him, now is against him. Few accidents happened while Tesla autopilot was engaged and investigations are on-going to clarify if the firm feature is related. In addition, Tesla batteries burnt after accidents due to the chemical composition of the battery.

Elon defended saying that Tesla are the safest cars statistically, and indeed have the highest ranking in safety in multiple rankings, and the autopilot feature requires pilot the driver to be active once activated.

Elon Musk is making the impossible to impede bankruptcy of Tesla, took charge of production, and in CNBC interview stated that he sleeps within the building.

The corporation, in order to increase production rates added a night shift thus almost manufactures 24 hours the seven days of the week. Only pauses to boost productivity in scheduled advance. Therefore, once restarts increases the output. The pressure is so strong that even Bloomberg established the Model 3 tracker, a system external to Tesla to analyse how productivity is evolving.



Model 3 is a car designed for production, as Elon described in Twitter, learnt from the errand committed in Model X. Besides that is dependent to supplier, if those external parties fail, the process would bottleneck. Although, this risk is reduced due to Tesla is a highly vertically integrated.

Even though, Model is a standardized product, the engineering problems appeared paradoxically, in the production system. The CEO as stated wanted the factory to be the product, this approach which seems futuristic, happened to be too advanced. Some new robots that replaced human resulted slow and were too innovative. Therefore, Elon acknowledged the mistake on Twitter and increased human labour because is faster in certain activities. Indeed, he delayed the boost in car-making for the model Y, if the company avoids bankruptcy.

Public is enthusiastic about model 3, even if some presented some flaws. Tesla retains a backlog orders of more than 400,000 cars and keeps receiving new orders. And to increase cash position and profitability, Tesla gives priority to expensive configurations, this action did not affect other reservations nor the image. Thus, demonstrating brand power.

To sum up, advances in production technologies are complicated, if made too early will impact negatively to the planned output and are expensive but that will cost in short term will be a benefit in the long term.

5.6 The Lean concept

Before knowing about any type or strategy, must be understood, what is manufacturing.

Manufacturing is defined as processing raw materials into finished goods by using diverse techniques. Manufacturing is a value-adding process that allows businesses to sell finished products at a premium over the value of the raw materials used.

Manufacturing has been carried out from the beginnings of humanity, since it is the art to transform raw materials into products.

During first industrial revolution the concept was emphasized, first large factories appeared and engineering gained level at business practices because investing in better factories supposed greater output while reduced costs at long term, that it is higher economical profit.

Lean thinking has multiple definitions, from Womack and Jones 1996 “helped us to understand the principles of lean: the identification of value, the elimination of waste and the generation of flow (of value to the customer).”

Extending the definition, lean thinking is eliminating unnecessary steps or procedures to enhance greater efficiency, trying to reduce the human effort, recombining labour into teams dedicated to that activity. An approach to be able adapt production to demand or circumstance that is strive for flexibility.

The comprehension of the work as something more than a mere production system. Always searching ways to improve. That is to have an ambitious approach, optimistic about the optimization of the production while rejecting conformism.

Lean management or manufacturing origins from Toyota car assembly method that outperformed Western mass production systems and helped the firm to broaden worldwide.

The main benefits of being lean are well documented: Less process waste, defining by that: wasting not only generates the economic expense of the inefficiency per-se but also the cost of eliminating that inefficiency- that's getting rid of the waste-.

Actually, probably due to the competitive advantage and use of lean concept Toyota retains the crown of largest car company, with more than 200Bn \$ of market capitalization.

Since Toyota was born, their leaders had clear that key to success was investing in people and that fundament evolved to lean thinking.

The Toyota Way is primarily about culture—the way people think and behave is deeply rooted in the company philosophy and its principles.

“At the core it is about respect for people and continuous improvement...”
(Liker and Hoseus 2008, p. 4).

In 1970, Toyota own supply base was 'lean' and by 1980, their distribution base became 'lean'. The key factors of the system summarized: poke yoke- an 'error-proofing' technique used to reduce defects in the production. Kanban (the Japanese word for "card") by the premise of better information flow: represents a pull signal that related to a handling unit of a specific item or an item family, combined with manufacturing and/or transport instructions.

The Kanban information conveyed by simple visual devices such as cards, balls, carts, containers, and so on. It can apply to both material and product flow within a site and material flow between suppliers and customers, or any partners of the supply chain with the aim of adapting the manufacturing process for the customer.

In addition, there are five fundamental control techniques, known as the 5 S's. (list from five Japanese words): seiri (tidiness), seiton (orderliness), seiso (cleanliness), seiketsu (standardization) and shitsuke (discipline) a visual housekeeping technique which devolved control to the shop floor and the Visual control- a method which was by an operator team in charge to revise defects by eye, which relates to kanban information flow.

These processes may seem primitive nowadays, but back then supposed a revolution. As an example, Ford model T, the most famous car model in history by which Henry Ford, back in 1908, was able to reduce drastically the cost of car manufacturing by setting uniform assembly lines and standardizing the products.

However, the manufacturing process generated a lot of waste and mispending in raw materials thus, Toyota greatly improved automobile production and once competitors realized they imitated or adapted characteristics of their production system.

From that sizeable improvement there have not been significant changes if modern product lines are analysed most of them are founded in the lean manufacturing from Toyota, except one: Tesla, which is currently trying to push further the lean concept through high-technology: with more and greater robots and the aim of sizing output and reducing human labour.

5.7 Lean Management in services: The Amazon example

Over the years, many companies around the world applied the lean vision, which is not exclusive of manufacturing industries but also occurring in services, that is why: some authors do not differentiate between lean manufacturing and lean management they think about 'lean' as holistic philosophical concept of conducting processes.

As an example, cutting edges service enterprises include lean management such as Amazon, Facebook, Google and Apple, which some do not manufacture per-se but indeed do produce products as service and used the lean vision to empower their business. Actually, these companies are the largest in the world, by market capitalization and expected to keep growing in size.

In Amazon, the lean thinking is entrenched in the culture of the company. Six Sigma and lean manufacturing are applied in the operational excellence guidelines that the firm established in 1999. From that plan, emerge practices like a special effort to recruit the best employees from top selection of universities like MIT or Harvard and retain them, while giving employees flexibility, some are able to work in home and have others benefits like above average compensations, childcare or medical insurance.

Other example of successful lean practice in Amazon is regarded as the retailer who has most control in every step of doing business almost everything that is quantifiable and the data collected passes to a processing data centre, which searches for patterns and matches the information with the best outcome.

This system applies on almost all activities the firm does: if a consumer buys in Amazon the data processor through calculations and information obtained will show the consumer possible products that may want or need.

Also the distribution channel, is said to be the best worldwide, controlling and accounting: what, where, how, how many and how profitable products are being shipped and if there is the necessity of fulfilling the warehouse through models provided by the forecasted demand from data centre.

Jeff Bezos, the CEO, is famous for throat cutting competition, stabilishing low margins and sharking ineffective industries by attack the model they use through lean management that has been applying since its very beginning.

Amazon born as an online book retailer, which outcompeted and brought to bankruptcy many book companies, then broadened their activities through time. As an example of organization competitive power, when Amazon entered the supermarket acquiring Whole Food. Announced discounts, and their competitors feared about their margins and investors sold their shares, nearly 12 billion \$ disappeared after the slump affecting companies like Kroger, Wal-Mart. Target, Costco, Supervalu and Sprouts Farmers.

As result of those practices, Amazon is the leader in retailing industry and second largest company in the world only after Apple.

5.7 Lean manufacturing and offshoring

In manufacturing, the most popular concept over the last decades has been outsourcing, based on moving factories from developed or rich countries to undeveloped nations in order to reach lower costs on production.

This vision is becoming widely argued by some authors, who affirm that bringing factories to other countries just reduces the human factor cost and as underdeveloped nations are growing to accelerated rates compared to their richer counterparts the benefit of outsourcing is shrinking. Furthermore, companies who offshore must upset other costs that they do not face in their countries such as geopolitical risk, lack of qualified labour and weak infrastructure.

Geopolitical risk: political instability is a fact in underdeveloped countries and appeared the risk from their own countries with Trump and Brexit protectionism (the practise of imposing taxes for product coming outside the border) emerged.

Lack of qualified labour: difficulty in finding qualified human resources, the common solution is bringing national personal overseas, which is costly.

Weak infrastructure: port and airports may not be able ship some types of cargo or the lack in safety or the difficulties in bureaucratic legislation, although some countries as they progress try to mitigate these problems.

As consequence if a worker in Germany earns 3000\$ and one in Morocco 500\$ the difference is not 2500\$ but a lowered number and setting up a plant in at foreign country is a long-term investment therefore subject to volatility.

Authors embracing the lean management are in favor and against: the defenders of outsourcing in lean manufacture see it as an improvement on the human costs.

Whereas the others explain that companies have focused too much in reducing labor costs losing the big picture of lean manufacturing which is improving production system as whole rather than standardizing the process and locate it away from the headquarters.

Therefore, firms are settling and there is no incentives to create greater efficiencies in the production, the problem is especially important in high-tech industries, which the technology evolves like automakers and aircraft. As an example, in car manufacturing there has been no real change but to outsource the plants while there is a great deal in improving the plant through automation.

Furthermore, robots are able to develop more tasks enhancing productivity. Indeed, Elon Musk criticized the actual production system and the lack of progress in the recent decades. In the model 3 production.

“When you think of a manufacturing facility, for a given size of factory, the output is going to be volume times density times velocity. If you look at our factory and say what is the density of useful to non-useful volume. It’s crazy low. It’s like 2 or 3 percent if you look volumetrically – not on a footprint basis.

Then you look at velocity. What is a reasonable expectation for the exit velocity for the vehicle coming out of the factory. You might think that some of the most advanced car factories in the world are very good at making cars and they are maybe making a car every 25 seconds – that sounds fast, but actually, if you say the length of the car plus some buffer space is approximately 5 meters so it’s taking 25 seconds to move 5 meters.

That’s 0.2 meter per second or not much faster than a tortoise.”

The CEO intends to reduce human workforce in the car production as much as possible by replacing them for machines, which will yield in greater production rates and less defective products.

5.8 How Tesla applies Lean Thinking

CEO Elon Musk takes seriously lean management, about manufacturing in Tesla investor's conference said, "The most fundamental difference is thinking about the factory really as a product, as a quite vertically integrated product," said Musk. "It's treating it as more of an engineering and a technical problem as well," added Chief Technical Officer J.B. Straubel.

"Which is the Toyota Production System," replied Johnson.

"Yeah, we don't think so," countered Musk.

"I think that generally, it's more of an optimized operational problem, being extremely lean and really managing the flows of materials and the supply chain," said Straubel. "They're great at it, but this is, I think, a different approach, looking at it really from a deep technical lens in terms of automation, robotics, and process."

Musk wants to go beyond the actual lean manufacturing, emphasized that, in thinking about the factory as a product itself and relying on technology to strive in greater quality, quantity and efficiency from the plant.

Lean thinking in Tesla begins with the product per se. Electric cars besides economic difficulties manufacturing have less mechanical parts and are simpler than their combustion counterparts. For example, an electric motor comprises about half dozen moving parts whereas combustion engine has hundreds of moving parts.

The problems in electric vehicles surge from scaling the production and making innovative sophisticated technology with components that never existed before but electric cars not only count with fewer mechanical parts but also need less maintenance, from economical and engineering point.

BEV cost less yearly from the obviousness that are powered by electricity thus energy source can come from renewable systems as solar, wind, hydroelectricity or non-renewables like nuclear, carbon, natural gas or paradoxically even from oil therefore, enhance flexibility.

Whereas gas vehicles are subject to petrol price variation and costlier distribution costs. In addition, many governments do offer benefits from fiscal policies while, punishing combustion cars with higher taxes due to contamination output. Therefore, budget in energy consumption will be lower in electric cars.

From perspective engineering, electric cars do not need as many checks also can stand more kilometres without having to replace some parts.

For example, BEVs do not require traditional oil changes, fuel filters, spark plug replacements, or emission checks. In addition, brake pad replacements are rare because regenerative braking returns energy to the battery, significantly reducing wear on brakes.

In addition, electric vehicles use software updating to solve problems and usually has zero expense, and facilitate capabilities to find issues within the car. Although, the main drawback is the battery, which is the most expensive element, counting for at least a third part of car cost. That is why requires more inspection but overall, electric cars are easier to maintain.

The design in Teslas exemplifies perfectly the lean concept especially; in the model 3. The firm takes a minimalistic approach in their cars interior. As evidence, some firms have an array of buttons and a widespread of functions all over the vehicle, that some consumer may find it excessive and confusing. Whereas Tesla, reduces at the minimum the elements inside the car, the model 3 literally just has only one device, a 15.4 inch touchscreen in the center that controls everything. Therefore, the LCD panel displays all functions from heating, music, windows, mirrors, even the velocity indicators also customers able to control some of these with their smartphone.

tesla model 3 interior picture below



Distribution highlights the ambitious view on 'lean thinking'. The automobile industry distribution system mainly relays on concessionaries, which sales are done by different company than the parent where agency problems can occur and carmakers do not dispose total control about customer's data neither brand, and the costs may affect their profit margins.

Whereas Tesla is the first and only automaker, which possess his own distribution channel, without using an outsider to accomplish the function, has total control, solving the problem cited before. Therefore, the information flow from clients has been essential to improve their products demonstrated in consumer satisfaction leading in ratings achieving 90% by Consumer Reports statics in 2018.

The game-changing feature comes from the website configurator. Where customers are able to choose the car characteristics like colour, size of wheels, solar roof. This peculiarity flows the information to the factory facilitating production output, and then informs the client about car's delivery date thus, uniform demand and supply.

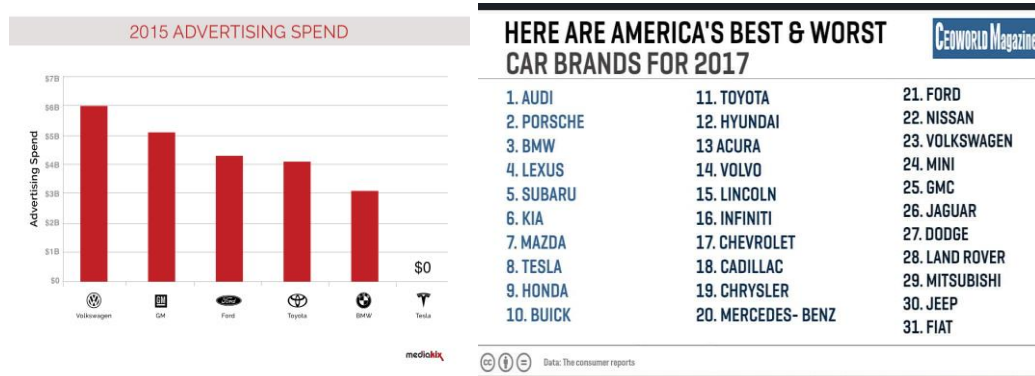
Even more astonishing is that if potential buyers go to a Tesla store, the process will be the same as home, only difference will be company staff helping to make the order online.

Manufacturing in Tesla is a controversial issue though, the company acknowledgedly has the most advanced robots and tech, and has the most automated plant in the world besides Tesla remains unprofitable and some argue that experienced automakers have not entered the electric production so they may be able to produce better. Moreover, the company problems to increase production support this theory. Although, from standpoint the company it is a game changer puts emphasis on automation and improvement while others did not do any significant change thus the losses from innovation.

Another approach where the firm differentiates is in vertical integration approach, Goldman Sachs situate it at 80%. Vertical integration allows not only cutting costs but also smoother manufacturing. As an example, if some problem arises from a supplier the whole production would suffer by a fault from an external party also, if there were the necessity to change some characteristics would mean more delays, and quality issues can appear from these supplied parts. Therefore, Tesla strives for vertical integration, the firm acquired suppliers and if thinks that can meliorate parts outsourced will step in and produce them in-house, that is lean manufacturing at is best.

Furthermore, Elon Musk well documented that to disrupt in the market, the product it does not has to be better, and it has to be much better than the others. To achieve that, Tesla puts all the efforts in practises that actually make the product better like research and development.

As an example, the company does not spend on marketing, and that did not deprive from having a highly valuable brand image.



Internal communication structure relies heavily on lean management. The organization emphasises flexibility. Elon Musk explained, that flattening human resources helps information flow and helped the company in finding solutions and prevent problems. By flattening human resources, meaning an opposite way to hierarchal organization where all workers are able to inform to the high end without having to overcome steps. Therefore, an application of Kanban system from Toyota. Furthermore, Tesla communication guidelines demand understandable data to make it easier for the receptor. As an example, prohibit the use of acronyms or abbreviations, this practices are not in order to just enhance information flow but also a quality flow.

In addition, the CEO directly contacts all members of the organization through mail to inform about the company on-going situation. This approach it is said to be more efficient and facilitates company adaptation to troubles.

However, many analysts think that Elon Musk possess too much power and the company may rely on his figure too much. In addition, the CEO holds Chief architect position (job in charge of product design) and has multiple roles in other companies like SpaceX or the Boring Company. Although, CEO work ethics and output is impressive besides that.

6. Personal Perspective

In my opinion, automakers see only troubles in the Tesla, they do fail to realize the basics of technology, and they will have to incur the cost of executing such technology eventually, and in car industry advance is essential. Latecomers will suffer more difficulties; also, automakers have been enjoying prosperous sales periods of profit, many firms seat on large quantities on cash or marketable securities.

As an example: Daimler has 23.5 billion euros in their coffers and is able to give their investors 3.5 billion euros in form of dividends annually.

Volkswagen has 40 billion euros in cash and giving their owners 1.3 billion euros in 2017 and enjoy high credit ratings; BMW has A+ from S&P and A1 from Moody's, that is what in finance industry call investable bonds and imply easiness to access money markets to finance their operations.

In addition, Tesla regarded as junk bond or Caa1 from Moody's also ICE automakers could cut their dividends to finance their electric operations.

Although, may the effect on share prices (valuation of the companies) is uncertain. Investors like dividends and usually fly away after cuts in dividends, but many investors may feel encouraged to put capital in company betting on electric vehicles.

The opportunity cost of entering the electric markets is very low considering the facts exposed.

What in future may be called traditional automakers made a several mistake and with it, failed to the lean manufacturing, the industry which originated the concept and spread it to all business. They got comfortable with a system and not preoccupied to improve, that is, failing at the lean manufacture core. It is sever one because the low opportunity cost represented. In addition, Tesla is 14 years and no other automaker really put their best resources to outcompete, the GM Volt and Nissan Leaf are inferior products, where parent companies invested low amounts of budget. And if they felt technologically constrained, could have acquired them rather than that, the one's that entered in Tesla ownership, with low amounts, divested, like Daimler.

On the other hand, Tesla already succeeded, they put the electric car on the road, on the eyes of the public, near concluding their objective by making it economic accessible.

Personally, the electric cars are here to stay, are products evolving constantly. While, gas powered cars did not make significant changes thus electric cars are more "lean" oriented. The argument goes stronger when looking at luxury segment the model S dominates over his petrol competitors.

Regarding model 3, the firm eventually will figure out how to increase production rates and financially and bankruptcy is not likely.

Because the demand is there, 400,000 reservations in the backlog and the possibility of acquisition by a big tech is possible Apple, Google, Facebook, Cisco, Amazon could be possible buyers.

And succeeded, by their own, because quoting Elon Musk technology does not get better as time passes, gets better because a lot of people worked hard to make it happen, in this case Tesla work team, brought the change.

What is prodigious about the firm is overcoming high entry barriers and the resilience to keep believing despite of financial hazardous, criticism, required creativity and innovation. A company, which is applying lean concept beyond.

In conclusion, Tesla promises do not come in time but they do come.

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