Case Study of Tesla

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Individual Research work submitted for:

Responsible Supply Chain Management

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Executive Summary

This report provides an evaluation and analysis of the supply chain configuration of Tesla, the challenges faced, and the enablers needed to deal with them. The present supply chain with respect to the processes, facilities, transportation, inventories, information system and people is touched upon. The key findings show that Tesla have suppliers not conventional to the auto-world as it deals with the electric powertrain. Tesla has a 'vertical integration approach' which can help in few aspects with regards to not being reliant on suppliers and lowering the cost of the final products, but the downsides being loss in flexibility and focus. The challenges with respect to climate change, political instability, raw materials scarcity and labor aspects is covered with potential enablers being the implementation of Sustainable Supply Chain Management by triple bottom line approach and Technological developments in the field of Material Science, IoT, Robotics, AI and sustainable energy sources. Initiatives for enabling a wholistic supply chain in a networked economy without silos between business teams and partners is enabled with new business models and recommendations.

Key words: Responsible Supply Chain Management, Vertical Integration, Networked Economy.

Introduction

Tesla, Inc., formerly known as Tesla Motors, is an all-electric car manufacturer of American origin, founded in the year 2003 by Martin Eberhard and Marc Tarpenning (Schreiber and Gregersen, 2013). Co-founded by Elon Musk, the company has become a global phenomenon within a span of 15 years. “Tesla’s Mission is to accelerate the world’s transition to sustainable energy” (About Tesla, n.d.).

Market and Product Range

Tesla is one such company that works towards a sustainable future and competes with the gasoline vehicle segment with its electric powertrain. At present, it is still a small player competing against the giants such as Toyota, General Motors and Daimler AG etc. Tesla has a promising future though it is faced by the challenge of economies of scale possessed by its competitors. Its markets are in the continents of North America, Europe and Asia (Statista, n.d.).

In 2008, Tesla released its first car, the all-electric “Roadster” which achieved an incredible range of 245 miles in a single charge. At about $109,000, it was powered by Lithium-ion batteries with no emissions and targeted at the wealthy customers who wanted environmentally-friendly sports cars (Schreiber and Gregersen, 2013). In 2012, Tesla focused on producing the “Model S” which was high on performance, design and efficiency. It was targeted at the customers who wanted luxury cars, challenging their status quo. In March 2014, Model S became Norway’s most popular car and in 2017 it was the highest selling all-electric car in the US market (Statista, n.d.). In 2015, Tesla came out with the “Model X” which was a “cross-over” vehicle, having a battery range of over 295 miles (Boylan, 2016). Finally, in 2017, the “Model 3” was manufactured for the mass segment with a price tag of $35,000. Annexure: 1(b) shows the different car models produced by Tesla along with some interesting facts.

Business Model of Tesla

The Business Model Canvas which was developed Alex Osterwalder and Yves Pigneur is a useful framework to understand the company's functioning with respect to each block such as key partners, key activities, value proposition etc., as shown in Annexure: 1(a).

The Business model of Tesla is quite non-conventional by nature as it is vertically integrating processes across the value chain from supply to delivery, for example: not involving dealers to sell their vehicles. Apart from electric car production, Tesla is also into scalable clean energy generation and storage products (About Tesla, n.d.). The "Tesla Gigafactory" which was operational from 2016, is a large scale (Lithium-ion) battery manufacturing plant based in Nevada, USA. It aims at producing batteries for its electric vehicles at a cheap cost, by in-house production, alongside creating a lot of employment opportunities for the local economy. We can see that Tesla is trying to build an ecosystem that revolves around sustainable energy. This is also a strategy for reducing its reliance on suppliers by the vertical integration approach.

Current Supply Chain Configuration

As stated by the company's CEO Elon Musk, the goal for Tesla is to reach 500,000 car deliveries by the year 2020 (Monsellato, 2016). To establish a supply chain for such an ambitious goal will be a very demanding and challenging task for Tesla. The three major car models manufactured by Tesla (Model S, Model X and Model 3) along with the projected sales targets until the year 2020 is shown in the Annexure: 2.

The main manufacturing unit of Tesla is situated in Fremont, California, USA. Annexure 3 gives the layout of the Tesla factory in Fremont having a total area of 5.5 million sq. m, where operations such as assembly, stamping and painting etc., takes place (Teslarati, n.d.). Annexure:4 shows the other facilities of Tesla worldwide with related activities. Tesla requires more than 2000 parts from 300 suppliers to produce the "Model S" alone (Monsellato, 2016). Tesla try to build the components in-house in-order to have high vertical integration as it can be seen from the Gigafactory example. This can be advantageous in a way as it reduces its dependence on suppliers and reach the required economies of scale, but it can also have a negative influence on the supply chain as it can reduce the flexibility.

The Value Chain of Tesla is as shown in Annexure: 5. It consists of the Design, Engineering, Manufacturing, Sales and Distribution, Service, and Charging stages (Christaininoa, 2016). The strategic initiatives at each level of the value chain is disruptive by nature because of its unique business model. With respect to Tesla, the levers of supply chain are explained as follows:

- **Processes**: Tesla integrates automation in its manufacturing processes with some level of human intervention (Thompson, 2018). This is to ensure productivity and operational efficiency within its plant. Through vertical integration, they manufacture lithium-ion battery packs, gearboxes, electric motors and components for their various car models. The

Gigafactory 1 is about 3.5 million sq. feet in size and has a production capacity to manufacture batteries for more than 500,000 cars per year (TESLA, INC., 2018).

- **Facilities**: Logistical nearness to suppliers, resources and markets are important aspects for Tesla to consider for strategic reasons. Apart from the Tesla factory in Fremont, California, it also has manufacturing and assembly operations in Lathrop, California, USA and Tilburg, Netherlands. The Battery manufacturing facilities i.e., The Gigafactory 1 and 2 at Nevada, California and Buffalo, New York respectively, aid with sub-assembly of battery modules (TESLA, INC., 2018). They have their own Tesla flag-ship stores without any intermediaries such as dealers or ad agents, thereby redefining the traditional sales strategy of the auto-industry.

  After acquiring the NUMMI plant in 2010 which was previously owned by Toyota and GM in a joint venture, Tesla converted it into the Tesla factory. In 2016, the plant managed to produce only 83,922 cars with a productivity of less than 20% compared to that which was achieved previously by Toyota-GM partnership (which manufactured around 400,000 cars in 2005 at the same plant) (Barkai, 2017). Ramming up production for a new comer was a challenging task, especially when tacit knowledge was involved, which is only acquired over years of manufacturing experience.

- **Transportation**: Logistics is a challenge as far as delivery of vehicles to customers is concerned. Recently, the CEO Elon Musk had commented on its logistics by saying “Sorry, we’ve gone from production hell to delivery logistics hell, but this problem is far more tractable. We’re making rapid progress. Should be solved shortly.” (Cosgrove, 2018). Tesla also introduced an unconventional door-to-door service of its vehicle delivery to its customers called ‘Tesla Direct’ (Lambert, 2018). This could be inefficient way to deal with deliverables as they aren’t involving a third-party courier service or dealers to manage this issue.

- **Inventory**: Tesla's partnership with Toyota has helped reduce inventory costs due to implementation of the Just in time philosophy for the inbound inventory. But it keeps outbound inventory to a minimal level as it assembles according to consumers' demand, thereby reducing the need for space for finished products (Tao, 2014). This also reduces the risk and costs associated with excess inventory storage.
- **Information System**: It is very essential aspect of the supply chain to improve the processes involved in the company with respect to procurement, production, and project management. For production processes they have custom built ERP systems, Requirements Management System (RMS) for planning projects, Facility Management System (FMS) to ensure that the facility is functioning efficiently and safely, and Product Data Management System (PDMS) to support the engineering activities. Interesting fact: Tesla Vehicles are also integrated with advanced software system which is referred to as the "Computer on Wheels" (Evannex, 2017). In Electric vehicles, it is easier to integrate the electronics and software, making them super intelligent. With all updates of the software done online, Tesla is bringing out innovation in the connectivity aspect.
- **People**: One of Tesla's core competency is its human resource. It's main manufacturing hubs (Fremont and Lathrop) are at the heart of the Silicon Valley in California which has no shortage of intelligent, smart and hard-working human resource. Tesla's advantage of sharing workforce and technology with Elon Musk's other companies such as SpaceX, Hyperloop etc., has been very helpful. For instance, the infotainment system for Model S was done entirely in the Tesla Factory with the help of SpaceX engineers (Monsellato, 2016). This mindset of open innovation has given Tesla the opportunity to work alongside lead users and suppliers who aren't traditional to the auto world.

Industry Trends

The supply chain is categorized as forward and reverse parts (Günther et al., 2015). In the context of the Automotive industry, the general supply chain is as shown in Annexure: 6. The different competitors in the automotive industries and their market share is as shown in Annexure: 7. The demand for electric vehicles is set to grow in the coming years. However, Tesla still holds a huge share of the U.S Market (shown in Annexure: 8) with model S and X being the top two electric vehicle models with sales share of 29% and 16% respectively between January and June 2017 (McCarthy, 2017). In global market though, it is behind the Chinese automaker BYD (shown in the Annexure: 9).

Market Trends

According to the Market trend for the electric vehicle segment, it is yet to catch up with its gasoline counterparts. It has 2% of the total market share as of 2016 and projected to grow to 22% by the year 2030 (The Times of India, 2019). This rise is demand is depicted in Annexure: 10, which is mainly due to advancements in battery technology due to which electric vehicles will become affordable. People are getting environmentally conscious as well and more investors are placing their bet on the EV segment. Tesla is also heavily investing in R&D on battery technology and Autonomous driving. In the future, Autonomous driving will become a part of our lives and is more compatible with electric vehicles. Annexure: 11 shows the market trends scenario of the future. Continuous development of Tesla's core technology with regards to battery innovation is an essential market driver (Mangram, 2012).

Main Current Supply Chain Challenges

Climate change: Tesla is making efforts in the sustainable energy area by making products which are eco-friendly by nature, which is their mission. But one must note that "they are only as green as the electricity they are using" (Harder, 2018). Emissions occurring from

manufacturing of batteries and other components of the electric car must also be taken into consideration. The challenges with regards to climate change must be addressed by using electricity which is produced by sustainable options such as solar or wind, rather than from coal or fossil fuel. Thus, by giving equal importance to the environmental aspect of the triple bottom line can improve the supply chain by making it sustainable and responsible (Günther et al., 2015).

Political instability: Tesla has an international presence and is penetrating to different countries such as having a delivery hub in Beijing, China or an administrative centre in Amsterdam, Netherlands. It may also have to face challenges with respect to political instability in the countries it is located, as it may cause disruption in the supply chain leading to financial loss. Also, it has many sourcing partners from around the world whose supply depends on the political stability of the respective country and the foreign relationship the country has with America.

Economy: The economic factors such as market growth, currency exchange, trade levels and other variables can have an impact on its growth (Kissinger, 2018). Free trade agreements with other countries can increase the opportunities to expand into further locations, but it should investigate the economic facets too. Another important aspect to consider is the spending power of people in the countries it is penetrating to, as most of the middle-class people would consider buying cars they can afford.

Raw material Scarcity: Tesla uses many raw materials especially for its battery production. As the demand for electric vehicles will grow in the future, it will also result in raw material crisis. As reported by the form 10-K (Annual report) of Tesla, it uses many raw materials such as aluminium, copper, steel, cobalt, nickel and most importantly lithium to name a few (TESLA, INC., 2018). In 2015, The U.S Geological Survey concluded that the world has enough reserves for the current production rate (as of 2015) of Lithium for the next 365 years. Considering the

future scenario, with the rise in demand of EVs and the production volume of the next 100 Gigafactories which is set to be constructed can all result in less than 17-year supply of Lithium (Hunt, 2015).

Labour aspects: Tesla is strong in-terms of labour aspects with a total of 45,000 employees. Recently, staff lay-offs have made it to the headlines due to which employees aren't feeling a sense of job security. These cost-cutting measures can have an impact on the reputation of the company as focusing only on the economic aspect of the triple bottom-line can lead to unsustainable supply chain practices (Günther et al., 2015).

Enablers

Existing Supply Chain concepts: Tesla must follow the Sustainable Supply Chain Management practice which focus on the triple bottom-line framework, by considering the domains of the natural environment, society and economic performance (Günther et al., 2015). The three facilitators of this approach are: Risk Management, Transparency, and Strategy & Culture (Carter and Rogers, 2008). Tesla should have a proactive supply chain system similar to that of Toyota's. This will also help Tesla manage risks and contingencies by implementing strategies of lean management, thereby reducing lead times and also reducing the carbon footprint. Involving all the stakeholders by actively engaging them and creating a feedback mechanism can enhance the supply chain performance to a drastic level. And finally, developing a strategy and culture which is intertwined to sustainability initiatives should be the focus.

Technological Developments:

Material Science: Tesla must invest in material science especially with regards to new sustainable options for battery production. Without solely relying on Lithium, they should also

put their efforts in developing batteries which uses other materials which can be used as an alternative, thereby countering the challenge of depleting Lithium reserves.

Sustainable Energy: Tesla is creating an ecosystem around sustainable energy options with their subsidiaries like SolarCity which takes care of the issue regarding climate change. They should also invest in wind energy as a potential enabler to further expand into sustainable options. Tesla should make sure that their customers use energy produced from renewable/sustainable sources to recharge their cars.

Robotics, IoT and AI: Tesla has already invested R&D in robotics, Internet of Things and Artificial Intelligence. As they are into vertical integration, it makes sense to make processes more efficient by investing in Robotics and AI. The future of transportation is autonomous vehicles which communicate with each other through the concept of Internet of Things. Out of the 5 levels of autonomous vehicles (graded from 0 to 5), Tesla has already reached stage 3 and is pushing towards reaching level 5 (Reese, 2016). These are potential enablers to leverage on.

Additional Policies, Actions and Initiatives:

Though Tesla has taken actions to counter the challenges, there is lot more which can be done. For instance, to bring about Sustainable Supply Chain Management into practice, it must bring about responsible policies and intertwine sustainable practices along the value chain (Knoppen, 2015). Employees should be treated with dignity and respect and their aspirations should be taken into consideration to solve the challenge of lay-offs. There shouldn't be any silos between suppliers, functional teams and customers, in order to enable collaboration, transparency, and better flow of information in the supply chain. Having this kind of a holistic supply chain view can help in the long-term goal of developing a responsible supply chain. Therefore, by considering all the '3-Ps' of the supply chain i.e., Planet, People, and Profit (as shown in Annexure: 12), Tesla can become a sustainable and responsible organization.

Conclusion

After having analysed the present configuration of supply chain and the challenges faced by Tesla, we get to know that it has a very high degree of vertical integration along the value chain from producing few sub-components like Battery system to delivering the cars to customers by themselves. The way forward would be by the practice of Sustainable Supply Chain Management along with enablers such as Technological developments in the field of material science, robotics, sustainable energy etc., to name a few. There should be high collaboration with all the stakeholders of the supply chain. Having a holistic view of the supply chain by using the triple bottom line framework can help Tesla in the long-run.

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Supporting Charts, Graphics, Data and Variety of sources

<table>
<tr>
<td rowspan="2">Key Partners
Stakeholders
Technology partners such as SpaceX and SolarCity
Charging network partner: Panasonic
Infotainment partner: NVIDIA
Strategic alliance with Daimler AG & Toyota</td>
<td>Key Activities
Sales, Marketing and Production
New innovations in the electric vehicle segment
Supercharger Network</td>
<td rowspan="2">Value Propositions
Superior/high-end luxury electric cars
High safety
300+ miles in single charge
Battery range & performance
Eco-friendly
Contribution to green economy
Global sustainability
Software update
Customizable options
Autonomous driving technology (updatable) thereby reducing accidents</td>
<td>Customer Relationship
Personalized relationship
Public events for new model releases
Free test drives</td>
<td rowspan="2">Customer Segments
Environmentally conscious and Safety conscious people
Model S and X for the wealthy customers who wants to maintain their status quo.
Model 3 for the mass segment.</td>
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<tr>
<td>Key Resources
Intellectual and hardworking employees
Gigafactory for Battery technology
Patented technologies
Location: at the heart of Silicon Valley</td>
<td>Channels
B2C model for selling its cars
Store (firm held)
Online platform (Phone shopping)</td>
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<td colspan="3">Cost Structure
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ICT
People
Firm held retail Stores
Software development
Production, Sales, Servicing</td>
<td colspan="3">Revenue Streams
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Pre-sales through internet
Maintenance plan</td>
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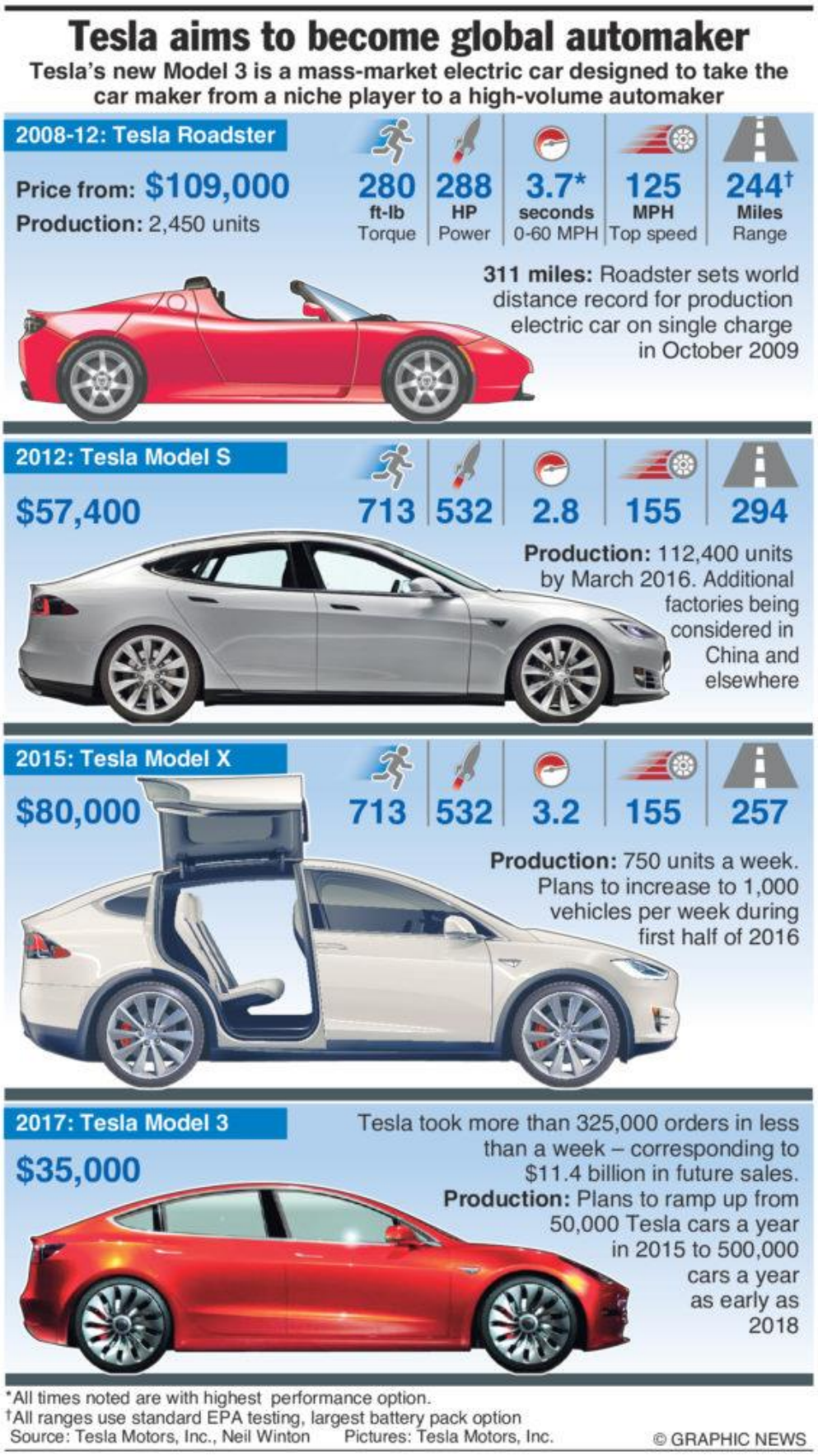
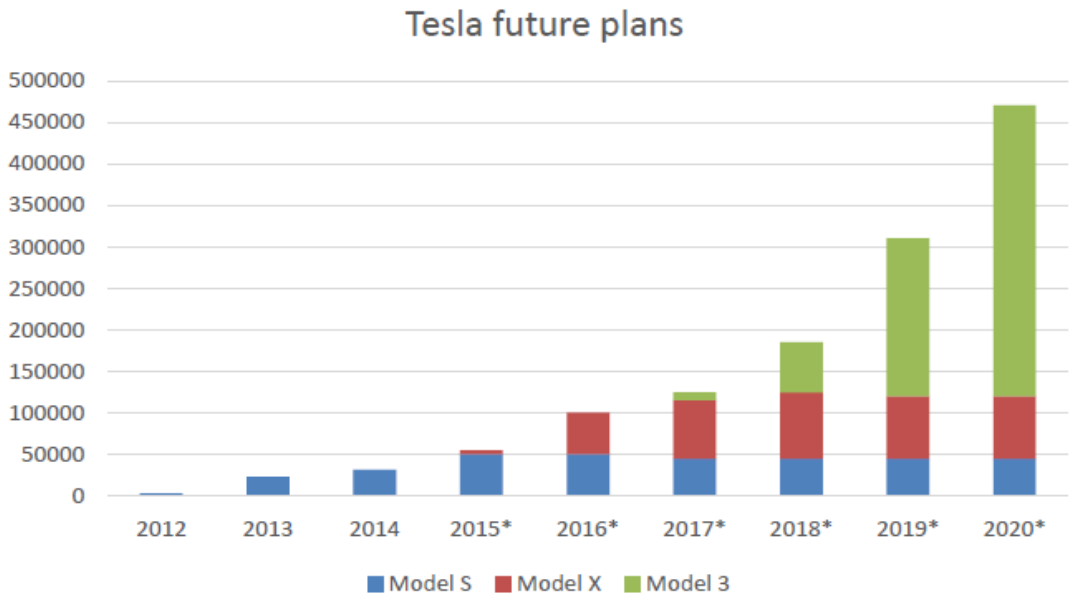
Annexure 1(a): The Business Model Canvas of Tesla

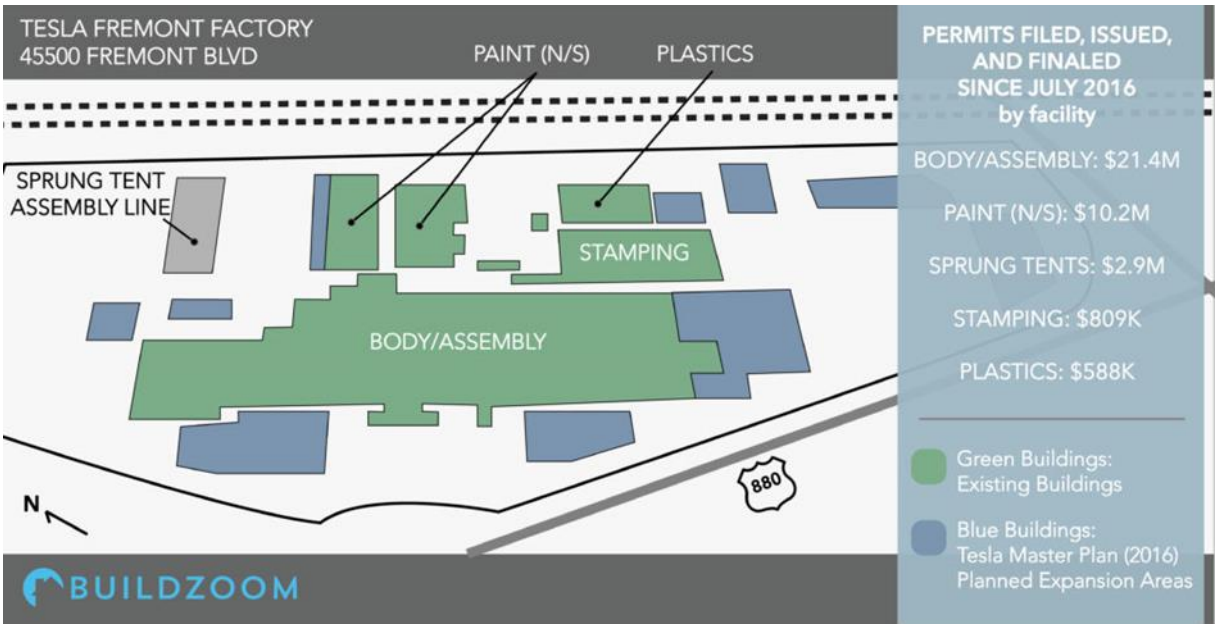


Annexure 1(b): Tesla's car models (Source: Clean Technica (Boylan, 2016))



Annexure 2: Projection of sales for each model (year v/s numbers sold /*to be sold)

(Source: Monsellato, 2016)



Annexure 3: Tesla Layout (Source: (Teslarati, n.d.))

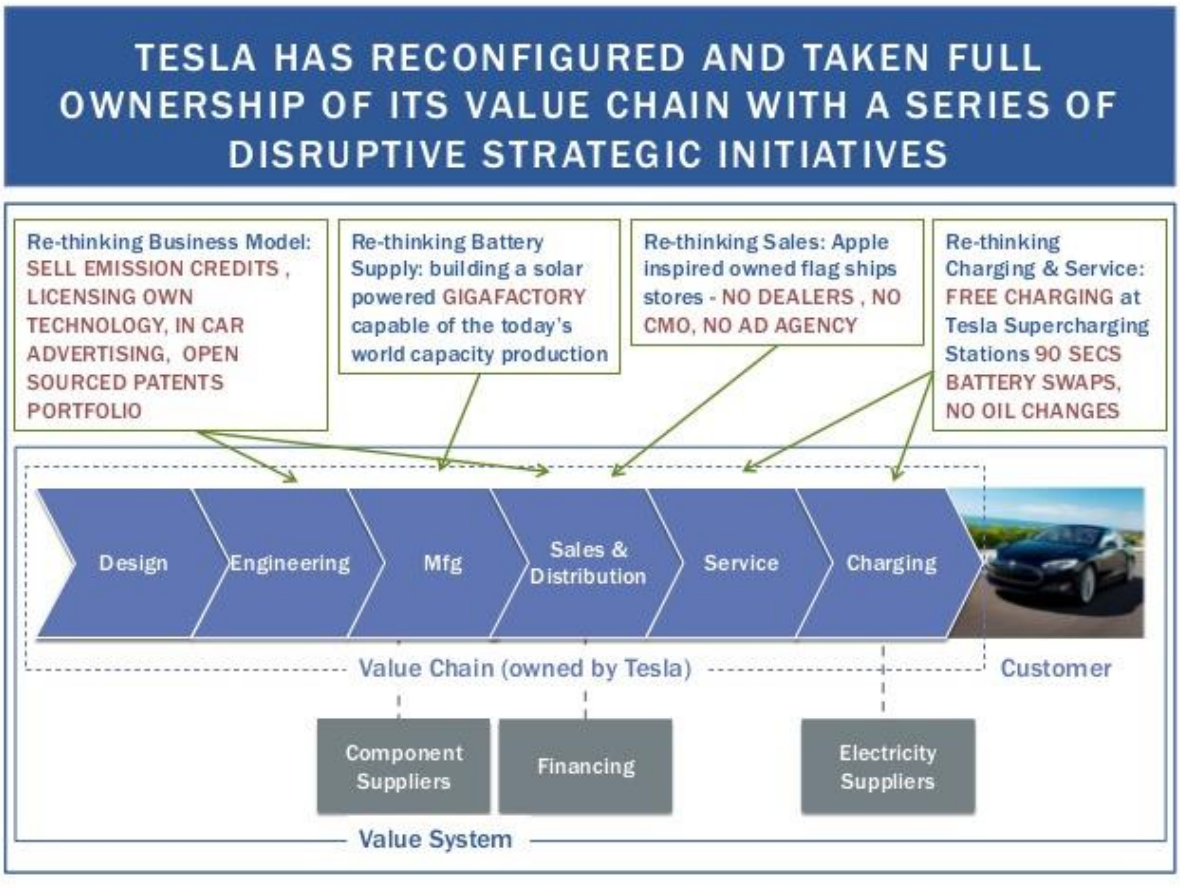
ITEM 2. PROPERTIES

The following table sets forth the location, approximate size and primary use of our principal leased and owned facilities:

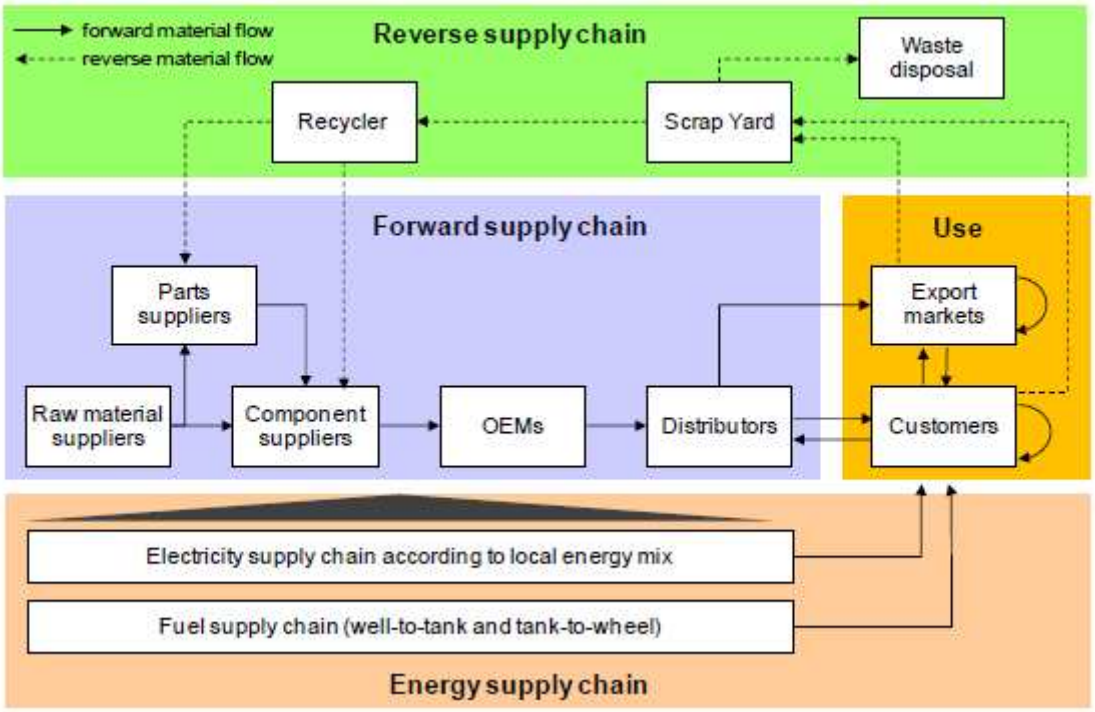
Location	Approximate Size (Building) in Square Feet		Primary Use	Lease Expiration Date
Fremont, California	5,500,000		Manufacturing, administration, engineering, service, delivery and warehouse	Owned building
Sparks, Nevada	3,500,000	*	Gigafactory 1, production of lithium-ion battery cells and vehicle drive units	Owned building
Livermore, California	1,002,703		Warehouse	October 2026
Fremont, California	506,490		Administration and manufacturing	September 2029
Tilburg, Netherlands	499,710		Manufacturing, administration, engineering and service	November 2023
Lathrop, California	496,888		Manufacturing	Owned building
Palo Alto, California	350,000		Administration and engineering	January 2020
Lathrop, California	338,564		Warehouse and manufacturing	February 2030
Sparks, Nevada	328,245		Warehouse	December 2020
Sparks, Nevada	304,200		Warehouse	December 2019
Fremont, California	302,400		Engineering	March 2028
Lathrop, California	276,228		Warehouse and manufacturing	September 2024
Lathrop, California	271,075		Manufacturing	May 2025
Fremont, California	229,530		Administration	March 2029
Fremont, California	199,352		Administration and manufacturing	June 2025
Draper, Utah	154,846		Administration	October 2027
Hawthorne, California	132,250		Engineering	December 2022
Bethlehem, Pennsylvania	130,971		Warehouse	April 2022
Beijing, China	83,119		Delivery hub	April 2020
Amsterdam, Netherlands	73,597		Administration and service	February 2024
San Mateo, California	68,025		Administration	July 2022

* Gigafactory 1 is partially constructed with current occupancy of 3.5 million square feet.

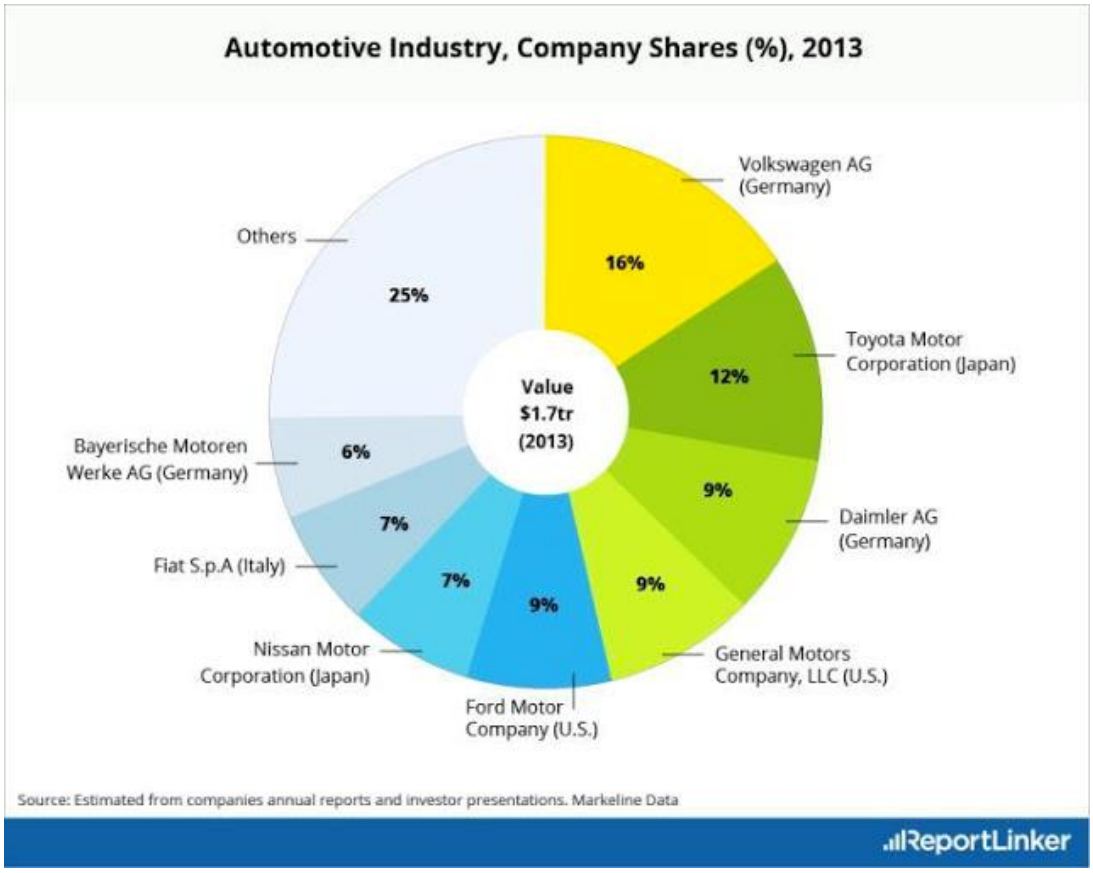
Annexure 4: Tesla facilities worldwide (Source: (TESLA, INC., 2018))



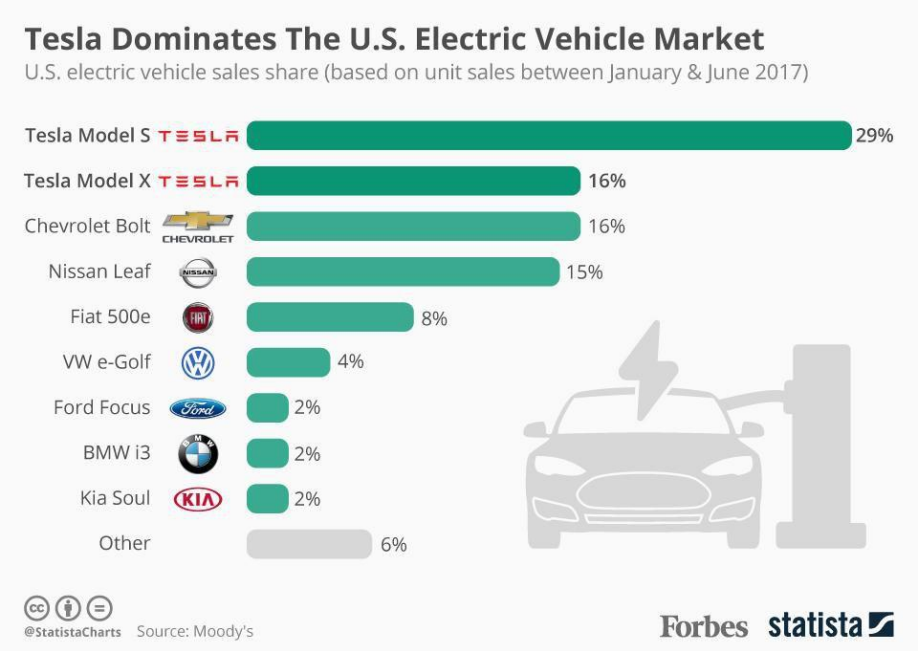
Annexure 5: Value Chain of Tesla (Source: WordPress (Christaininoa, 2016))



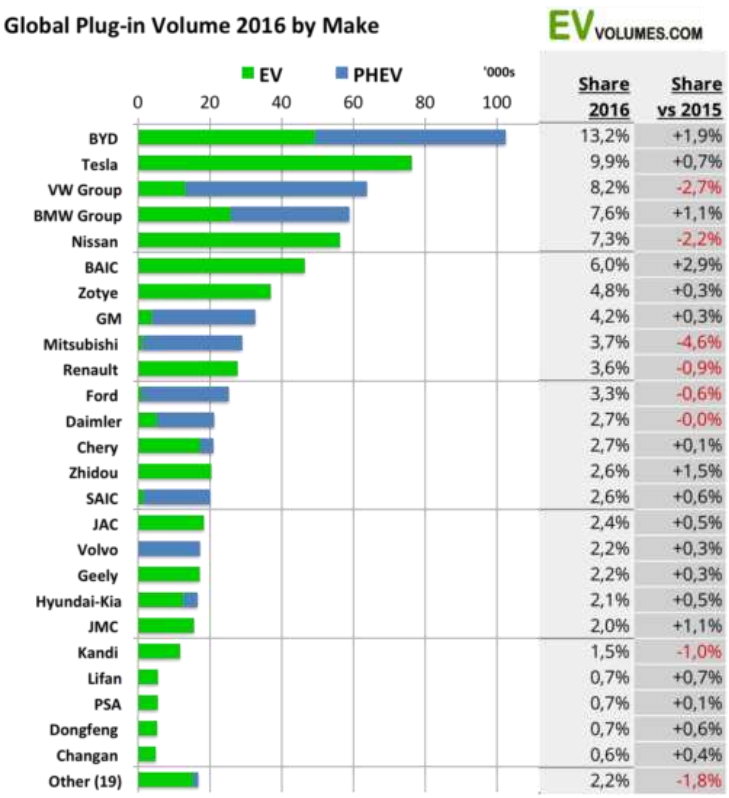
Annexure 6: Automotive Industry Supply chain (Source: Günther et al., 2015)



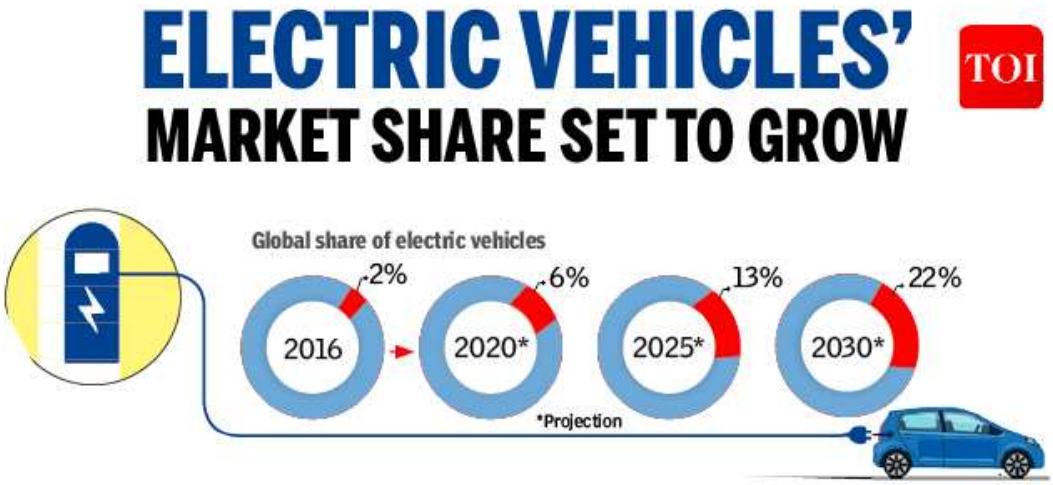
Annexure 7: Automotive Industry, Company Share (Source: (ReportLinker, 2014))



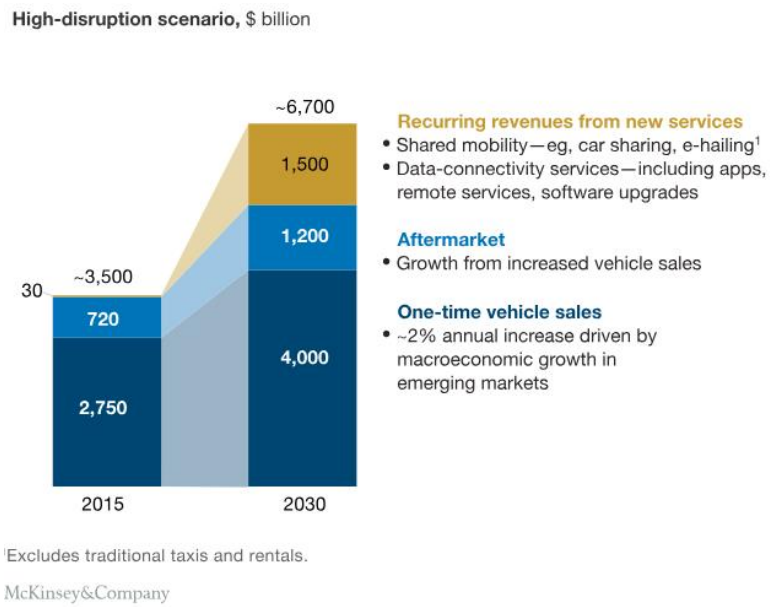
Annexure 8: U.S electric vehicle sales share (Source: (McCarthy, 2017))



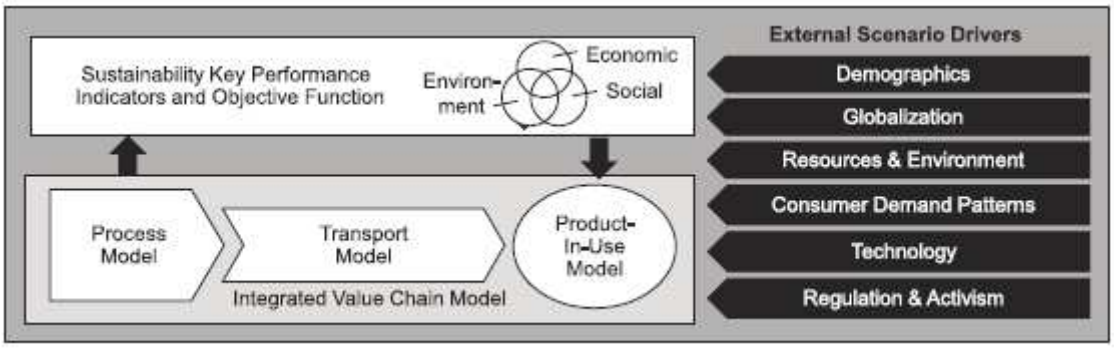
Annexure 9: Global electric vehicle sales share (Source: (Shahan, 2017))



Annexure 10: Market Share of electric cars with respective to total sales globally (Source: (The Times of India, 2019)



Annexure 11: Future of Automotive Industry (Source: McKinsey & Company (Paul Gao et al., 2016))



Annexure 12: Sustainable Supply Chain Optimization Framework (Source: Günther et al., 2015)