

Application of Artificial Intelligence Technology in Tesla- A Case Study

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ABSTRACT

Background/Purpose: *Artificial intelligence algorithms are like humans, performing a task repeatedly, each time changing it slightly to maximize the result. A neural network is made up of several deep layers that allow for learning. Financial services, ICT, life science, oil and gas, retail, automotive, industrial healthcare, and chemicals and manufacturing sectors are among the industries that employ these algorithms. The electric motor is a new concept, and the automobile industry is now undergoing intensive research to determine whether it is practicable and financially viable. There are already some first movers, such as Tesla, who have successfully established their model and are moving forward. Tesla is forcing the auto industry to adapt quickly. Tesla introduced Autopilot driver capability for its Model S vehicle. Tesla Autopilot is a suite of sophisticated driver-assist technologies that include traffic adjustment, congested roads navigation system, autopilot car-parks, computer-controlled road rules, semi-autonomous route planning on major roadways, and the ability to summon the vehicle out of a designated car-park. This article provides a comprehensive analysis of Tesla Company and Innovations of Autopilot Vehicles.*

Objective: *This case study report addresses the growth of Tesla Company in the field of Autonomous Vehicles.*

Design/Methodology/Approach: *The knowledge for this case study of Tesla was gathered from various academic articles, online articles, and the SWOT framework.*

Findings/Result: *Based on the research, this paper discusses the technological histories, Autopilot driving features, safety concerns, financial plans, market challenges, different models, and how Tesla Inc. is accelerating the world's movement in multiple initiatives such as the contribution of the global economic system, study in the Artificial Intelligence and Machine Learning area.*

Originality/Value: *This paper study provides a brief overview of Tesla Inc. given the various data collected, and information about Tesla Autopilot vehicles using Artificial Intelligence based Innovations in Entrepreneurial Oriented Cars.*

Paper type: *A Research Case study paper - focuses on Application of Artificial Intelligence in Tesla Autopilot Vehicles and growth & Journey of the Tesla Inc. Company.*

Keywords: Artificial Intelligence, Neural Network, Machine Learning, Autopilot, Self-driving, Deep Learning, Electronic Vehicles.

1. INTRODUCTION :

Fossil fuel depletion and awareness of sustainability have led many countries to opt for cleaner fuels. In this respect, we believe that the Indian government has set a 2030 goal to move to fully electric vehicles. Tesla, Inc. is a California-based electric and renewable energy corporation [1]. Martin Eberhard and Marc Tarpenning established the business in 2003. Tesla's current list contains, among others, the Model S, Model 3, Model X, and Autopilot Suite Model Y. Other than automobiles, energy storage is produced through household, sunroof tiles, solar panels and accessories and services. Tesla Motors has been engulfed by electric vehicle and battery markets since 2003. Under Elon Musk's

leadership she has followed her so called "Secret Master Plan" diligently and completed, which will forever change the driven world. Initially known as Tesla Motors, renamed to Tesla, Inc. in 2017. The company's name was inspired by Nikola Tesla, a 19th-century inventor renowned for discovering the trend of spinning electric radiation. The case of Tesla was examined considering their approach to technology such as electric cars, as well as the concept of Deep Neural Network to train the Autopilot model [2].

2. RELATED RESEARCH WORK :

The following table shows the Related Research work in the area of Business, Finance, Employee's Review, Artificial Intelligence implementation and Impact of COVID-19 in Tesla.

Table 1: Research Related Work

SI. No	Area of Study	Focus	Reference
1	Business Strategy	Analyses the innovation related to vehicle, innovation related to battery, concerning the recharge system	Chen, Y et al. (2018) [3]
2	Financial Strategy	Growth and Production Strategy	Bilbeisi, K. M et al. (2017) [4]
3.	Artificial intelligence implementation	AI techniques used	Mahajan, D et.al (2016) [5]
4	Employee's review	Musk's apparent extraordinary work ethic and programming abilities	Dobbs, M. E. et al. (2016) [6]
5	Artificial intelligence implementation	Reinforcement learning used	Char, D. S et al. (2020) [7]
6	Deep Learning techniques	Deep learning Segmentation	Lim, S. H et al. (2021) [8]
7	Marketing Strategy	Strategies in order to attract its competitive edge	Thomas, V. J.et al. (2019). [9]
8	Employee's review	performance evaluation	Black, S. et al (2019) [10]
9	Financial Strategy	Tesla's organization's strategic decision - making encompassing the release of the Roadster	Fisher, M et al. (2019) [11]
10	Impact of COVID-19	Tesla stock market in pandemic	Xu, Z. et al. (2020) [12]

3. OBJECTIVES OF STUDY :

This is a case study report based on the data obtained from the Tesla Ltd. Business Models Cars in Deep Neural Network Innovations.

The report addresses the following goals and objectives.

- i. Innovation of Electric Cars
- ii. To study the development storyline for Tesla
- iii. Financial Analysis of Tesla Ltd
- iv. Artificial Intelligence-Deep learning used in Tesla Autopilot.
- v. SWOT analysis used to suggest future success plans for Tesla.
- vi. Pandemic Impact on Stock market-Tesla

4. MISSION AND VISION :

Tesla, Inc.'s mission statement is "to speed up the world's transition to sustainable energy." Tesla's mission statement discusses the world's inevitable shift to sustainable energy, as well as the company's commitment to being an active catalyst in the process [13].

Tesla, Inc.'s vision is to "create the most compelling car company of the twenty-first century by driving the world's transition to electric vehicles." Tesla's vision statement expresses the same concept as its mission statement, but in greater detail. It focuses on the organisational goal of the company.

5. METHODOLOGY :

The data for this study is gathered from the journal, published papers, archived newspaper articles, official Tesla Inc. websites, and other ventures.

6. MODERN ELECTRIC CARS :

Electric cars (EV) are frequently encouraged as low-noise, emission options to petrol cars. Participants have struggled every time due to poor efficiency and overall expenses. Cars emit up to 70percent of toxic gases into the atmosphere; each year, approximately 22 million tonnes of contaminants of various origins are emitted globally [14]. A car absorbs oxygen and emits highly poisonous components into the air, resulting in an estimated increase in environmental damage. A source of pollutants in the atmosphere is a chemical mixture, the proportion of which depends on the type of engine, the kind of fuel, and the work environment of the car. Many more toxic chemicals end up in the soil due to chemical interactions with other toxic gases. A rechargeable car is powered by an electric engine rather than an internal combustion engine (ICE) and does not have a gearbox because the shaft is attached to the tyres [15]. It can be charged using both dedicated filling stations and a standard household electrical access point. In terms of power and speed, modern electric motors are on par with combustion engines. They are dependable, cost-effective, and safe to use. The maximum range of an electric vehicle increases, while the time required to charge the battery decreases. To address the issue of environmental conservation, most governments are attempting to persuade users to change to electric vehicles by establishing determines the quantity, leasing, and tax breaks. As a result, the adoption of an electric car in every large city worldwide is unavoidable. An electric car has environmental advantages over a traditional vehicle because it does not use fuel combinations, causing no toxic pollution to the atmosphere and significantly reducing the vehicle's explosiveness. Today, the energy used in electric cars is undeniably less expensive than that used in gas - fuelled vehicles. The batteries in such cars can be charged while moving downhill or by direct sunlight. Convenient assembly and simple construction ensure an electric car's longevity and service life, extending delivery duration fuel economy and resulting in substantial cost for the driver. The low level of noise [16] ensures comfort. Electric vehicles are comfortably capturing the automotive product markets of the United States, Europe, and Asia in the twenty-first century. Tesla Motors is rightfully recognised as one of the leading electric vehicle manufacturers.

7. JOURNEY OF SUCCESS :

Tesla's company Journey from 2003 to 2020:

- **2003-2008**

Tesla Motors has dominated the electric vehicle (EV) and rechargeable industries since its inception in 2003. Under the leadership of Elon Musk, it has faithfully initiated and accomplished the so-called "Secret Master Plan" to truly transform the world of automobile. Nikola Tesla was a major pioneer in the field of electricity. Tesla was a technological titan during the time of Edison, Westinghouse, Marconi, and J.P. Morgan due to his accomplishments in electricity, radio, and robotics. Martin Eberhard, Tesla's co-founder, chose the name since it was perfectly tailored to his vision of the company. Then, on 23 April 2003, Marc Tarpenning, co-founder of Eberhard, legally registered a domain name: Teslamotors.com. Musk stated unequivocally in a 2006 blog titled "The Secret Tesla Motors Master Plan" that Tesla's goal is to boost the number of a "solar electric economy"[17]. The Tesla Roadster is a strong power sports car that was the company's first product. Their brief strategy is to create a diverse range of models, such as reasonably priced sedans. Ze'ev Drori was appointed CEO of the Company in 2008[18]. Drori's mission is to put the roadster into manufacturing on time and on the budget in February 2008; Musk, who was then the president of the firm, had the first car delivered. Drori described this as a "landmark for the organisation and a watershed moment for the modern electric car era". Tesla postpones the Model S, and Musk takes over as CEO.

- **2009-2014**

Tesla released its first electric vehicle, the Model S, in March 2009 at SpaceX's headquarters in Hawthorne, California. Tesla initially planned to produce the Model S in 2011. However, Deliveries did not begin until late mid-2012. Musk's decision to open-source Tesla's patents in 2014 proved his aim is to promote the development of electric vehicles.



Fig. 1: The Roadster 2.5 Sport model's appearance and dashboard [19]

In February 2014, in Nevada, Tesla revealed its intentions to develop its giant battery plant, called the Gigafactory. The massive producer would assist it in significantly lowering the price of its batteries by leveraging economies of scale, creative processing, waste reduction, and simple enhancement of placing much of the manufacturing process under one roof [20]. The semi-autonomous Tesla self-conducting system was launched by Elon Musk on 9 October 2014. A new two-engine Model S option was unveiled and the fact that all vehicles produced at Tesla were equipped with autopilot device before the beginning of October 2014.

The system is divided into 4 parts: a front radar, a photo recognition camera, and an ultrasonic sensor that allows the system to see the vehicle from every angle. It also contains certain basic functions such as automated control, lane maintenance and active emergency braking.



Fig. 2: Tesla Model S model appearance and dashboard [19]

• **2015-2020**

At an event in Hawthorne, California in 2015, Tesla made a huge foray into power generation when it introduced the Power pack and Power wall. Tesla is more than just an auto manufacturer; it is also a leader in energy innovation. Model X deliveries begin in 2015. The vehicles specialized features, such as its Flying doors and biological weapon security mode ventilation system, made large - scale production difficult [21].



Fig. 3: Tesla Model X exterior and interior design [19]

Tesla started using Autopilot on October 14, 2015[22]. In October, Tesla began updating its 7.0 programme, gradually enabling self - driving functionality in vehicles equipped with the computer systems. Initially, the feature enabled cars to drive themselves in some circumstances. However, the company released its 7.1 software upgrade in January 2016, which added more features to Autonomous car vehicles, including the ability to self-park. In 2016, Musk unveiled the concept of Tesla's first bulk vehicle, the Model 3, as well as his intention to purchase Solar City. The second phase of his business's master plan consists of four main goals:

- i. Create "awesome" solar roofs that work in tandem with Tesla's batteries.
- ii. Roll out more compact cars "to resolve all important aspects."
- iii. Improve autonomous technology so that it is "ten times safer" than human driven cars.
- iv. Carry out a journey system that enables Tesla drivers to earn money by renting out their self-driving cars.

To help it advance deeper into automation, Tesla has acquired a German engineering firm, Grohmann Engineering, and this company is specialized in developing automation production systems. Federal

authorities concluded their research into the first Self - driving fatality in January 2017, concluding that there were no flaws in the system. Tesla unveiled the Semi-truck prototype in 2017. The Semi had a capacity of 500 miles and a range of 400 miles with a cab positioned at centre after 30 minutes of charged. In 2018, SpaceX launched the Falcon Heavy Rocket into space alongside Musk's Tesla Roadster. The Falcon Heavy Rocket was effectively put into space by SpaceX. In the driver's seat, a dummy driver known as "Starman" is dressed in a SpaceX space suit [23]. In 2019, Tesla became the first Western automotive manufacturer to own a factory in China without partnering. In 2019, Tesla Model Y was unveiled. It is a new compact SUV set to hit the market in 2020. According to the Verge, the Model Y has a claimed range of 300 miles, can seat seven people. The standard-range variant will cost \$39,000 and have a 230-mile range, but it will not be available until 2021.

8. TESLA MAJOR SHARE HOLDERS :

Elon Musk, a Tesla CEO and active supporter, is the company's majority shareholder, owning 21.7 percent of the stock. Baillie Gifford & Co. (7.7 percent), FMR LLC (5.3 percent), Capital Ventures International (5.2 percent), T. Rowe Price Associates (5.2 percent), and Capital World Investors are also significant shareholders (5 percent). Another significant individual shareholder is Larry Ellison (co-founder and CEO of Oracle), who owns 1.7 percent of the company [24].

9. FINANCIAL STATEMENT :

Tesla Incorporation (Inc.) provide well cars with ample capacity and high greenhouse gases, that had aided Tesla's brands truly make a signature for themselves in this expanding industry. Tesla Inc.'s reach has been commendable, with the company establishing a presence in prominent markets such as the United States, Europe, Asia, and Canada. This same progressive change in consumer choice for eco-friendly automobile options has aided in it. Following table shows the Analysis of financial statements of 2019 and 2020 in different Quarters which shows the growth change in the industry even in the pandemic Beginning.

Table 2: Financial Statement of Tesla [25]

(\$ million with the exception of percentages, per share)in millions with the exception of percentages and per share)	Q4 -2019	Q1-2020	Q2-2020	Q3-2020	Q4 -2020
Automotive revenues	6,368	5,132	5,179	7,611	9,314
Automotive gross margin	22.5%	25.5%	25.4%	27.7%	24.1%
Regulatory credits(Automotive revenues)	133	354	428	397	401
Automotive gross profit	1,434	1,311	1,317	2,105	2,244
Revenues	7,384	5,985	6,036	8,771	10,744
Gross margin- GAAP	18.8%	20.6%	21.0%	23.5%	19.2%
Gross profit	1,391	1,234	1,267	2,063	2,066
Operating margin	4.9%	4.7%	5.4%	9.2%	5.4%
Operating expenses	1,032	951	940	1,254	1,491
Income from operations	359	283	327	809	575
Adjusted EBITDA	1,175	951	1,209	1,807	1,850
Adjusted EBITDA margin	15.9%	15.9%	20.0%	20.6%	17.2%
Net income -non GAAP	386	227	451	874	903
Net income -GAAP	105	16	104	331	270
EPS diluted-non GAAP	0.41	0.23	0.44	0.76	
EPS diluted - GAAP	0.11	0.02	0.10	0.27	0.24
Net cash -operating activities	1,425	(440)	964		3,019
Capital expenditures	(412)	(455)	(546)	(1,005)	(1,151)
Free cash flow	1,013	(895)	418	1,395	1,868
Cash and cash equivalents	6,268	8,080	8,615	14,531	19,384

10. ARTIFICIAL INTELLIGENCE USED IN TESLA :

Tesla had already begun developing innovative versions of these electric cars, built in California, at a time when they were not widely popular. Sixteen years have passed, and it is now one of the best names in the automobile industry, and they have delivered on their promise in more ways than one. Artificial intelligence and big data have been a consistent companion all along their path in the automotive market. Tesla has used artificial intelligence and big data to grow its customer base. Since the beginning, data from an established user base has aided Tesla data analytics. This data collection enabled Tesla to identify requirements and adapt their systems accordingly, allowing them to become one of the most competitive automotive corporations in the industry today. Any autonomous car, including the ones at Tesla, has the key feature of remaining in the right lane, then shifting lanes to meet the right trajectory. A significant portion of the stack is functions such as obstacle detection. Finding the motorist on a driveway is also possible, as is the Smart Summon system. These new jobs include, amongst other activities, the major lane and path functions to pursue the long-term aim: maximum potential for self-driving using Sensors. Tesla operates with the help of eight cameras. As a result, all areas around the car can be secured, ensuring that there are no weak points. The 8 scanners are combined with external RADARs to detect and identify obstacles accurately. RADARs are excellent supplemental detectors because they can precisely predict speeds [26].

Using neural networks, the camera processes images. It takes into account attributes such as cars, traffic paths, street limits, pedestrian crossings, and other external conditions. In reality, they should run at least 50 neural network models at the same period to produce it work. That is simply not true on ordinary computers. Tesla uses a proprietary structure called HydraNets. It has infrastructures that have been trained on all objects and heads that have been trained on specific tasks, which is analogous to delivering training, in which it has a basic block and prepares specific blocks on various linked tasks. As a result, both the rate of implication and the rate of readiness increase. PyTorch, a deep neural system, is used to outfit the machine learning. This neural network processes each dimensional image. The foundation is a modified ResNet- "Dilated Convolutions" is the only difference. The heads are focused on the FPN/DeepLab/UNet semantic segmentation architecture. The effects of a deep net must frequently be represented in three dimensions. It's Birds - Eye Perspective will help in measuring things and providing a much clearer and truer understanding of the world. Some tasks work on multiple cameras. Stereo cameras are typically used for depth estimation. Using two cameras allows for more accurate data points [27]. Tesla accomplishes this by utilising neural networks to perform depth regression. Tesla also has routine work, like traffic system estimation. The basic idea is same: different neural networks operate independently, and the connection is made by another neural net. This neural network may be recurrent, necessitating the passage of time. The main issue with Tesla has been that it uses eight sensors, sixteen-time cycles, and 32 batch sizes. This ensures each forward transfer handles 4096 images. Tesla is betting big on HydraNet's infrastructure. A single neural network is used to process each camera. The intermediate neural net then integrates it. The incredible thing is that only a small portion of this vast network is used for any given mission. The front camera, the front backbone, and a 2nd camera will be used for image classification. Not everything is processed in the same way. PyTorch is used to finish learning algorithm. Numerous tasks are required, and training all 48 neural network heads will take a significant amount of time. In reality, training would take 70,000 hours of GPU time to finish. That's almost eight years. Tesla is transitioning from a "round robin" to a "pool of workers" training mode. The long, improbable solution is on the left. They use the options in the middle and on the right. Tesla's applications are updated on a regular basis. They collect and use consumer data from thousands of cars travelling outside to enhance their designs. Similar to the active learning strategy, each piece of data is accumulated, labelled, and is used for training. Tesla's ambition is to be the first organisation to achieve complete autonomy. They are now the world's largest automaker, and they are not going to stop there [28]. They face a slew of fascinating challenges that we do not when they learn Machine learning, artificial intelligence, and machine learning from the comfort and privacy.

11. TESLA AUTOPILOT :

Tesla argues that Autopilot provides you greater trust behind the wheel, enhances road safety and enhances road mobility. Although fully driverless vehicles are still a several years away, Tesla Autopilot operates in a manner similar to that of airline pilots when the weather is clear. The operator is also in charge of the vehicle and is responsible for it. Tesla provides easy access to the information that it uses to control its actions to the driver [29]. Tesla Model S and Model X electric vehicles are

powered to enable cars to independent steer, alter tracks, follow cars and curves, and park. In the garage, in addition to the usual combination of accident prevention technology, including ADAS, which drives and brakes emergency steering. The essence of these vehicles is markedly different from that of the majority of other vehicles on the market. Tesla has released Model S software version 7.0, a software update for Tesla's autopilot hardware in Model S and Model X production vehicles that enables cars to use data from around its cameras, radars, and radars. In reaction to traffic circumstances, ultrasound sensors are employed for steering the car, changing lanes and adapting speed. The Model S or Model X scans the parking places as the driver arrives at the location. On the driver's command, and parallel parks. The new driver-focused design of the instrument cluster in the latest Autopilot reveals real data used by the car to smartly understand the parameters of a vehicle at a certain time based on its environment. Along with the autopilot feature, each Tesla vehicle's driving actions while driving in various traffic conditions are shared with the company's centralized computer.

Based on the advice of ML and Tesla concept engineers, a feature upgrade is being developed and released for every other Tesla vehicle in the world [30]. The instrument panel displays a path defined by the vehicle's sensors, informing drivers about features such as lane departure, rear view detection, traffic assist, accident alerting, responsive cruise, and auto driving.

12. DEEP LEARNING IN AUTOPILOT :

Among the most important factors influencing how deep neural nets perform is supervised learning. So much training data works more effectively. That is why Tesla has the world's best potential automated vehicle plan [31]. With 1.5 million vehicular traffic equipped in what Tesla considers complete Auto-pilot innovation, Tesla's Car travels the same amount of distance daily – approximately 15 million – as Waymo has travelled in that lifetime. The following technologies are used in Autopilot

- Machine vision
- Forecast
- Driving Track planning

Machine vision: Object detection is an important machine vision activity. On the street, some objects, such as dogs, can be found. When a Tesla discovers what the neural net thinks is a dog, the cameras take a screenshot, which is later recorded via Wi-Fi. It helps to have cars that drive vast distances per year to get a lot of rare items. It is possible that Tesla will improve her ability to identify unusual objects over time. Tesla is more likely to pay people to manually mark images containing common objects. It's easy to take more photos than you'd pay for on a sticker. Tesla marks rare items and develops software to trigger snapshots at the appropriate time [32].

Forecast: Forecasting is the process of predicting the motions of vehicles, commuters, and cyclists just several seconds advance [33]. The most common reason for the lack of driverless cars is incorrectly estimating the actions of surrounding drivers and people. Tesla's cars of nearly half a million vehicles represents an excellent opportunity. Whenever Tesla creates an erroneous estimation about a vehicle and perhaps a crosswalk, it will store an information about the image for later folder and add it to Tesla's learning collection [34]. Rather than uploading video, Tesla may be able to stream a conceptual scene generated by its machine vision neural nets. It minimises the storage space requirements for submitting this data. Unlike pictures often used train image classification, which require physical tagging, a neural predictive system can just understand associations between the possible futures from time sequence of events. Tesla can train its neural networks with as much usable data as it can obtain there is really no need for humans to mark the data. As a result, the training dataset's length will be proportional to the total distance [35].

Driving track planning: Driving track planning and driving policy refers to the actions which a car takes, such as remaining in its lane at the safe speed, changing direction, attempting to pass a slower vehicle, turning left on a green signal, guiding there with a parked vehicle, stopping to overcome obstacles, and so on. It appears challenging a guideline that will cover any move that a vehicle might need to make even under circumstances [36]. Yet another method for feigning complexity is to use a learning algorithm to mimic what humans do. It's referred to as reinforcement learning. By establishing links between the history as well as the future, a neural network is trained to simulate the performance of other drivers on the road during the training process. A learning algorithm to forecast what a human suburbanite does by drawing interrelations between what it perceives) and human operator deportment in reinforcement learning. In driving activities such as navigating the uphill bends of a highway traffic circle and helping make a wide turn at a crossroads, Tesla employs imitation learning. Tesla appears

to be planning to expand imitation education to other duties, such as how and when to change roadways, over period. As with predicting, rather than posting footage, a conceptual description of the picture encompassing the car may suffice. It could necessitate drastically reduced memory and disk requirements. Once the data is recorded, no human classification is required, as it is with predictions. Because the neural net predicts what the driver does in any given state, it only considers the current situation and the driver's actions. Reinforcement learning, in fact, forecasts the actions of Tesla vehicles rather than the activity of other road users observed by Tesla [37]. Tesla will activate a car to avoid a replay if it is unable to accurately predict whether the car in front will be cut into Tesla's driveway. Similarly, when the neural network involved in route planning or driving strategy fails to correctly predict the Tesla driver's actions, Tesla can record retry data. The human driver will take over when the Tesla is in Autopilot mode and also in the future urban semi-autonomous mode. It could be a great source of references in which the computer makes a mistake and the motorist easily explains how to rectify it. Other techniques for capturing fascinating recordings include: rapid acceleration or weaving through traffic, airbags, accident or accident alerts, and more advanced ML algorithms like anomaly detection and novelty detection. Only when Tesla recognizes what it needs to record, such as lane changes at crossings, will it set up an alert to record a replay whenever the vision neural networks detect a stoplight and the spin lane sensor is activated, or when the tyre moves to the left.

13. SWOT ANALYSIS :

Among industry enthusiasts, Tesla has appeared among the most debated and researched industries. The company's own SWOT analysis will provide all of the necessary observations into each aspect of Tesla's sales model. Furthermore, the overall impact of this analysis includes strategic adjustments in terms of all SWOT variables, i.e., control, vulnerability, opportunities, and threats [38].

Tesla's Strengths:

- i. Tesla Inc.'s strengths include the company's positive attributes that have helped Tesla to become one of the globe's greatest powerful corporate giants. The major aspects, which are thought to be Tesla's greatest strengths, have ensured the company's long-term expansion, development, and success [39].
- ii. The success of any business is proportional to how well it recruits. As in the case of Tesla Inc., it is one of the major drivers of the industry's impressive growth. Because of its diverse and creative workforce, Tesla has become the capital formation for employment. Youthful aspirants with great talents and effort have recently been recognized as one of the best places to work. Fortune magazine named the company one of "America's Best Employers 2019."
- iii. Top Car Enterprise: Amidst its difficulties, Tesla's revenues have increased. It has risen to prominence of the automotive market, producing winning combination vehicles in 2019. Few luxury automakers, such as Mercedes-Benz and BMW, have abandoned the Company.
- iv. Top electric automobiles: Tesla has surpassed all other manufacturers in the race to produce quality EVs. It is one of the best places to work. Tesla's electric coaches have proven to be the quickest to travel great distances in comparing to their range. According to the most recent comparison, Tesla ranks first, second, and third. Along with words of measurements. The Tesla Model S has the longest range, with a single battery lasting up to 600 miles.
- v. Tesla Regulates U.S. Electric Car Purchases: As per Internet world stats, the Model 3 was the most popular electric vehicle in 2019, with 187,971 units sold. With 155,477 vehicles sold, the Chevrolet Volt takes second place. The Model S is in 3rd position with 134,392 vehicle sales, but it is a close call. Tesla will, in a nutshell, dominate the electric car revenue market.
- vi. Investments: Insure MyTesla is a complete and accurate auto insurance program designed by Tesla in collaboration with Mutual Life Insurance Company.
- vii. Sector for Advancement: Tesla possesses a high level of inventiveness. As a result, believe in the company and anticipate the firms to develop competitive and successful goods that will, of course, result in massive economic gain.

Tesla's Weaknesses:

Weaknesses are defined as any internal factors in a company that cause harm or limit performance evaluation. As a result, these are some of Tesla's organisational flaws that limit its competitiveness and business growth [40].

- i. Complications in Manufacturing: The greater the intensity of innovation, the more mechanical complications there are, and the higher the risk aspect for production. Tesla is constantly facing release, manufacturing, and manufacturing issues in order to release expensive vehicles and other items. As it prepared to launch the Model X, Tesla faced numerous manufacturing challenges, resulting in constant distribution delays. Manufacturing the Model X charger component assembly process at Gigafactory 1 has proven to be extremely difficult for the company.
- ii. Failure to satisfy supply: It can influence the value of the brand. Offerings and requests from Tesla may not, owing to highly test and sophisticated procedures, be able to satisfy manufacturing needs.
- iii. Inadequate output quantity: Without a doubt, Tesla seems to be the dominant player in true electric cars. However, it has battled to transport heavy numbers of vehicles with any of its designs. And now, as the company plans to create significant Model 3 vehicles, Gigafactory 1 is undergoing challenges in terms of production costs, leadership capital, and area growth.
- iv. Battery shortfall: At the yearly shareholders' conference, CEO Elon Musk revealed that one's total production had lowered caused by a lack of rechargeable availability. The shortage has a particular effect on demand of electric vehicles and power storage.
- v. Elon Musk is Tesla's sole leader: Tesla admits that the company is a "one-man show." Unfortunately, Elon Musk has a bunch on his shoulders in order to give his all to the company. Musk is actively involved in other ventures at the Space Technology Systems Organization and The Dull Group, such as space launch vehicles [41].

Tesla's Opportunities:

- i. The opportunity section highlights the industry's arising growth potential. It is an environmental factor that, once established, will assist Tesla in improving its competitiveness, organisational structure, success, and other elements [41].
- ii. Higher production in a previously unavailable market: The Asia - pacific region, which is lack of employment in the automotive and sustainable energy industries, is the company's most critical demand. Especially given Tesla's desire to expand its global market in order to improve its economic security and market position.
- iii. Cheaper automobile: Tesla is cheap due to its unusual relying on technology, which requires optimum investment resources to sustain new invention. Tesla recently introduced Model 3, a lower-range, lower-power, and lower-featured version of the Model S. However, it is a great chance for Tesla to increase consumption for its audiences.
- iv. Introducing internal charger computational methods throughout: Tesla intends to produce its own car batteries. The switch can be a big thing because it allows the company to increase its sales costs while decreasing its manufacturing costs.
- v. Introduction of the pick-up truck: According to the National Car Dealer Association's profitability projections, picking up truck accounts for a tremendous opportunity for expansion in electric vehicles.
- vi. Trust of industry in Tesla: The share market reaffirmed its belief in Tesla after two successive profitable quarters. Tesla's share price has more than doubled since the start of this year.

Tesla's Challenges :

Its Risk dimension deals with a bias which prevents the company from reaping benefits of its available strengths. These are, however, the few threats that Tesla experiences in keeping the business running in the face of volatile economic conditions [42].

- Claims about Product Liability
- The Rivalry Comprehensive
- Defects of Goods
- Trust in the long term
- Adaptation of costumer
- Self-driving cars for pedestrians are also a concern.
- Production disruption caused by a material shortage
- High-risk factor related to the use of lithium-ion

- Lack of self-driving regulations
- Elon Musk's Erratic Conduct Affecting Tesla's Credibility

14. PANDEMIC IMPACT ON STOCK MARKET –TESLA :

Tesla's progress has been demonstrated in the share market through consistent rises in share prices and high profitability [43]. COVID-19 truly brought to a standstill in 2020, destroying world markets and claiming countless lives worldwide. Including the destruction caused by COVID-19 to healthcare, the share market suffered greatly. COVID-19 compelled the shutdown of several companies, leading to a loss of employment. Everyone's working routines altered as more and more people began working from home and no longer had to travel. Restrictions on travel as well made it difficult for individuals to travel around and avoided commodities of being supplied. Its hard effects of COVID-19 on the industry are still unknown as nations come back to a semblance of normalcy, with more persons starting work. It was expected just at start of the global epidemic that Tesla would be the dominant player in electric cars and would keep that position even after the global epidemic ended. Through 2021, the transport sector had grown dramatically, with Tesla, as projected, arising as the industry leader, particularly in the U.S in which they continued to deliver vehicles despite production challenges. In the first period of 2020, Tesla sold more than 1.7 million cars, outpacing rival company selling. Tesla has abilities to perform share price tenacity and retains shareholders' focus. Investors are closely monitoring Tesla's performance, new innovation projects, and any economic setbacks. Major trends as we continue to deal with COVID-19, news releases surrounding Tesla and their teamwork, and the adoption of innovative automobiles have all had an influence on how stockholders view the economy.

15. CONCLUSION :

Automotive electrical vehicles are using the most efficient technology for transporting people without drivers or fossil fuel-fuelled internal combustion engines, including a new generation of batteries and other fourth generation Industrial Revolution (4IR) technologies (ICEs). Given the benefits of cleaner and faster transportation, A-EVs theoretically help to accelerate much-needed reductions in greenhouse gas emissions. In three major areas, Tesla has an advantage over competitors (such as Waymo): machine vision, predictability, and route planning/driving strategy. To fix the challenges, researchers created powerful stimuli, used data without individual tagging, and used models rather than actual footage. Other competitors have put little focus on training data, especially in the case of uncommon artefacts and behaviour for which Waymo lacks adequate data to perform machine learning well, if at all. Autopilot vehicles solve problems like driving, which require forecasting human behaviour. Empirical evidence from the natural world is needed to predict human behaviour.

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