An analysis on how Tesla utilizes Data Warehousing, Big Data, Data Mining, Knowledge Management and Business Intelligence.

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1. Acknowledgement

First and foremost, I'd like to extend my sincere gratitude towards Mr. Rasika Alahakoon, my module lecturer. I am extremely humbled and grateful to have been able to receive his mentorship, guidance, and support.
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2. Abstract

Title: An analysis on how Tesla utilizes Data Warehousing, Big Data, Data Mining, Knowledge Management and Business Intelligence.

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This assignment presents an in-depth research and analysis on how Tesla has made use of Data Warehousing, Knowledge Management, Big Data, Data Mining and Business Intelligence to become the leading tech pioneer of the automotive industry.

3. Introduction

In 2003, a couple of ambitious engineers aspired to boost the transition towards sustainable means of transport. They achieved this by introducing electric cars, which helped deviate the market away from gasoline ridden cars towards electric vehicles. The sole intention behind Tesla is to advance the flow towards sustainable energy and transport so that the world ceases to depend on fossil fuels. Today, Tesla doesn't only manufacture electric vehicles, but also an interminably extensible clean energy generation and storage commodities.
As of June 2021, the Tesla Model 3 has become the first plug-in electric car to sell 1 million units globally. With a market capitalization of $1.118 Trillion, this has officially placed Tesla at the world's 6th most valuable company.

4. How Tesla utilizes Big Data

4.1 What is Big Data?

Big Data is a voluminous collection of data that grows at exponential speed and comes in a variety of formats. Since data is produced from a variety of sources, it could be so

complex and unpredictable that it is challenging to connect and correlate it. Due to this, it cannot be processed, analyzed or stored with the utilization of traditional tools.

4.2 Big Data and Tesla

Companies and organizations like Tesla collect big data to utilize outside intelligence with the aim of enhancing operations, offer more improved customer service and engagement, polish advertising methods as well as improving marketing and promotion tactics.

It is undeniable that Tesla is pre-eminent in the electric vehicle game. This is mainly because of how deeply Tesla relies on big data, artificial intelligence, and other aspects to outdo its competitors. Big Data plays a significant role in the company's success. On a weekly basis, Tesla produces 2 to 5 terabytes of data on average. Tesla's invaluable asset is the quantity of data gathered for data analysis.

Before Tesla initiated its automobile manufacturing venture, the most notable data collection tactic that it executed was the documentation of data that both consumers and cars generated. With that, they constructed a large database containing the details of customers who are interested in purchasing the latest drive technology.

4.3 How Tesla utilizes Big Data in Autonomous Cars

Tesla takes advantage of Big Data to propel electric cars towards greater heights. Autonomous vehicles (vehicles that possess self-driving capabilities) possess the ability to sense its surrounding environment and drive around with little to no human engagement. This entails autonomous vehicles to fully rely on data and information. Having over 730,000 vehicles on the road, Tesla has acquired 3.3 billion miles of autopilot data as of now. These autopilot accoutered cars have been running all around the world in different weather circumstances. Tesla gathers all viable data analytics from their vehicle owners. Based on the data accumulated, Tesla can foresee and solve issues before they occur.

Cameras, radars, LIDAR, and ultrasonic sensors that are installed in Tesla's cars collect various aspects of information.

A variety of data, from the point of hazard occurrences on the road all the way to something as mere as the driver's hand placement on the vehicle is all crowdsourced by Tesla.

The data culminated between the company cloud and car is gathered and observed. This also includes data such as weather data, real time traffic circumstance data, object mapping database (for the identification of light poles, trees, animals, or humans, etc.), GPS data and data from other vehicles. Tesla's vehicles are also equipped with sim (3G/4G) to wirelessly link vehicles to their corporate cloud for further evaluation.

From this data analysis, the driver's actions and the car's positions are combined and mapped. This enables Tesla's primary autopilot data tracking system to determine the paths that the car should take.

Tesla also utilizes a fleet learning algorithm. When a vehicle observes something new from the newly updated dataset via a machine learning method, all the other connected vehicles would instantaneously learn it. A deep neural network algorithm is utilized to inculcate its autopilot with obtained real world data.

4.4 How Tesla leverages Big Data using Artificial Intelligence (AI)

To make Tesla's cars autonomous, the company must leverage both Big Data and AI to teach cars to drive on their own.

AI is utilized when it comes to anticipating and understanding the actions and movements of pedestrians, cars, and surrounding areas. It aids in determining movements within a time span of a split second.

To do this, Tesla gathers the appropriate data needed to train algorithms to feed the AIs. The company crowdsources data from thousands and thousands of occupied vehicles that are on the roads. This bestows Tesla with an exuberant advantage. Data that ranges from driver behavior all the way to the internal and external sensors are all gathered.

A machine learning approach called "Imitation Learning" is utilized by Tesla. This particular algorithm picks up and learns all movements, reactions and decisions executed by millions of existent drivers around the globe. (Marr, 2021)

4.5 How Tesla uses Big Data for Decision Making

The collection of data hasn't only aided the creation of Tesla's famous autonomous vehicles. It also assists research and development, customer satisfaction, maintenance, vehicle performance and the improvement of Tesla's future products. This data helps Tesla in future decision making. Data is also utilized from both positive and negative customer feedbacks to know where future improvements must be made.

4.6 How Tesla uses Big Data for Customer Satisfaction

According to Forbes, Tesla boasts the highest customer satisfaction ratings within the automobile industry. Tesla has managed to create an extremely loyal fanbase as it treats each customer as a separate individual. Statistics reveal that the company's customers are highly loyal as 91% of customers intend to lease or buy another Tesla vehicle. (Morgan, 2021)

Tesla enhances customer satisfaction by collecting data from an online forum which their customers have access to. Data from the customer base has helped Tesla abundantly increase sales. This data is collected and analyzed with the aim of making improvements to the next production. Frequent complaints and demand trends are identified and catered to in forthcoming updates. (Thakkar, 2020)

1. Big Data utilization for Personalized Driver Profiles –

Driver profiles are what distinguishes Tesla's customer personalization efforts. Tesla's driver profiles surpass ordinary vehicle personalization. Changes are automatically made depending on who is driving. Driving style, radio presets, suspension, lights and even breakings are made to match the user perfectly.

2. Big Data utilization for Data Driven Design –

Tesla's vehicles gather movements from a number of sensors. The data obtained from the sensors help in strengthening Tesla's self-driving technology. It also contributes towards beneficial customer insights. This aids Tesla in obtaining a clear understanding of who their customers are (individually and as a whole).

3. Big Data utilization for Dynamic Personalization –

Apart from most other vehicle companies, Tesla aspires to devise a fluid system which is updatable while the system improves. Tesla has an entirely upgradable dashboard, meaning that as software upgrades over time, the improvement and development of the driving experience will also be witnessed. Innovative and dynamic personalization is supported by the internal software and the fluid dashboard.

4.7 Tesla and Cloud

With the rapid advancement of Tesla's technical requirements and business complexities, the company has acclimated to Cloud. It addresses big data, scalability, and advanced analytical needs, also holding the advantage of platform expansions and far-reaching capabilities.

Every Tesla vehicle dispatches data to the cloud instantaneously, even when it's not autopilot enabled. Data is accumulated in the cloud to help enhance and improve the AI model.

All software updates are handled by the cloud when in connection. To improve functionality, data is sent back to the cloud server whenever a vehicle goes into autopilot mode. Via software updates, this intelligence is pushed back to Tesla's cars. Currently, Tesla is preparing to maneuver driver profiles to the cloud with the interest of synching them between vehicles. It will also load all preferable settings onto the Tesla vehicle that the driver is currently using. This will adulate a smooth experience for owners of multiple Tesla vehicles or even for those who are renting or sharing a Tesla.

5. Data Mining at Tesla

5.1 What is Data Mining?

Data mining is the procedure of examining immense amounts of data in furtherance of anticipating patterns and trends. Companies like Tesla utilize the process of Data Mining to acquire useful information from raw data.

5.2   Tesla and Data Mining

Tesla has the contingency to develop more potent marketing strategies, boost sales and amass a more superior market position with the utilization and identification of the patterns and trends within the data. Tesla utilizes Data Mining to devise data-enriched maps, boost sales and increase customer loyalty and satisfaction ratings.

5.3   Data Mining in reverence to Autonomous Cars

Tesla's vehicles harvest data with cameras and sensors within every passing second while you're driving, even while Autopilot is off.
A wide range of data such as braking and acceleration, speed, milage, location, where and when the vehicle is charged is collected by the company.
The vehicles external cameras capture video clips of the surroundings, pedestrians, and other neighbouring entities to detect objects and determine drivable roadway.
The patterns and trends identified in the gathered data is deployed to devise data-enriched maps. This will reveal implications like speed increments on roads, hazardous danger zones and where an average amount of vehicles slow down. It is proclaimed that this data holds an accuracy x100 than other common navigation systems.
(Lobzhanidze, 2021)

5.4   Data Mining for Customer Satisfaction, Loyalty and Personalization

Tesla utilizes Data Mining to learn more about their customers in pursuance of identifying frequent complaints and demand trends.
A stratagem that Tesla uses to enhance customer satisfaction is by collecting data from an online forum (which their customers have access to). This data is collected and analyzed with the aim of making improvements to the next production. Patterns of frequent complaints and demand trends used to classify and analyze common problems and are catered to in forthcoming updates.
In addition to the complementation of higher customer satisfaction ratings and loyalty, it also abundantly increases sales.

6.   Tesla and Data Warehousing

6.1   What is Data Warehousing?

Data Warehousing is the method of gathering and managing data from various sources in pursuance of providing substantial business insights.
Being the tech pioneer that Tesla is, it derives its data from several sources. The data collected is leveraged to improve customer satisfaction, vehicle performance, research and development, maintenance, and many other aspects.

6.2   Tesla and Cloud Data Warehousing

Tesla makes use of Cloud Data Warehousing with regards to expanding their information accessions. It is also utilized to include newer sources that are unsupported in their conventional environments.

Cloud Data Warehousing administers a flexible management environment and composes a service-based approach to strategic analytical solutions. Furthermore, levering in Cloud Data Warehousing gives Tesla a more superior way to manage and store their data, also conceding easier data access.

6.3   Problems faced with Cloud Data Warehousing at Tesla

Similar to other Cloud users, Tesla equally encounters cybersecurity risks. In fact, Tesla had succumbed to an impingement of their Amazon Cloud account in the past. An unidentified hacker had performed a cryptojacking attack to "mine" cryptocurrency. This led to the exposal of the electric carmaker's proprietary data. Tesla's credentials had been located on an unprotected admin console that didn't have password protection. Via Tesla's environment, the hackers had run scripts that sanctioned them to mine digital coins or virtual currencies.

7.   Tesla and Knowledge Management

7.1   What is Knowledge Management?

Knowledge Management is the cognizant process of capturing, accumulating, storing, managing, and sharing organizational knowledge.

The use of Knowledge Management greatly aids Tesla in advancing the efficiency of managerial aspects and decision making. It compliments a more dynamic workplace, better constructive organizational knowledge, decisive decision making and employee happiness.

7.2   How does Tesla utilize Knowledge Management?

Tesla's top management has established its organizational structure, culture and other aspects in a manner that substantiates Tesla's vision, mission, and goals. Strategic partnerships and cost-effective approaches are utilized with the aim of producing affordable high-quality vehicles. They also aim towards providing their customers with remarkable customer care services.

- Understanding Tesla's Key Drivers

Tesla has vivaciously understood that the key drivers of their company are their electronic cars. The electronic car has been a fundamental source of Tesla's revenue generation. Due to this, it is mandatory that it is well expressed in the market.

- Employee Culture, Recognition and Appreciation

Tesla's management makes sure that its employees are dedicated to being consequent to technologies that are employed within the firm. With the aim of instilling motivation and deriving abundant productivity, Tesla presents their employees with recognition and rewards. This helps their employees become more driven and focused. Monetary gain is the key motivative for employees, so Tesla overtures rewards of revenue. Furthermore, this also emulates a positive working environment within the organization. (Karamitsios)

7.3 Problems faced with Knowledge Management at Tesla

Although many are fanatical about Tesla, some hold the incapability of purchasing the vehicle due to its effusive cost. Latest vehicle versions like Model S and Model X have a whopping starting price of $80,000. Due to their costly price, the middle-class society doesn't have the potentiality to afford it. Tesla suffers from a high per-vehicle production cost as the construction of their vehicles and sub-assemblies take place in-house. Furthermore, the Model 3 is not priced in a way for Tesla to earn a substantial profit. This contributes as a risk factor in terms of financial profits.

8. Business Intelligence at Tesla

8.1 What is Business Intelligence?

Business Intelligence is the technological process of anchoring in software and services to extract litigable insights from data with the aim apprehending an organization's strategic business decisions.
The utilization of Business Intelligence helps Tesla capture, integrate and analyze business information in a quicker manner.

8.2 How does Tesla utilize Business Intelligence?

- ✓ For Financial Analysis.
- ✓ For quicker decision making.
- ✓ Utilized to improve Customer Satisfaction and Service.
- ✓ Employed to provide a better insight and also improve products of the company.

8.3 Microsoft Power BI

Tesla's custom applications have Microsoft Power BI embedded to enhance real-time decision-making potentialities. It is hosted in the Cloud and can smoothly conform with 12 of Tesla's central data sources. The BI platform can analyze data from existent data sources and yield key insights into Tesla's data.
Power BI has permitted real-time analysis of key performance indicators (KPIs). KPIs have also been provided to stakeholders. This will assist them in making fundamental decisions for Tesla's guaranteed success. Dashboards have been developed to accommodate the preferred working pattern of Tesla's team members.

This helps Tesla:

- ✓ analyze data from existent data sources.
- ✓ obtain end-user adoption.
- ✓ gain value feedback.
- ✓ insure user adoption and usability to key stakeholders.
- ✓ enforce powerful visualizations within Power BI.
- ✓ obtain data from several data sources.
- ✓ improve real-time decision-making potentialities.

9. Summary

Ever since inception, Tesla has utilized data in a manner that has given it a threatening competitive advantage against the rest of the high-performance super car market. Tesla is known to be a data driven company and has actively taken advantage of data to incite electric cars towards greater heights. Tesla's customer satisfaction, maintenance, customer service and engagement, vehicle performance, research and development and the improvement of future products have all benefitted from the utilization of data.

10. Conclusion

Tesla is in a league of their own when it comes to the electric vehicle rat race. The main advantage that the company holds among its competitors is the unique data driven technological approach that it follows.

The company has transformed the way that vehicles are driven and designed by reconstituting the driving experience with technology.

As of 2021, Tesla received recognition as the "Most Valuable Automotive Brand" worldwide. It is also the world's fastest growing brand, flaunting a growth rate of over 157%.

This proves that the implementation of Big Data, Knowledge Management, Data Mining, Data Warehousing and Business Intelligence will enact Tesla in achieving more milestones in the foreseeable future.

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