Case Study Analysis

INF20016: Big Data Management

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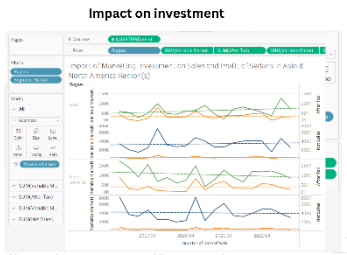
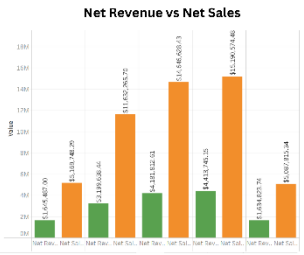
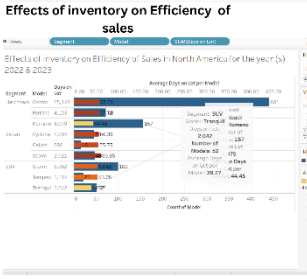
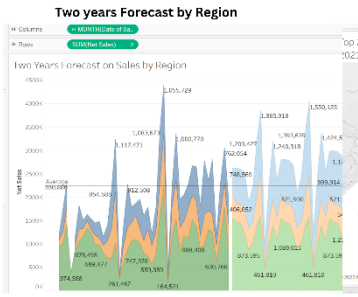
Executive Summary

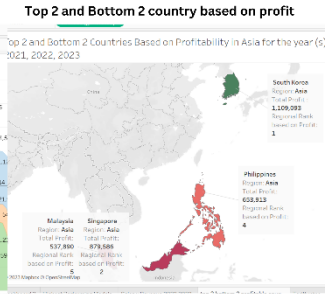
This report aims to provide a comprehensive analysis of the sales database of an emerging player in the EV industry, SparkEV. The analysis delves into the company's overall performance, financial performance, operational efficiencies, trends, and patterns. Some key findings include yearly sales trends, performances of different car models across different regions, the influence of marketing in different regions, and the relation of inventory levels to the eventual sales figures. Additionally, the report explores the influence of Tariff rates on sales in Asia. Finally, a two-year projection of the sales and profits is presented to provide future directions for the operations of SparkEV. Before the analysis, a rigorous data cleaning was also carried out to root out missing, inconsistent, and repetitive data points.











1. Introduction

The electric vehicle industry is seeing a promising potential for growth as environment consciousness keeps growing (Duane-Davis, 2023). Amid an industry largely monopolized by Tesla (Duane-Davis, 2023), up-and-coming company Spark EV is trying to make a breakthrough. This report will analyse their sales database containing transaction and product details from 2019 to the second quarter 2023. The eventual goal is to extrapolate sufficient insights into the company's performance, financial, and operational domains. The data integrity was also examined before the analysis was conducted, and a data cleaning process was carried out to root out the inconsistencies and missing data.

2. Data Cleaning

2.1. The Significance of Data Cleaning

Data cleaning, often called data cleansing or scrubbing, is an indispensable aspect of data analysis. It involves identifying and correcting errors, inaccuracies, inconsistencies, and anomalies within a dataset to ensure that the data is of high quality and suitable for analysis (Tableau, 2022). In the case of SparkEV and its dataset spanning 2019-2023, data cleaning plays a pivotal role in preparing the data for meaningful insights and actionable conclusions.

2.2. Detecting and Handling Missing Data

Missing data is a common challenge in datasets, and its presence can hinder the accuracy and reliability of subsequent analyses. In the SparkEV dataset, missing data was observed in various columns, including 'Transmission,' 'Seats,' and 'Defects.' To address this issue, data cleaning involved a strategic approach.

For numeric columns such as 'Seats,' missing values were imputed with the mean value of the respective column. This imputation method ensures that the data remains complete and retains statistical integrity. Imputing missing values in this manner is a common practice in data cleaning as it minimizes the impact of missing data on statistical measures (Yang et al., 2022).

In cases where categorical columns like 'Transmission' had missing values, the mode, or most frequent value, was employed for imputation. Using the mode ensures that the imputed values represent the most common category within the dataset, thereby preserving the overall distribution and structure of the data.

Some missing data points were critical, and imputation could not resolve their absence. In such cases, the entire corresponding rows were removed from the dataset. This cautious approach was essential to maintain the quality and reliability of the remaining data, as retaining rows with substantial missing information could introduce biases and inaccuracies in the analysis (Kang, 2013).

2.3. Resolving Inconsistencies

Inconsistencies in data can arise from various sources, including differences in data entry, naming conventions, and data integration processes. The SparkEV dataset exhibited inconsistencies in columns such as 'Country of Sale' and 'Facility.'

To address inconsistencies, standardization of country names was undertaken. Variations in naming conventions, such as 'USA' and 'United States,' were unified as 'United States.' This standardization enhances data consistency and simplifies future data retrieval and analysis by providing a single, unambiguous representation of each country (Visser et al., 2020).

Furthermore, inconsistencies related to date formats in the 'Date of Sale' column were identified and rectified. Ensuring uniform date formats across the dataset is imperative for accurate temporal analysis, as inconsistencies in data representation can lead to misinterpretation of chronological events.

2.4. Dealing with Duplicate Records

Duplicate records, or records that appear more than once in the dataset, can lead to skewed results and undermine the accuracy of analyses. In SparkEV's data cleaning process, addressing duplicate records was crucial.

The duplicate records were identified based on attributes, including 'VIN #,' 'Date of Sale,' and 'Model.' This multi-attribute approach ensured that duplicate records were identified comprehensively and accurately.

Duplicate records were subsequently removed from the dataset, retaining only the first occurrence of each unique record. Removing duplicates streamlines the dataset, preventing redundancy and enabling precise and undistorted analyses (Kirkland, 2018).

2.5. Handling Outliers

Outliers, or data points that deviate significantly from the rest of the dataset, can disproportionately influence statistical analyses. In the SparkEV dataset, outliers were identified in numeric columns such as 'Gross Sales' and 'Total Variable Cost.' The treatment of outliers was a key component of data cleaning.

Outliers were identified using the Interquartile Range (IQR) method, a statistical technique that identifies data points outside a specified range (Chaudhary, 2019). This method effectively locates outliers by quantifying the spread of the data and identifying values that fall significantly above or below the central range.

2.6. Assurance Statement

Post-cleaning, we can confidently assert that the data is of good quality and is reliable for generating insights. The cleaning process effectively addressed missing data, inconsistencies, duplicates, and outliers, ensuring that the dataset is more robust and suitable for analysis.

3. Overall Performance Analysis

In today's data-driven world, companies like Spark Electric Vehicle (SparkEV) continuously seek insights from their operational data to enhance their decision-making processes and gain a competitive edge in the electric car industry. This report outlines the findings from an in-depth data analysis using Tableau, focusing on various aspects of SparkEV's operations, including sales, financial performance, sales channels, and trends.

3.1. Sales Performance Analysis

One of the key findings from our analysis is the observation of fluctuating sales performance over the years. We noticed that SparkEV's sales exhibited seasonal trends, with peak sales during specific months and relatively slower periods during others. This information is crucial for effective inventory management and marketing strategies (Yang et al., 2022). Additionally, the analysis revealed that sales performance varies across different regions, indicating the need for tailored marketing and sales channel strategies for each region (Locad Team, 2023)

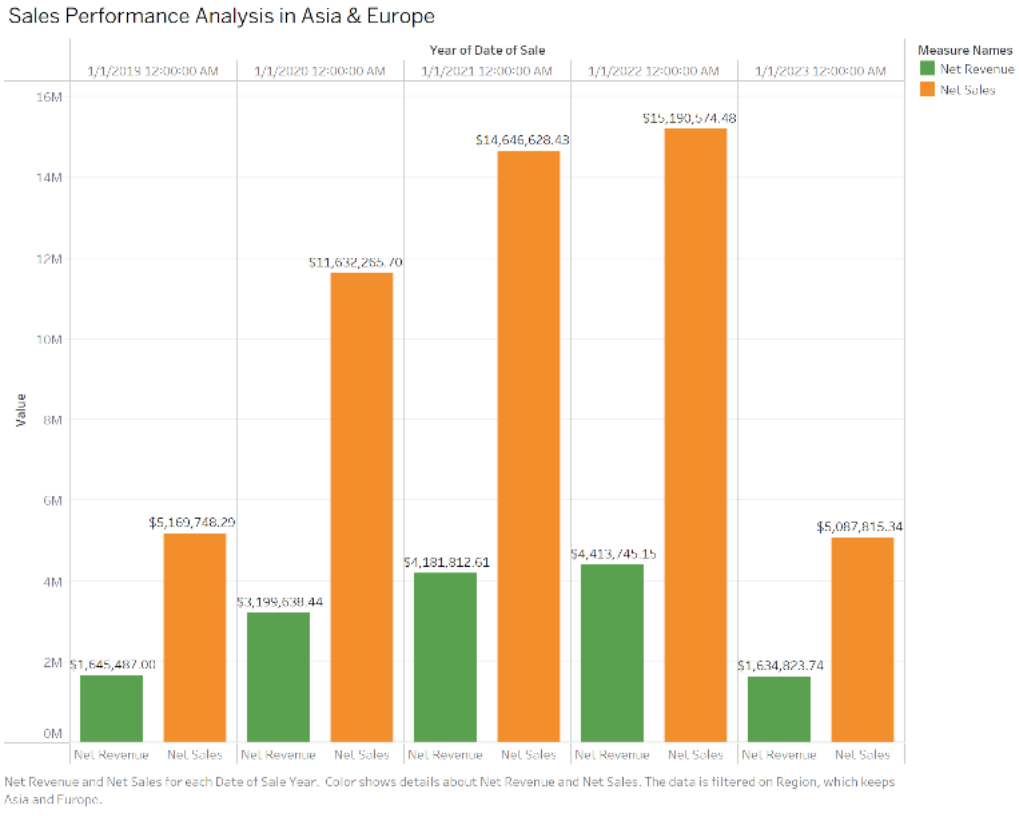


Figure 1.1.: Sales Performance Analysis in Asia and Europe

3.2. Financial Performance Analysis

The financial performance analysis showed that SparkEV's net revenue, a fundamental indicator of economic performance, has been generally positive. However, examining the contribution margin, a key profitability metric, revealed variances among car models. Some models have higher contribution margins than others, suggesting potential opportunities for cost optimization and pricing strategies.

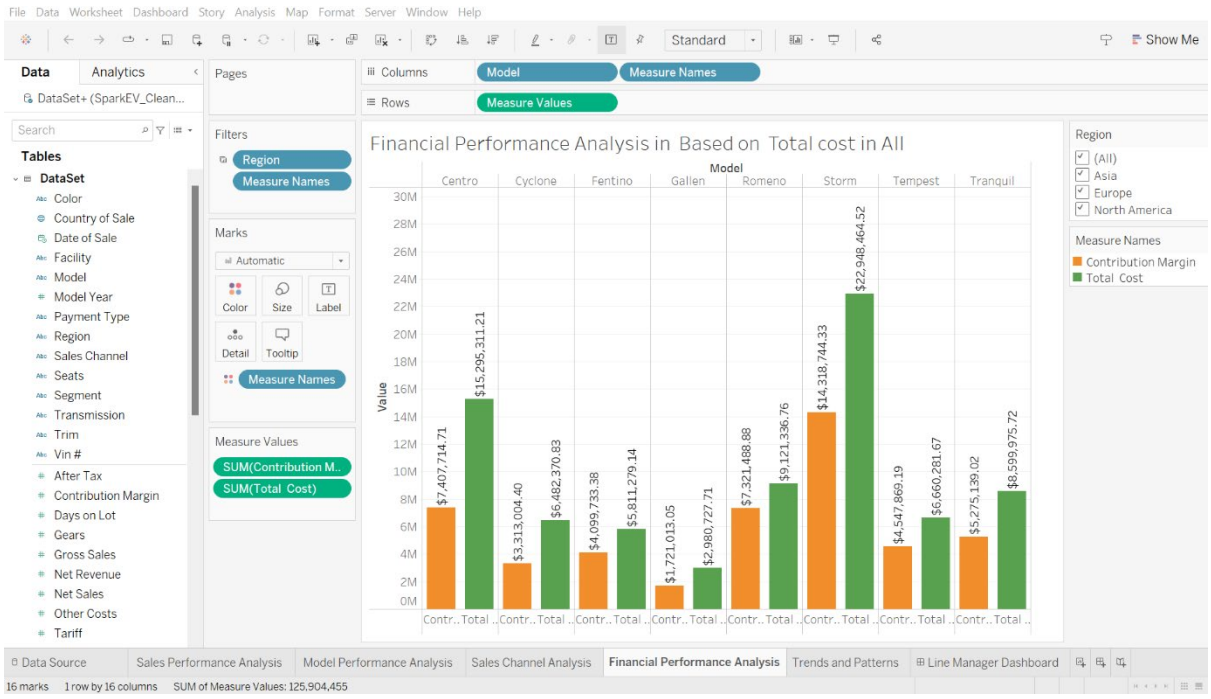


Figure 1.2: Financial Peformance Analysis Based on Total Cost

3.3. Sales Channel Analysis

Our analysis of sales channels indicated that SparkEV primarily relies on the Retail and Dealer channels, with Fleet sales accounting for a smaller portion of the total. Understanding sales distribution across these channels can help SparkEV allocate resources and tailor its marketing efforts accordingly. It is also worth noting that several factors can influence the market share of each channel, and a strategic evaluation of these channels is essential (Jones, 2021).

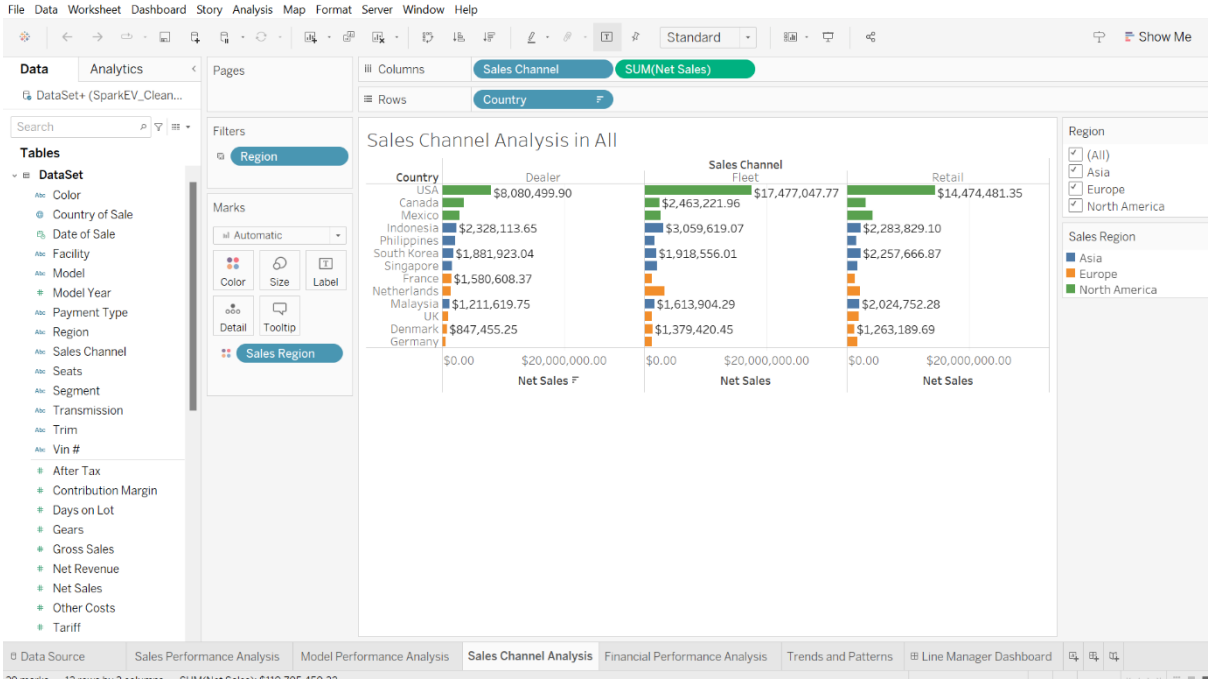


Figure 1.3. Sales Channel Analysis

3.4. Trends and Patterns

The analysis also unveiled trends and patterns within the data. For instance, the data suggested that SparkEV experiences seasonal variations in sales, which may be attributed to weather conditions, promotions, or the launch of new models. This insight can guide marketing strategies, inventory management, and production planning to better align with market demand (Patel, 2018)

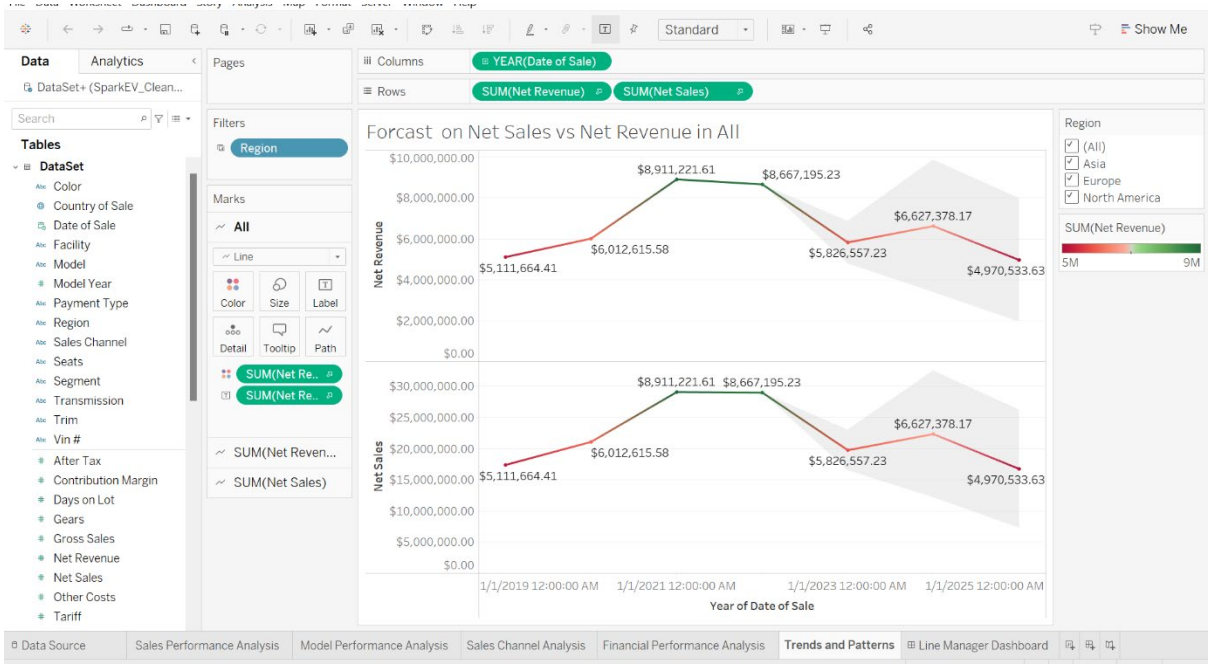


Figure 1.4.: Sales vs Revenue Trends

3.5. Recommendations

Based on our analysis, we propose the following recommendations for SparkEV:

- **Seasonal Marketing Strategies**: Implement marketing campaigns that leverage the observed seasonal trends in sales. Target promotions and product launches during peak sales months to maximize revenue.
- **Model Optimization**: Focus on optimizing models with lower contribution margins. This might involve reevaluating production costs pricing strategies or considering product enhancements to increase profitability.
- **Sales Channel Strategy**: Continuously assess the performance of different sales channels and consider diversification or adjustments as necessary to capture additional market share.

- **Data-driven decision-making**: Invest in data analytics and visualization tools to monitor sales trends, financial performance, and operational insights to remain competitive in the dynamic automotive industry (Adams, 2020).

4. Overall Financial Analysis

Multiple factors influence the sales and eventual profit made by automobile companies, which vary depending on region, country, configuration performance of the vehicle, and maintenance costs (Barulli et al., 2020). To uncover these elements, a financial analysis focused on sales and profit performance across various regions, countries, car models, etc.

4.1. Highest Performing Models based on Region

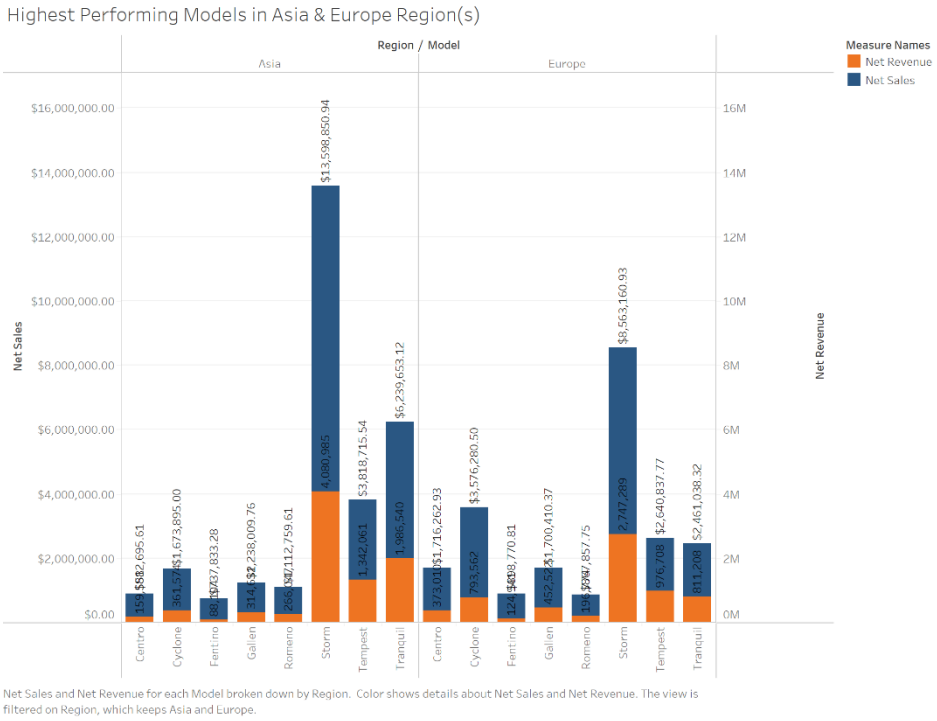


Figure 2.1.: Highest Performing Models in Asia and Europe

Among all the models, there is a conspicuous outlier in sales and profit performance, the Storm model of vehicles (Figure 2.1). However, the relatively lower performances of the other models are pretty telling as they struggle to reach the heights the Storm model did. Closely trailing behind are models such as Tranquil, Tempest, and Cyclone. While this model does not provide any particularly eye-opening insights, it provides a solid foundation to focus on and build further analysis.

4.2. Total Sales vs. Total Profit across Different Regions based on Model Year for the Storm Vehicle

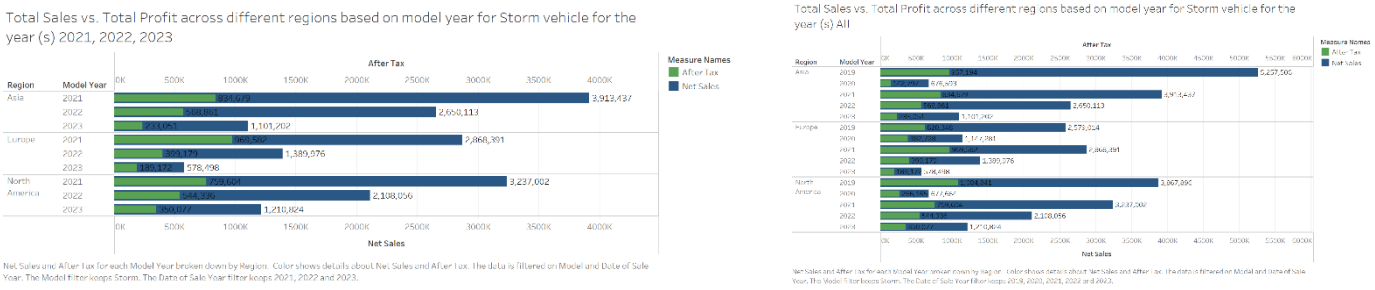


Figure 2.2.: Total Sales vs. Total Profit across different regions based on model year for Storm Vehicle

Figure 2.2 explores the different sub-models of the best-performing model, Storm. The chart looks at the sales and profit performance of the models depending on the year they came out. Analysing the entire time period, it can be seen that the 2019 model has historically performed higher than any other model. However, they are virtually non-existent when the analysis is narrowed to 2021-2023. This tells us that SparkEV has been struggling to maintain the sales of vehicles for over two years after they were manufactured.

Additionally, the newer models of Storm are struggling to achieve the same sales and profit as the older models. While the COVID-19 pandemic likely significantly reduced sales and profits (Wen et al., 2021), other factors should also be considered. For example, SparkEV may focus on a continuous technology approach that builds on pre-existing developments within the company or the industry (Coccia, 2020). For an industry that is monopolized mainly by Tesla (Duane-Davis, 2023), SparkEV should focus its efforts on developing destructive technologies to establish a stronger foothold in the industry and differentiate its newer models from their older ones to incentivize customers to purchase them (Coccia, 2020). Additionally, multiple factors affect electric vehicle longevity, such as technological advancements, infrastructural support, regional policies, and consumer behavior (Coccia, 2020). SparkEV should carefully consider these factors in developing newer versions of Storm and the other models.

4.3. Top 2 and Bottom 2 Countries Based on Profitability in Different Regions

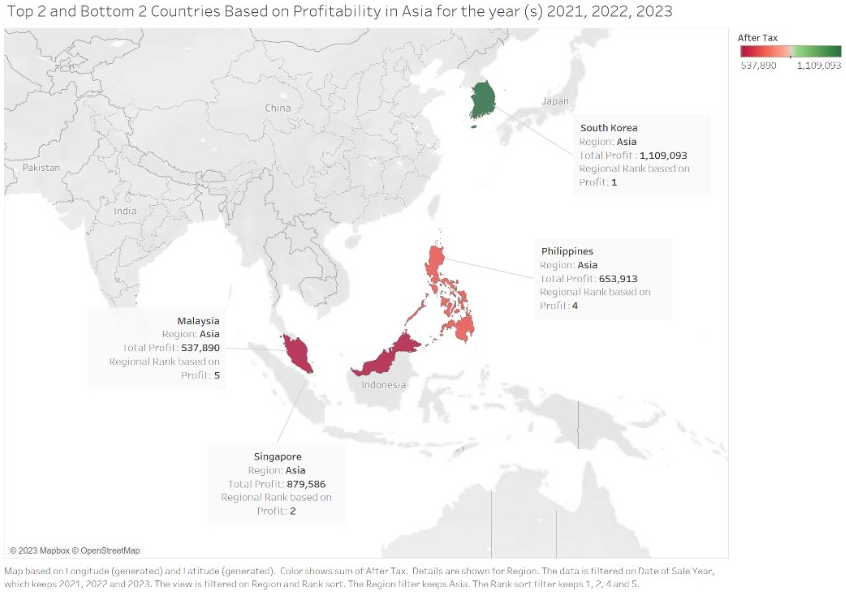


Figure 2.3.: Top 2 and Bottom 2 Most Profitable Countries in Asia

The map visualization identifies the best-performing countries in Asia: South Korea and Singapore. Therefore, SparkEV should focus its marketing efforts on boosting sales in these countries. Beak et al. (2020) conducted an analysis to analyse consumers' perceptions regarding electric vehicles in South Korea. The study found that the price, battery life, and driving range are some of the key factors driving consumers' purchase decisions for electric vehicles (Beak et al., 2020). Similarly, price and driving range were substantial factors driving Singapore's people (Xu et al., 2017). SparkEV should consider these factors to improve South Korea and Singapore's profitability further. Another factor outside of SparkEV's control is the high cost of obtaining a Certificate of Entitlement in Singapore (Xu et al., 2017). Despite that limitation, their positive profitability figure in Singapore could be viewed as a favorable implication for future performance in the area, provided SparkEV can maintain its quality.

On the other hand, the company seems to be performing the worst in terms of profitability in Malaysia and the Philippines. Asadi et al. (2020) identified key factors affecting customer intent to purchase electric vehicles. Aside from common factors such as price, longevity, and driving range, ascription of responsibility, subjective norms, and awareness of consequences

positively influence Malaysian residents' purchase intent (Asadi et al., 2020). Therefore, SparkEV should focus on increasing its marketing communication, highlighting the consequences of conventional automobiles on the environment and painting it as an individual responsibility not to be a part of it. Appropriate segmenting is essential to ensure that the marketing messages reach the right audience. Finally, the Philippines, with the lowest profitability ranking in the region, is at an early stage of electric vehicle deployment (Lopez et al., 2021). Here, factors beyond SparkEV's control, such as regional policies, lack of sufficient infrastructure, and high cost of owning an electric vehicle, impact the overall profitability in the country (Coccia, 2020).

4.4. Influence of Tariff Rates on Sales in Asia

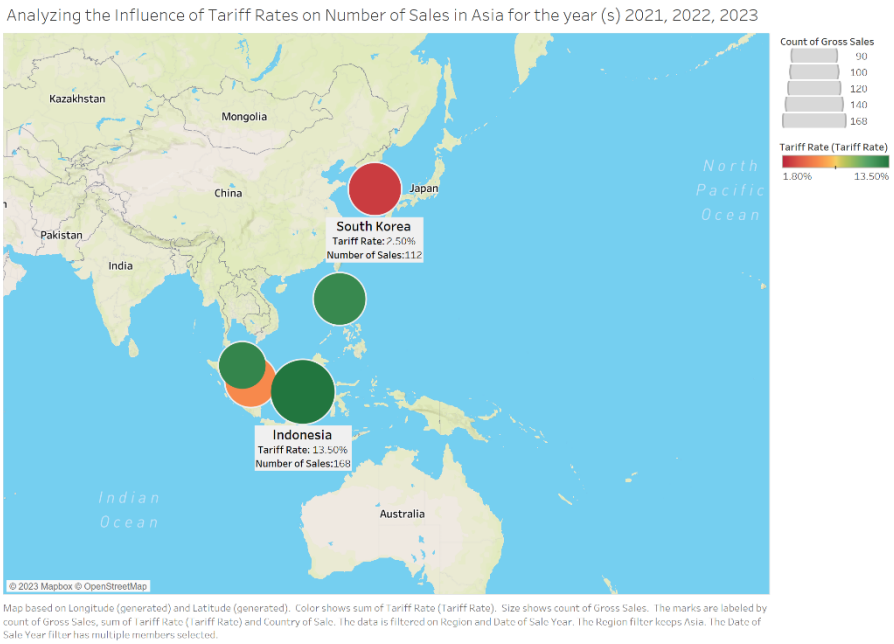


Figure 2.4.: Influence of Tariff Rates on Sales

For most of the analysis, the typical pattern is that the number of sales increases with the decrease in tariff rates. However, Indonesia is an outlier in the analysis despite the challenges in user acceptance, infrastructure, and technology (Setiawan et al., 2022). A massive contributor to that could be the policies implemented by the Indonesian government to reduce carbon emissions and increase the adoption of electric vehicles (Setiawan et al., 2022). Expert stakeholders consider Indonesia ready for electric vehicle adoption (Maghfiroh et al., 2021). However, increased marketing communications to raise awareness of the consequences of carbon emissions could be a helpful way to incentivize consumers' purchase intention (Maghfiroh et al., 2021). Maghfiroh et al. (2021) also recommend investing in two-wheelers along with four-wheelers for easier adoption into the country. SparkEV should consider these recommendations carefully as the high sales volume despite the high tariff rates indicates a potentially promising future in the country.

5. Operational Overview

The operational overview section explores the number of days on the lot, variable marketing costs and their impacts, and the various cost drivers of the products.

5.1. Impact of Inventory on Sales

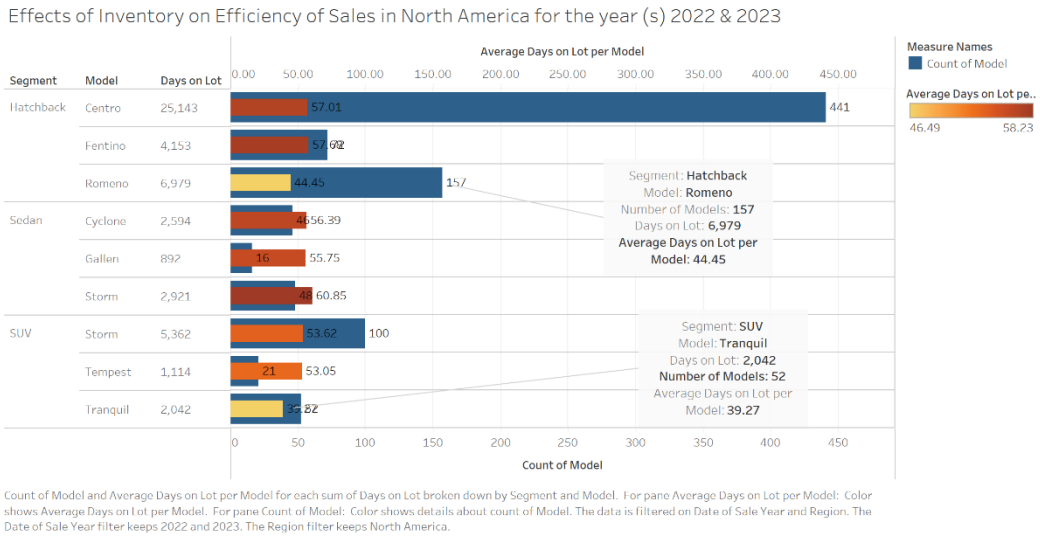


Figure 3.1: Number of Models Sold vs. Average Days on Lot per Model Comparison in 2022 & 2023

Cachon et al. (2019) explore the impact of inventory on sales in the automotive industry. While higher inventory leading to higher sales is considered a standard principle, Cachon et al. (2019) argue that the automotive industry does not necessarily operate the same way as automobiles are a specialty product that consumers spend much time researching (Dahiya, 2017) and are much likely to prefer something specific (Cachon et al., 2019). However, low inventory can cause problems such as higher wait times for customers and a lack of options for customers looking for options. So, it is recommended to diversify the inventory with different models to attract a wide range of customers (Cachon et al., 2019).

Figure 3.1 is aimed at testing this theory on SparkEV's products. It can be seen that among hatchbacks, the Romeno model spends the least number of days in the car dealership. This result can be attributed to the fact that the number of Romeno models stocked is neither as high as Centro nor as low as Fentino, thus providing enough diversification of choices with fewer redundancies to spend a lower amount of time in the car dealership (Cachon et al., 2019). A similar case can also be made for the Tranquil model in the SUV segments.

It should be noted, however, that the number of models sold does not accurately portray the inventory figures. This measure is merely used as a guideline to analyse the average days on lot spent by each model under the three segments.

5.2. Impact of Marketing on Sales in Asia and North America

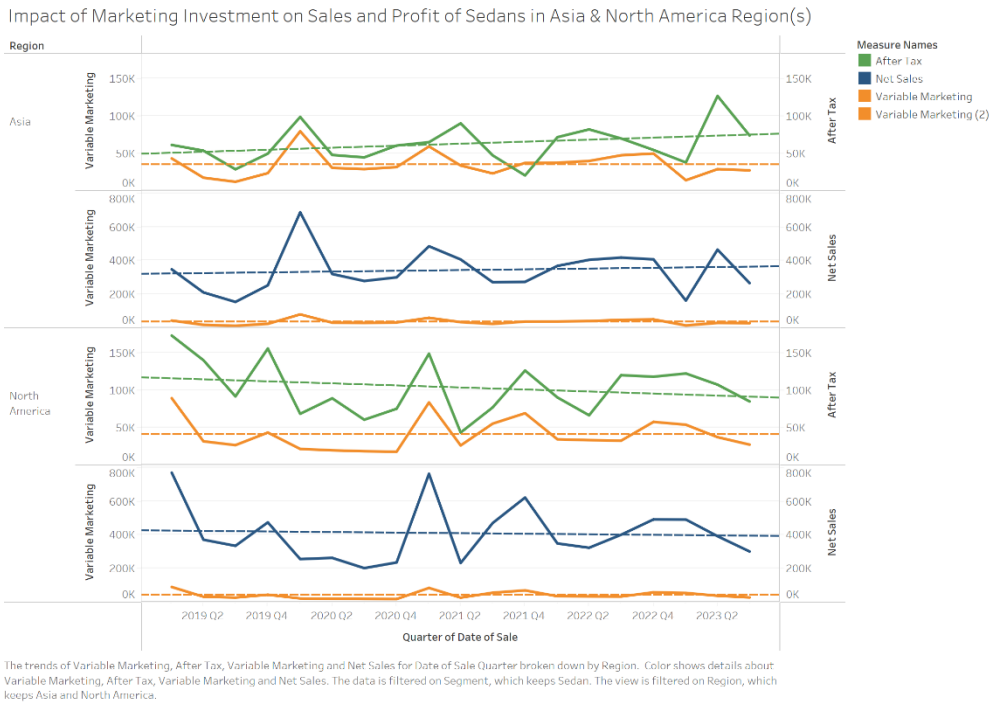


Figure 3.2.: Impact of Variable Marketing Expenditure on Sales and Profit in Asia and North America

Figure 3.2 aims to visualize the impact of variable marketing expenditure on Sales and Profit across two regions, North America and Asia. It is pretty interesting to compare the two regions as their perceptions of marketing vastly differ from one another (Waluya et al., 2019). In North America, the sales and the profits seem to follow a similar trend to the variable marketing costs, showing an almost proportionate effect, which suggests marketing to be a positive driver of sales and profit. However, the pattern cannot be noticed in the case of Asia. Waluya et al. (2019) state that Asian people tend to gravitate towards automobiles with a preexisting solid brand image. As an up-and-coming company, SparkEV does not have a strong brand image to convey its marketing messages effectively to the Asian market. To boost sales, it might be worthwhile to invest time and money into building up its brand image in the most profitable countries in Asia.

5.3. Median Cost Comparison between Thailand and USA

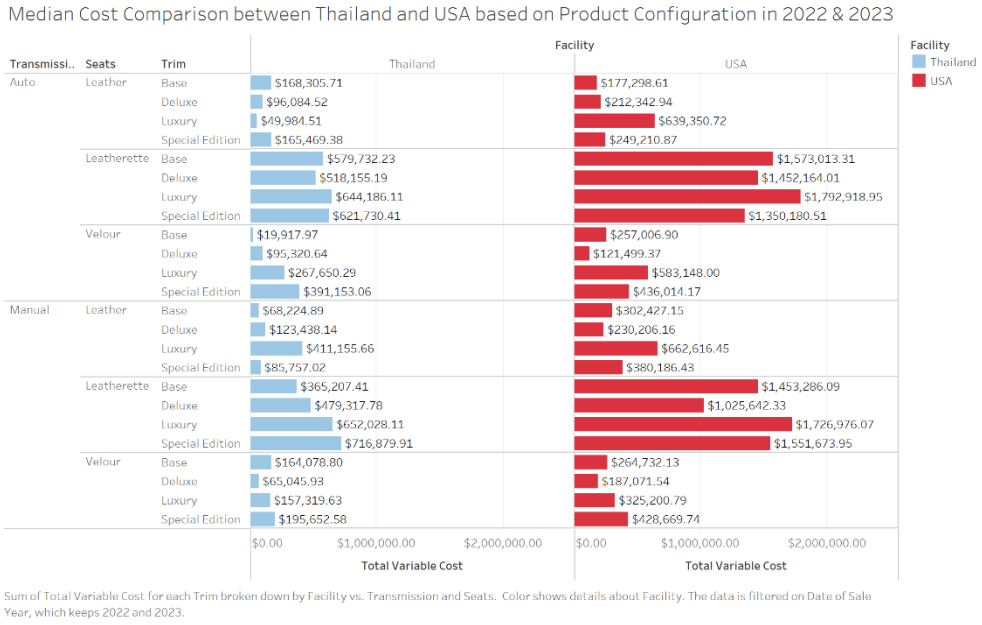


Figure 3.3.: Median Cost Comparison between Thailand and USA

While countries worldwide are beginning to adopt EVs, with many countries taking an active part in its production, the USA is still lagging as EVs dominate only a minor section of the automobile market (Graham et al., 2021). Among the reasons cited were the high expenses of manufacturing EVs from the US (Schröder, 2021). On the other hand, Thailand is a booming market when it comes to EV parts manufacturing because of increased government support and sufficient business incentives (Schröder, 2021). In SparkEV's case, it is pretty clear from Figure 3.3 that they incur much higher costs in manufacturing from the US than in Thailand. So, in order to minimize production costs, it might be worthwhile to shift its entire manufacturing operations to Thailand.

Breaking down the cost drivers into configurations such as transmission, type of seat, and type of trip provides us with deeper insights into the cost drivers of SparkEV. It can be seen that the type of seats, i.e., the type of interior, plays a massive role in the cost increase. Mainly, leatherette seats cost a lot more than those of other materials. It might be worthwhile to look into better and cheaper exporters of leather and leatherette, like Brazil, to minimize costs in these areas (Jenkins, 2018).

6. Two-year Forecast

While forecasting may not always accurately reflect the state of the future, as unprecedented events cannot be predicted, it still provides a general guideline into where the company is headed. Analysing the patterns created in the past, a two-year forecast was made to gather a rough idea of SparkEV's potential future performance.

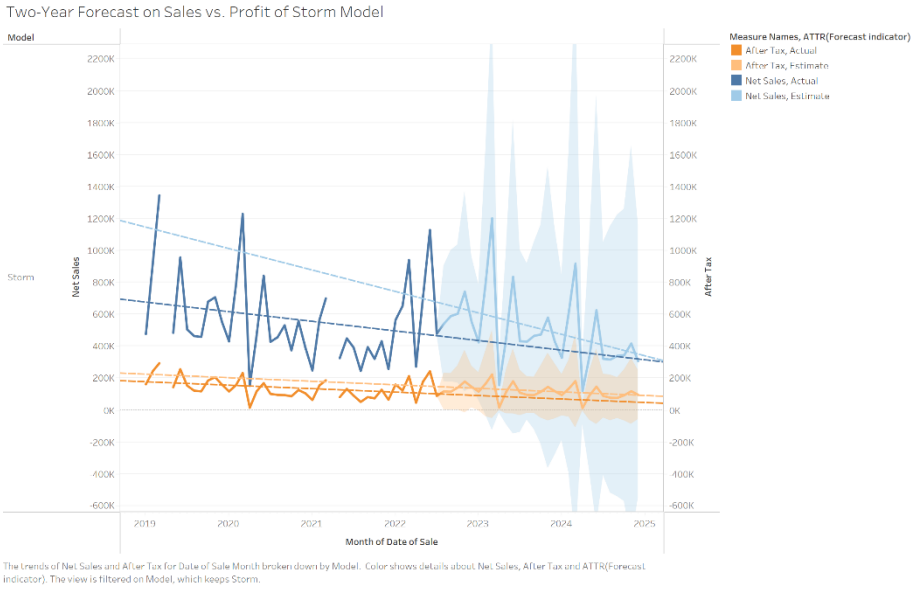


Figure 4.1: Two-Year Forecast on Sales vs Profit for Storm

As the Storm model is the most expensive and profitable model of EVs offered by SparkEV, the two-year forecast on sales and profit was focused on this model. While the forecast follows a similar pattern to the historical data, it also shows an overall downward trend in sales and profit. This is quite concerning as the Storm model bears the bulk of the profitability of SparkEV, and due attention should be paid so that the sales and profit of Storm can be optimized for the future.

Moving on from the models, it is essential to analyse the regions to focus the operations in more in the future. Figure 4.2 shows North America is forecasted to remain the highest-selling region after two years. Again, it should be noted that these are merely a reflection of pre-existing patterns. SparkEV should consider these and focus their future marketing communications towards the people of Asia and Europe to boost their sales in those regions. They should also focus on building a stronger brand image to have more of a sway with the Asian consumers (Waluya et al., 2019).

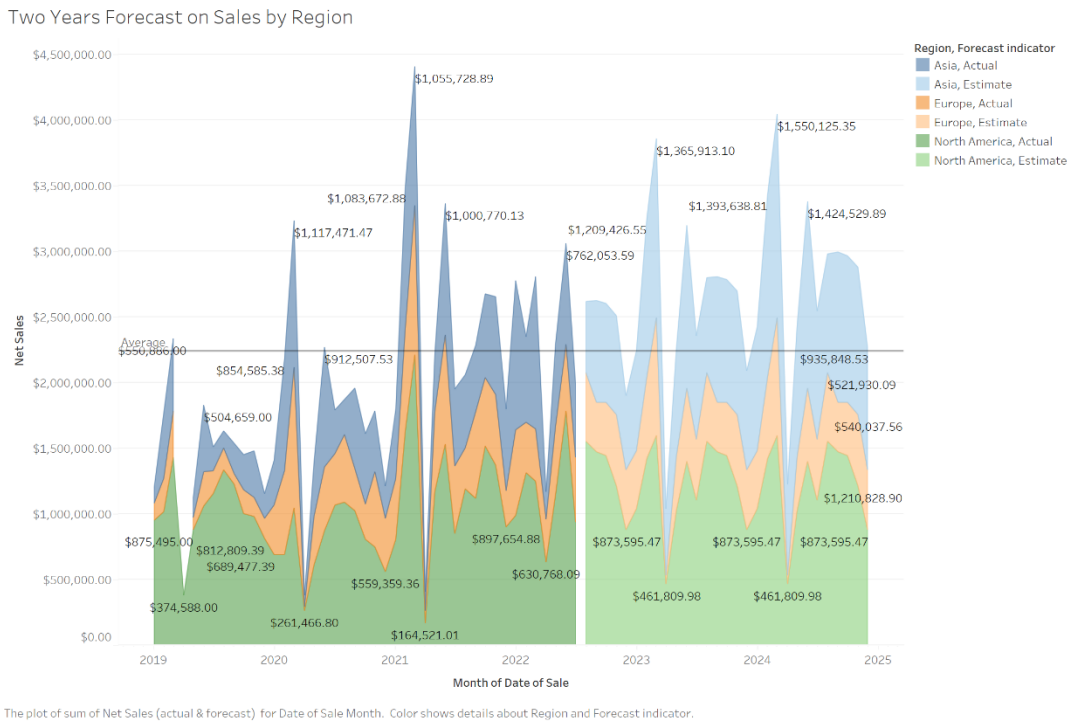


Figure 4.2.: Two Years Forecast on Sales by Region

7. Conclusion

With the rise of environmental consciousness, the Electric vehicle industry is in a critical spot concerning the future (Beak et al., 2020). With more and more countries pushing to adopt energy-efficient electric vehicles, companies in the industry are presented with a unique opportunity to penetrate the market (Barulli et al., 2020). However, with Tesla monopolizing almost 50% of the market share in the industry (Duane-Davis, 2023), up-and-coming companies like SparkEV must differentiate their offerings to make a mark in the growing EV market (Barulli et al., 2020). That is why it is essential to explore historical data to gather more profound insights into what has been successful for the company thus far. Additionally, data analytics can reveal new opportunities to exploit and challenges that must be overcome (Lv et al., 2020). SparkEV must climb uphill to expand its market shares in this highly competitive industry (Duane-Davis, 2023). However, effective data analysis can reveal the path they must take on this journey (Lv et al., 2020).

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