NATIONAL UNIVERSITY

College of Computing and Information Technologies | Bachelor of Science in Computer Science

MOTORS CASE STUDY IN **TESLA** COMPANY

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In **Partial Fulfilment** of the **Requirements** in the Degree of

Bachelor of Science in Computer Science

Submitted to Prof. **Salazar**, Armida P.

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I. Introduction

A. Project Overview

Tesla Motors, which was established in 2003, has transformed the automotive industry through its sustainable energy solutions and innovative electric vehicles (EVs). With an emphasis on enhancing customer satisfaction and factory productivity, this case study investigates Tesla's business model, market strategy, and the obstacles and opportunities it encounters in the swiftly evolving automotive sector. This project undertakes a comprehensive review of Tesla's production process, and how JUDAY can create an application that can help customers order more efficiently. Tesla, a leader in the electric vehicle industry, is renowned for its cutting-edge technology and high demand for its cars and innovative approach to tech. Which is why it makes sense for them to create an app to ease the process of ordering their cars.

This not only improves worker satisfaction, but also streamlines production, ensuring Tesla cars continue to roll off the assembly line efficiently.

Managing orders and calculating build time according to factors is where we **OUR TEAM - JUDAY** fill in.

Our system can improve the following:

- Order efficiency
- Customer satisfaction

I. Introduction

B. Objectives

The primary goal of this project is to develop and implement a system that addresses these issues, ensuring smoother operations, efficient ordering, and overall customer satisfaction.:

I. Streamline Ordering: The core objective is to create a system that lets user order a car based on the specification that they want, view their existing orders, and also check what parts are out of stock. Helping them decide on what they can order now for a faster arrival. This is to help customers have a set expectations for their orders and their arrival.

II. Track Orders: Customers are able to view their orders and their estimated time of arrival. Removing the need to worry about their orders not arriving in time. It also helps them find out which parts are out of stock in their order, which can cause delays depending on the part.

III. Customer Satisfaction: Delays in production and delivery can lead to customer dissatisfaction. By addressing the root causes of these delays through improved time coordination and giving them the expected time, the project aims to provide more accurate delivery estimates to customers. This reliability in delivery schedules will enhance customer trust and satisfaction, as they will receive their vehicles within the promised timeframes. Thus ensure that the vehicles produced meet high-quality standards by closely monitoring the production process. The system can include quality checks at various stages to detect and address any issues early on. This will reduce the likelihood of defects or recalls, further enhancing customer satisfaction.

I. Introduction

C. Scope

The scope of this project includes a detailed analysis of Tesla's current production challenges, development of an optimized system, and its implementation and evaluation:

(**1**) Analysis of Current Challenges: A thorough analysis will be conducted to identify the specific pain points in Tesla's production process. This includes examining the inefficiencies in restocking and the issues related to time coordination. By understanding the root causes of these challenges, the project can develop targeted solutions that effectively address them. (**2**) Development of a Coordinated System: Based on the analysis, a robust system will be designed to track and coordinate production timelines and budgets. This system will integrate seamlessly with Tesla's existing production workflow, ensuring that it enhances current processes rather than disrupting them. Key features will include tracking of part arrivals, automated auditing of completion times, and comprehensive budget tracking. (**3**) Implementation and Testing: The proposed system will be implemented in a controlled environment initially to test its effectiveness. This phase will involve rigorous testing to ensure that the system performs as expected and addresses the identified challenges. Feedback from this phase will be used to make necessary adjustments and optimizations. (**4**) Evaluation and Optimization: Once the system is fully implemented, its performance will be continuously monitored to ensure it meets the project's objectives. Regular evaluations will be conducted to assess its impact on production timelines, budget management, and customer satisfaction. Based on these evaluations, further optimizations will be made to enhance its efficiency and effectiveness.

The scope of this project is comprehensive and strategic, encompassing the identification of current inefficiencies, the development and integration of a sophisticated tracking system, and ongoing evaluation and optimization. By thoroughly analyzing Tesla's production challenges, implementing a robust and coordinated system, and continuously refining it, this project aims to significantly enhance production efficiency, budget management, and customer satisfaction. This systematic approach will ensure that Tesla can meet its high demand effectively, maintain its reputation for innovation, and continue to lead the electric vehicle industry.

I. Introduction

D. Technologies Used

TECHNOLOGY| ANDROID STUDIO

01. Development Environment: Android Studio is the official integrated development environment (IDE) for Google's Android operating system. It provides the tools needed for developing, testing, and debugging Android applications.

02. Features and Capabilities: It offers a robust editor with code completion, refactoring, and real-time error detection. Android Studio includes an emulator to test applications on different devices and configurations, ensuring compatibility and performance. It supports Gradle-based build systems, which streamline project management and build processes.

03. Importance for Tesla's Production System: In the context of Tesla's production system, Android Studio could be used to develop mobile applications that provide real-time updates on production schedules, inventory levels, and budget tracking. These applications could be used by factory workers, managers, and other stakeholders to access critical information on the go.

TECHNOLOGY| JAVA

01. Programming Language: Java is a versatile and widely-used programming language known for its portability, security features, and robustness. It is commonly used for building enterprise-level applications, web services, and Android apps.

02. Object-Oriented Design: Java's object-oriented design promotes modularity and reusability, which is essential for developing scalable and maintainable applications.

03. Usage in Production System: Java can be used to develop backend services and APIs that support the functionality of the production tracking system. For instance, it could handle data processing, business logic, and integration with other systems, ensuring seamless operations within Tesla’s production environment.

TECHNOLOGY| MySQL:

01. Database Management System: MySQL is an open-source relational database management system (RDBMS) that uses Structured Query Language (SQL) for accessing and managing data.

02. Performance and Scalability: Known for its reliability, performance, and scalability, MySQL is suitable for managing large volumes of data and supporting high-transaction environments.

03. Role in Production System: MySQL can be used to store and manage data related to production timelines, part inventories, and budget records. It allows for efficient data retrieval and reporting, enabling stakeholders to access real-time information and make informed decisions.

TECHNOLOGY| XAMPP:

01. Web Server Solution Stack: XAMPP is a free and open-source cross-platform web server solution stack package developed by Apache Friends. It consists of Apache HTTP Server, MySQL, and interpreters for scripts written in PHP and Perl.

02. Ease of Use: XAMPP is designed to be easy to install and use, providing a development environment for web applications. It allows developers to set up a local server with minimal configuration, making it ideal for development and testing purposes.

03. Application in Production System: XAMPP can be used to develop and test web-based interfaces for the production tracking system. This could include dashboards for monitoring production status, inventory management portals, and budget tracking tools. By simulating a live server environment, XAMPP helps ensure that the web applications function correctly before deployment.

Conclusion| The use of these technologies—Android Studio for mobile application development, Java for backend services, MySQL for data management, and XAMPP for web server solutions—provides a comprehensive and integrated approach to developing a robust production tracking system for Tesla. Each technology plays a critical role in ensuring the system is efficient, scalable, and user-friendly, ultimately contributing to improved production workflow, budget management, and customer satisfaction.

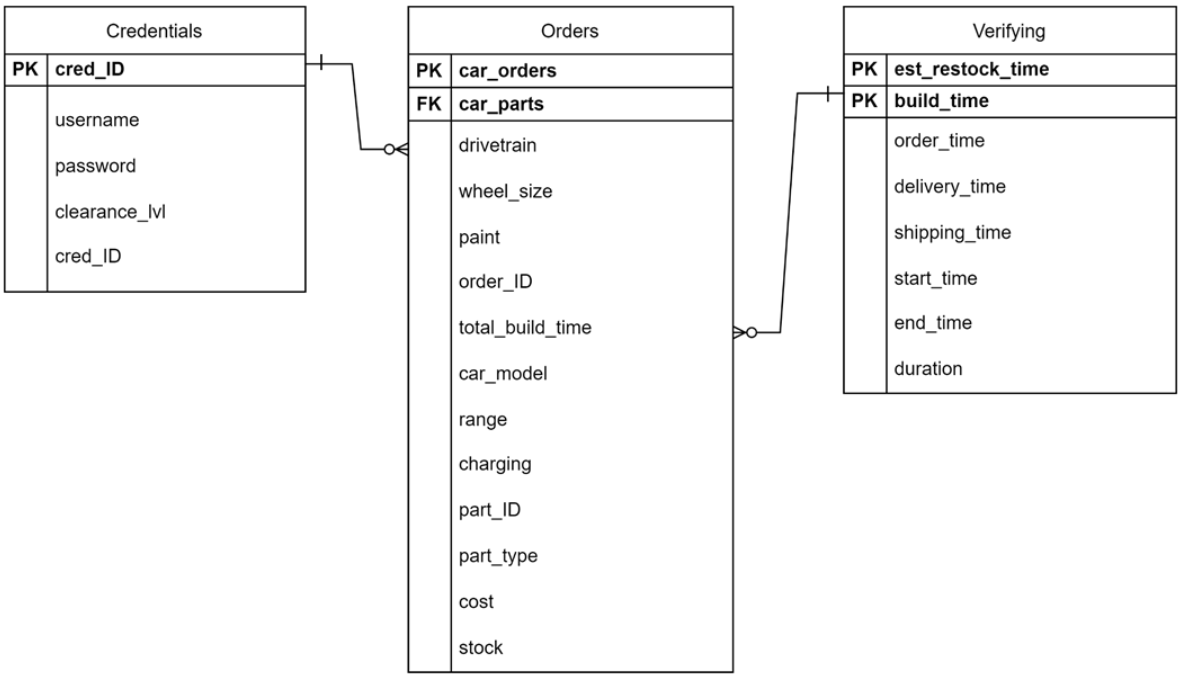
II. System Design

A. Database Design
B. ER Diagram (Entity-Relationship Diagram)
C. Schema Design
D. Normalization

II. System Design

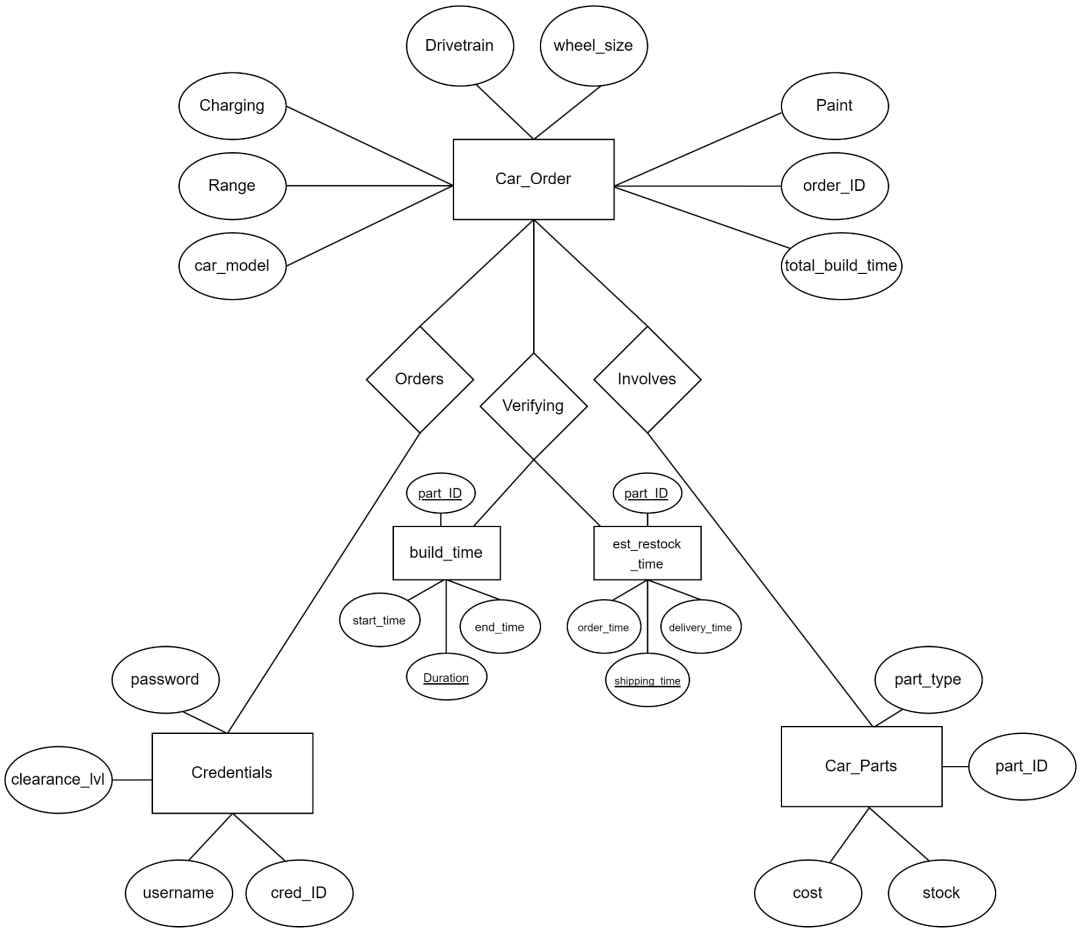
A. Database Design

In the context of designing a database for Tesla's production tracking system, a relational database design is the most appropriate choice due to its ability to handle complex queries, maintain data integrity, and support scalability. The following is an outline of the relational database design, including the key entities, their attributes, and relationships.



II. System Design

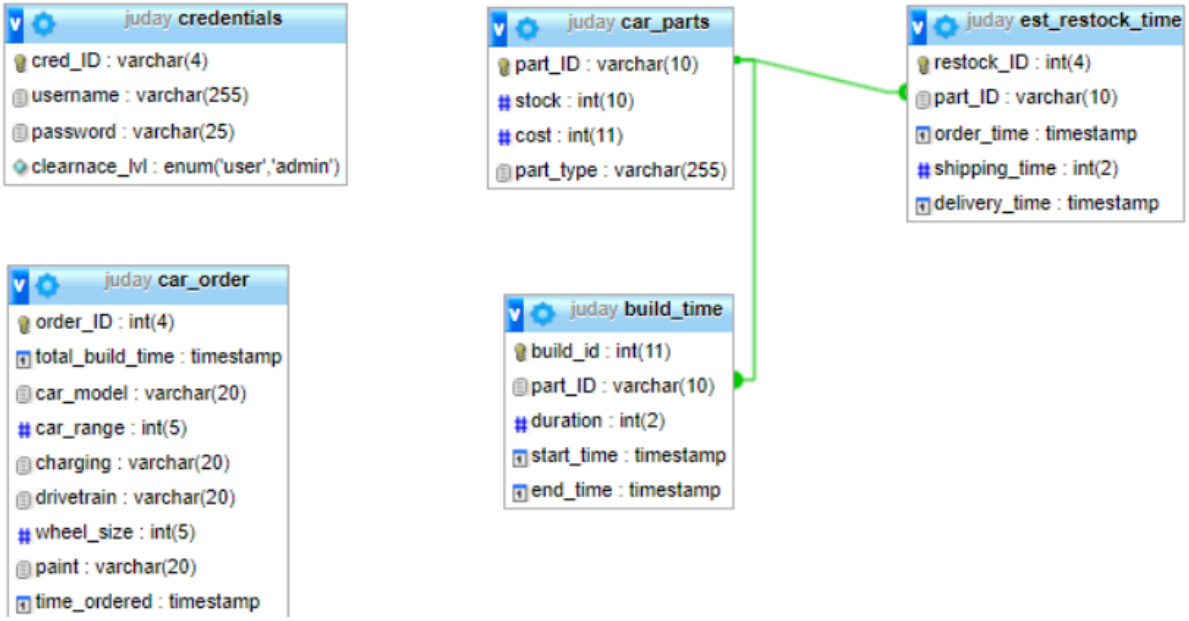
B. ER Diagram (Entity-Relationship Diagram)



The provided ERD depicts the structure of a relational database designed for a car order and production tracking system. The diagram includes entities (rectangles), attributes (ovals), and relationships (diamonds). Here's a detailed explanation of the ERD components and their interconnections: The ERD represents a database for managing car orders, parts, and user credentials. The main entities include Car_Order, Orders, Car_Parts, and Credentials. Key attributes for these entities are outlined, with Car_Order capturing details like drivetrain and build time, while Car_Parts includes part type and stock information. Relationships such as Verifying and Involves link Orders to Car_Parts, highlighting processes like part verification and involvement in orders. Credentials manage user access with attributes like username and clearance level, ensuring security.

II. System Design

C. Schema Design



The schema design provided represents a database model that manages various aspects of car orders, part verification, and user credentials. The schema design effectively organizes the necessary components and processes involved in managing car orders, part verification, and user credentials. It provides a clear structure for tracking the progress of each order, ensuring that all parts are verified before use, and maintaining system security through controlled user access. This design supports a streamlined and secure operational workflow, crucial for efficient and reliable car order management. Credentials Table: Manages user access by storing login credentials and associated clearance levels. Ensures system security by controlling user permissions based on `clearance_lvl`. Orders Table: Captures comprehensive details about each order, including various timestamps (`start_time`, `end_time`, `order_time`, `delivery_time`, `est_restock_time`, and `shipping_time`) to track the order's progress. The `build_time` attribute helps estimate the time required to complete the car order. Verifying Table: Facilitates the verification process of parts used in each order. Connects specific `part_IDs` to `order_IDs` to ensure that all necessary parts meet quality and availability standards before proceeding with the order.

II. System Design

D. Normalization

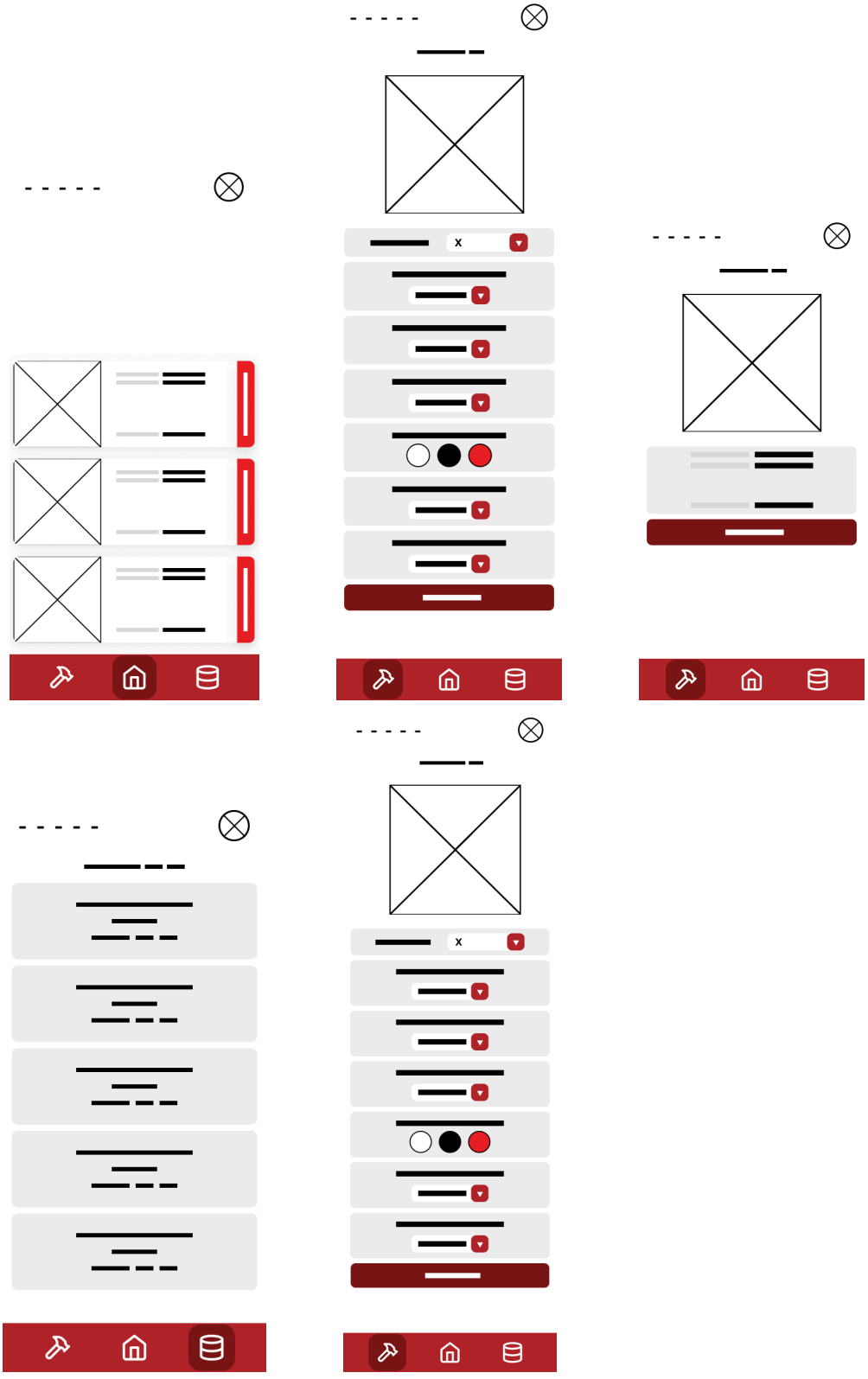
NORMALIZATION
Credentials Table: • Stores user authentication information with primary key `cred_ID`. **Orders Table**: • Stores details of each order with primary key `order_ID`. • Timestamps and other time-related attributes are maintained. **Verifying Table**: • Stores the relationship between orders and parts verification. • Primary key `verifying_ID`, with foreign keys `order_ID` and `part_ID`. **Car_Order Table**: • Stores specific details of car orders. • Primary key `car_order_ID` and foreign key `order_ID` linking to `Orders`. **Car_Parts Table**: • Stores details about car parts. • Primary key `part_ID`. **Build Time Table**: • Stores details about duration. • Primary key `build_ID`. **Est_Restock_Time Table**: • Stores details about car restock. • Primary key `restock_ID`.

III. User Interface Design

A. Wireframes
B. Mockups

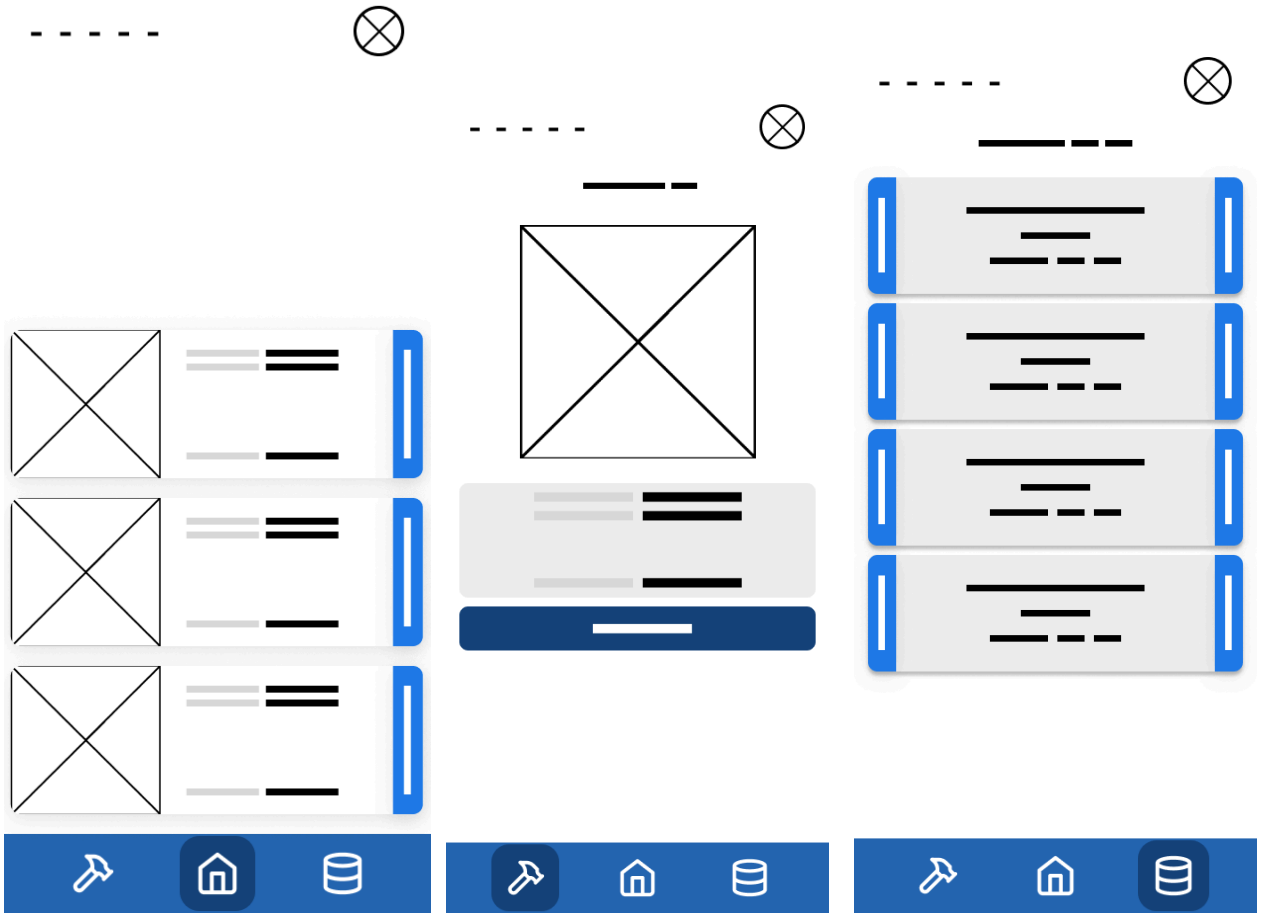
III. User Interface Design

A. Wireframes



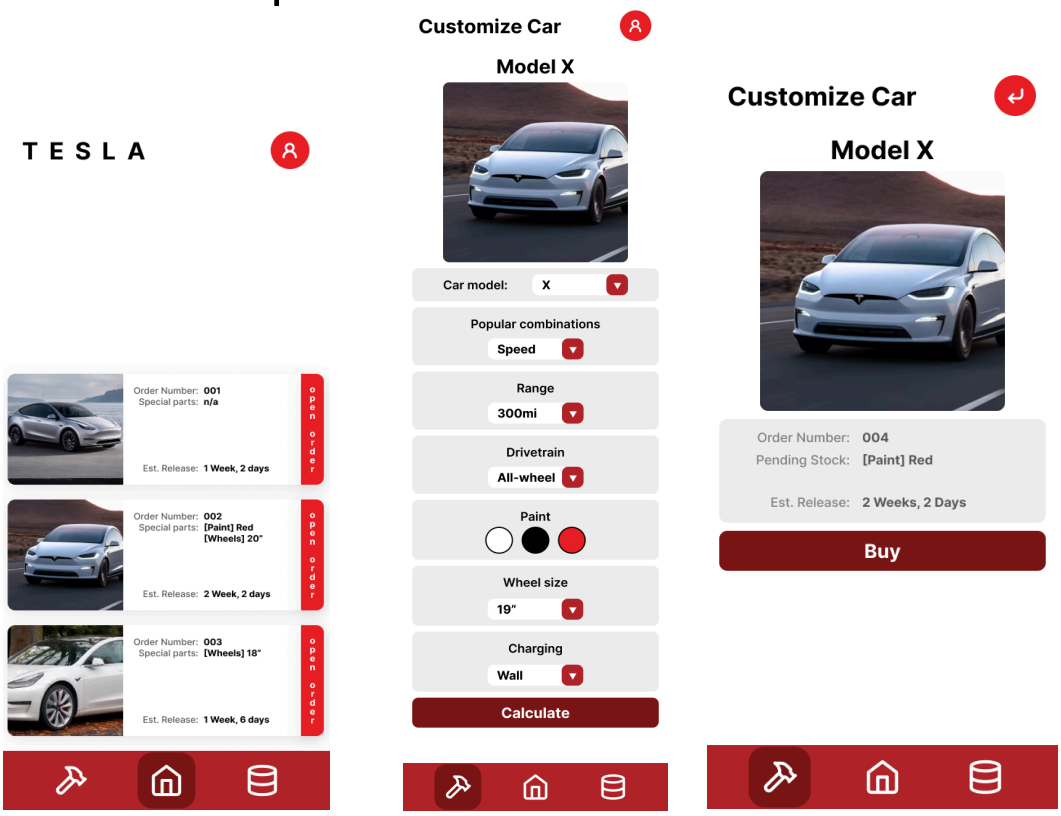
III. User Interface Design

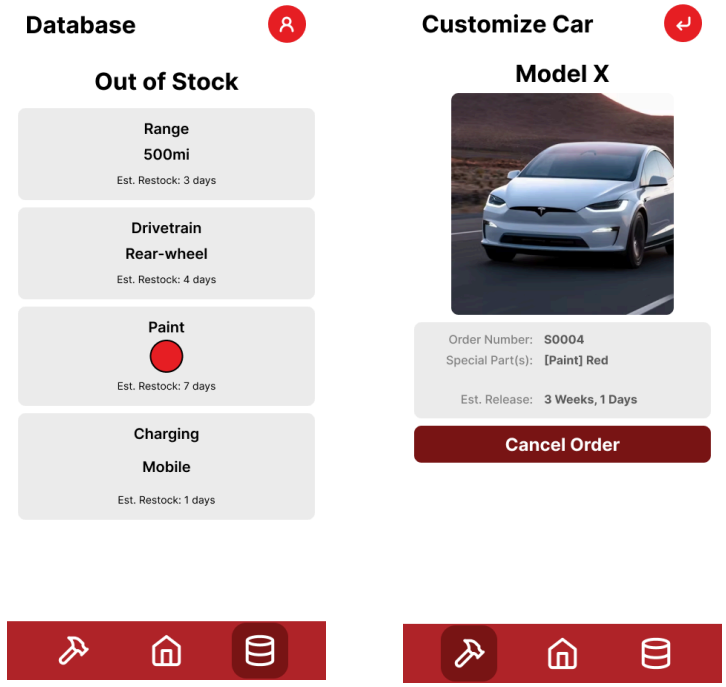
A. Wireframes



III. User Interface Design

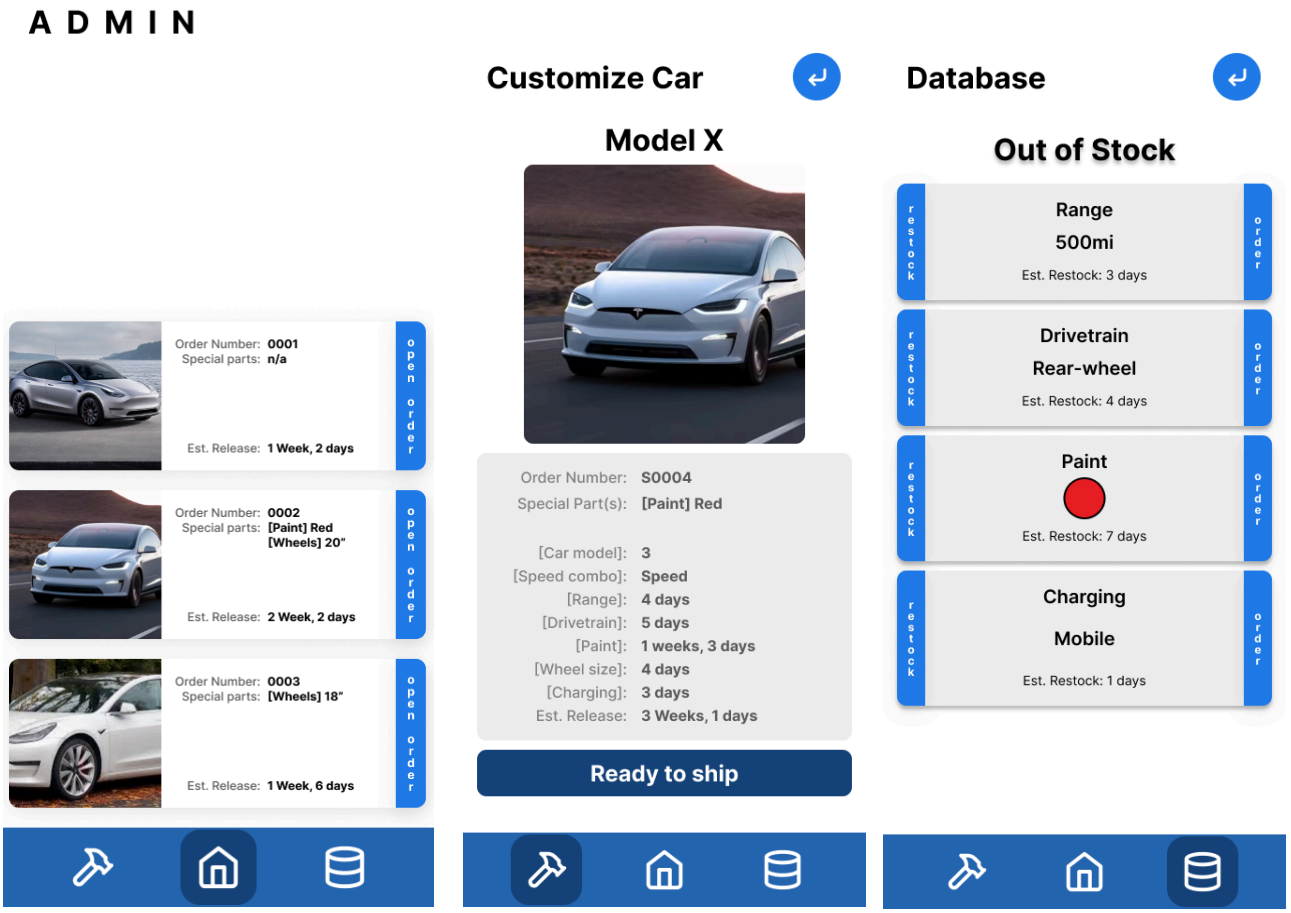
B. Mockups





III. User Interface Design

B. Mockups



IV. Implementation

A. Database Creation

01. SQL Scripts
02. Table Structures

A. Data Insertion
01. Sample Data

A. Application Development

01. Frontend

02. Backend

IV. Implementation

A. Database Creation

01. SQL Scripts

02. Table Structures

Car_Order		
Column Name	**Data Type**	**Constraints**
Order_ID	INT	PRIMARY KEY
Drivetrain	VARCHAR	NOT NULL
Charging	VARCHAR	NOT NULL
Range	INT	NOT NULL
car_model	VARCHAR	NOT NULL
wheel_size	VARCHAR	NOT NULL
Paint	VARCHAR	NOT NULL
total_build_time	INT	NOT NULL

Car_Parts		
Column Name	**Data Type**	**Constraints**
part_ID	INT	PRIMARY KEY

part_type	VARCHAR	NOT NULL
cost	DECIMAL	NOT NULL
stock	INT	NOT NULL

Credentials		
Column Name	**Data Type**	**Constraints**
cred_ID	INT	PRIMARY KEY
username	VARCHAR	NOT NULL
password	VARCHAR	NOT NULL
clearance_lvl	INT	NOT NULL

build_time		
Column Name	**Data Type**	**Constraints**
start_time	DATETIME	NOT NULL
end_time	DATETIME	NOT NULL
Duration	INT	NOT NULL

est_restock_time		
Column Name	**Data Type**	**Constraints**
order_time	DATETIME	NOT NULL
shipping_time	DATETIME	NOT NULL
delivery_time	DATETIME	NOT NULL

Orders		
Column Name	**Data Type**	**Constraints**
Order_ID	INT	PRIMARY KEY, FOREIGN KEY
cred_ID	INT	PRIMARY KEY, FOREIGN KEY

Involves (Relationship between Car_Order and Car_Parts)		
Column Name	Data Type	Constraints
Order_ID	INT	PRIMARY KEY, FOREIGN KEY
part_ID	INT	PRIMARY KEY, FOREIGN KEY

IV. Implementation

A. Data Insertion

01. Sample Data

Car_Order							
Order_ ID	**car_model**	**Range**	**Charging**	**Drivetrain**	**wheel_ size**	**Paint**	**total_build _time**
1	Model S	350	Supercharger	AWD	19”	Red	7 days
2	Model 3	320	Supercharger	RWD	18”	Yellow	10 days
3	Model X	300	Supercharger	AWD	20”	Pink	12 days

Car_Parts			
part_ ID	**part_type**	**cost**	**stock**
101	Battery	5000	50
102	Motor	3000	20
103	Wheel	200	200

build_time			
build_time ID	**start_time**	**end_time**	**duration**
1	2024-06-20 08:00:00	2024-06-25 17:00:00	5
2	2024-06-21 09:00:00	2024-06-30 17:00:00	9

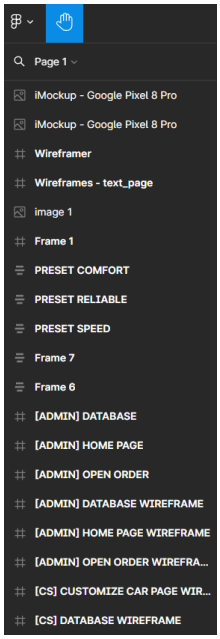
est_restock_time				
est_restock_time ID	**est_restock _time**	**order_time**	**shipping_time**	**delivery_time**
1	2024-07-05 00:00:00	2024-06-20 10:00:00	2024-07-01 08:00:00	2024-07-25 15:00:00
2	2024-07-10 00:00:00	2024-06-21 11:30:00	2024-07-02 09:00:00	2024-07-26 16:00:00

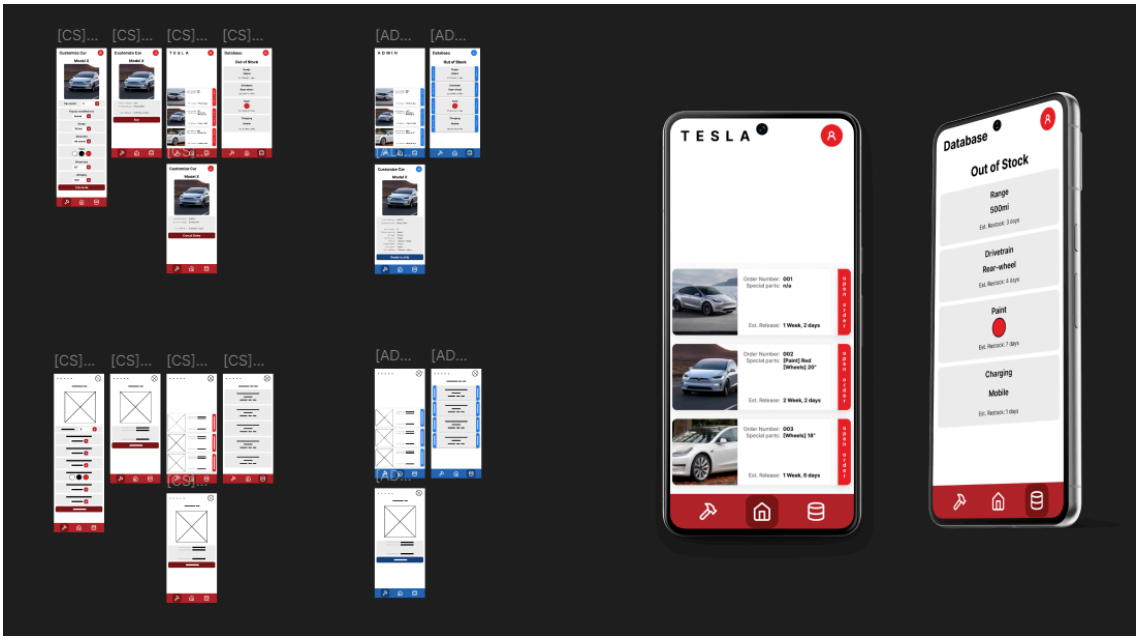
Credentials			
cred_ID	**username**	**password**	**clearance_lvl**
1	kcbll	********01	3
2	ubesa	m*****ju	2
3	akgin	******@24*	1

IV. Implementation

A. Application Development

01. Frontend
02. Backend





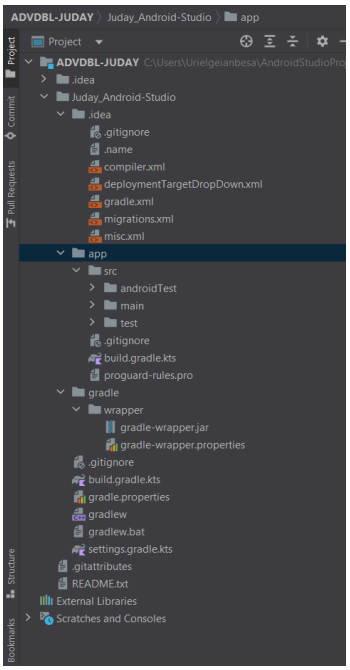
01. Frontend

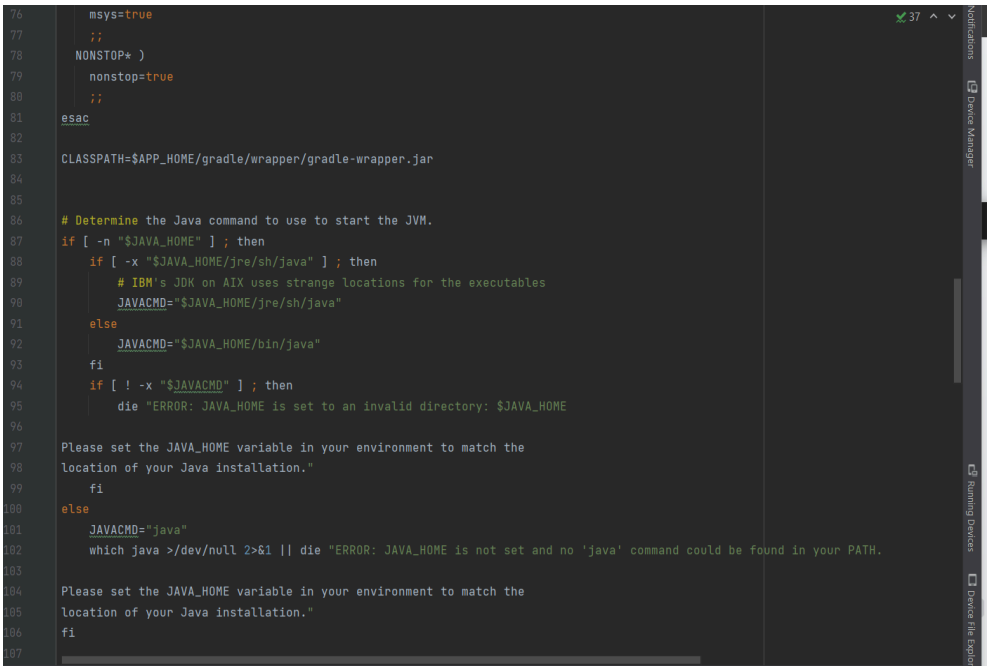
IV. Implementation

A. Application Development

01. Frontend

02. Backend





```
    msys=true
    ;;
  NONSTOP* )
    nonstop=true
    ;;
esac

CLASSPATH=$APP_HOME/gradle/wrapper/gradle-wrapper.jar


# Determine the Java command to use to start the JVM.
if [ -n "$JAVA_HOME" ] ; then
    if [ -x "$JAVA_HOME/jre/sh/java" ] ; then
        # IBM's JDK on AIX uses strange locations for the executables
        JAVACMD="$JAVA_HOME/jre/sh/java"
    else
        JAVACMD="$JAVA_HOME/bin/java"
    fi
    if [ ! -x "$JAVACMD" ] ; then
        die "ERROR: JAVA_HOME is set to an invalid directory: $JAVA_HOME

Please set the JAVA_HOME variable in your environment to match the
location of your Java installation."
    fi
else
    JAVACMD="java"
    which java >/dev/null 2>&1 || die "ERROR: JAVA_HOME is not set and no 'java' command could be found in your PATH.

Please set the JAVA_HOME variable in your environment to match the
location of your Java installation."
fi
```

01. Backend

V. Conclusion

A. Summary of Work Done
B. Challenges Faced
C. Lessons Learned
D. Future Enhancements

V. Conclusion

A. Summary of Work Done

Tesla Motors has transformed the automotive industry by pioneering the use of innovative technology and prioritizing sustainable energy solutions. Since its founding in 2003, Tesla has continually pushed the boundaries of what is possible in electric vehicle (EV) manufacturing. The company's strategic integration of advanced robotics and automation technologies has not only bolstered factory productivity but also significantly enhanced worker satisfaction. By delegating physically demanding tasks to machines, Tesla allows its human workforce to engage in more complex, intellectually stimulating, and rewarding activities. This approach not only boosts employee morale but also ensures that production processes are both efficient and scalable. Tesla's unwavering commitment to sustainable energy solutions has set it apart from traditional automakers. The company's focus on reducing carbon emissions and promoting renewable energy has attracted a dedicated customer base that values environmental responsibility. However, Tesla faces several challenges, including supply chain constraints, high production costs, and fierce market competition. Despite these hurdles, Tesla's relentless pursuit of innovation and strategic planning has enabled it to maintain a strong and growing market presence.

Our system aims to further support Tesla's operational objectives by optimizing inventory management and production planning. Accurate tracking of inventory levels and precise prediction of resupply times are crucial for preventing production delays caused by parts shortages. This ensures that Tesla can consistently meet customer demand in a timely manner. Additionally, providing customers with accurate and rapid information about their automobile orders enhances customer satisfaction and fosters loyalty. The ability to offer personalized setups and reliable order tracking further strengthens Tesla's reputation for excellence.

In conclusion, Tesla Motors' integration of cutting-edge technology and sustainable practices has established a new industry standard. The company's focus on data-driven decision-making and continuous innovation will be essential for its future success and ability to navigate the evolving automotive landscape.

V. Conclusion

B. Challenges Faced

Embarking on this project presented a variety of challenges that tested our analytical skills, technical knowledge, and teamwork. One of the primary challenges we faced was the complexity of Tesla's production and inventory management system. Tesla's manufacturing process involves a vast network of suppliers and an intricate assembly line that requires precise coordination. Understanding and mapping this complex system required a deep dive into various operational aspects, from sourcing raw materials to the final assembly of vehicles.

Data Integration and Accuracy: One significant hurdle was the integration and accuracy of data. Tesla's operations generate a massive amount of data from different sources, including supply chain logistics, production line performance, and customer orders. Integrating this disparate data into a cohesive system was challenging. We had to ensure that the data was accurate, up-to-date, and compatible across different platforms. This required meticulous data cleaning and validation processes to avoid inconsistencies that could lead to erroneous predictions and planning. Technical Challenges: On the technical side, developing advanced algorithms for inventory management and production planning was a significant challenge. These algorithms needed to be both sophisticated and efficient, capable of handling large datasets and providing real-time insights. We had to ensure that our models were scalable and could adapt to changes in production volume and market demand. This required extensive testing and iterative improvements to refine the algorithms and ensure their reliability. Team Coordination: Lastly, coordinating efforts within our team was essential but challenging. Effective communication and collaboration were crucial for the success of this project. With each team member bringing different expertise and perspectives, we had to ensure that everyone was aligned and working towards the same goals. This involved regular meetings, clear documentation of progress, and a collaborative approach to problem-solving.

In conclusion, the challenges we faced in this project were multifaceted and required a combination of technical expertise, strategic planning, and effective teamwork. Overcoming these challenges not only deepened our understanding of Tesla's operations but also equipped us with valuable skills and insights that will be beneficial in our future endeavors. The experience underscored the importance of adaptability, precision, and collaboration in tackling complex real-world problems and driving innovation in a competitive industry.

V. Conclusion

C. Lessons Learned

JUDAY| Jasper Eric Maraño

Reflecting on our project, I have developed a profound appreciation for the complexity and importance of optimizing production and inventory management in a high-tech industry like automotive manufacturing. The integration of advanced data models and algorithms to streamline operations not only enhances efficiency but also plays a crucial role in meeting customer expectations. This experience has deepened my understanding of how data-driven decisions impact real-world business scenarios and has equipped me with valuable skills in database management and systems analysis. I have learned that precision and attention to detail are essential for the success of such systems. The project also highlighted the importance of adaptability and responsiveness to dynamic market conditions and technological advancements.

JUDAY| Uriel Geian Besa

This project has been an enlightening journey into the intricacies of the automotive industry and the pivotal role of technology in driving innovation. Working on the Tesla case study, I realized the importance of robust data management systems in ensuring smooth operations and timely deliveries. The challenges we addressed, such as inventory optimization and build time calculation, have reinforced my problem-solving abilities and highlighted the significance of teamwork in tackling complex business problems. Additionally, the project has taught me the value of clear communication and collaboration, as working closely with my team was essential for developing effective solutions. This experience has also shown me the impact of strategic decision-making and how technology can be leveraged to achieve operational excellence and customer satisfaction.

JUDAY| Dhan Micheal Tamparong

Participating in this project has been a remarkable learning experience. It underscored the significance of precise data handling and system integration in enhancing productivity and customer satisfaction. The Tesla case study provided a real-world context to apply theoretical knowledge, especially in developing data models that support strategic decision-making. This project has not only improved my technical skills but also emphasized the importance of adaptability and continuous learning in a rapidly evolving industry. The ability to quickly adjust to new information and challenges is crucial, and this project has prepared me to face similar situations in my future career. The experience also highlighted the importance of sustainability and innovation in shaping the future of the automotive industry, inspiring me to pursue further advancements in these area.

V. Conclusion

D. Future Enhancements

To sustain its competitive advantage and continue its impressive growth trajectory, Tesla should focus on several strategic initiatives:

I. Increase Production Capacity: With the rising global demand for Tesla vehicles, it is imperative for the company to invest in new production facilities and upgrade existing ones. Expanding production capacity will help meet the growing customer demand, reduce the strain on current production lines, and lead to more efficient operations and shorter delivery times. Strategic location of new facilities could also reduce transportation costs and improve supply chain logistics.

II. Strengthen Supply Chain Resilience: Developing stronger relationships with suppliers and diversifying the supply chain are critical steps to mitigate risks associated with parts shortages and disruptions. By establishing multiple sources for critical components, Tesla can ensure a more stable and reliable supply of parts, reducing the risk of production delays. Additionally, Tesla could invest in predictive analytics to anticipate and manage potential supply chain disruptions proactively.

III. Invest in Research and Development: Continuous innovation is essential for staying ahead of the competition in the fast-evolving automotive industry. Tesla should continue to invest heavily in research and development, particularly in areas such as battery technology, autonomous driving features, and the development of new vehicle models. Advancements in these areas will not only enhance the performance and appeal of Tesla vehicles but also reinforce Tesla's reputation as an industry leader. Collaborating with academic institutions and other technology companies could further accelerate innovation.

IV. Enhance Customer Service: As Tesla's customer base expands, implementing more robust customer service protocols and support systems becomes increasingly important. Improving customer service will address issues or concerns more effectively, leading to higher customer satisfaction and loyalty. Expanding customer service teams, improving response times, and providing more comprehensive support resources, including online self-service options, will enhance the overall customer experience.

V. Maintain a Focus on Sustainability: Tesla should continue to integrate sustainable practices across its production processes and supply chain. This includes using renewable energy sources for manufacturing, reducing waste, and ensuring that suppliers adhere to sustainable practices. Strengthening Tesla's commitment to sustainability will benefit the environment and enhance the company's brand image among eco-conscious consumers. Implementing circular economy principles, such as recycling batteries and using eco-friendly materials, could further bolster Tesla's sustainability efforts.

FINAL PAPER

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