Project Implementation Phase

Project Activities & Implementation Plan

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Team ID	LTVIP2026TMIDS34838
Project Name	EV Charge and Range Visualization Platform
Maximum Marks	4 Marks

Introduction

To accomplish the EV Charge and Range Visualization Platform, we have to complete all the activities listed below. This document provides a comprehensive implementation plan covering data collection, database integration, visualization development, and web application deployment. Each phase is designed to build upon the previous, ensuring a systematic approach to delivering a fully functional visualization tool.

Phase 1: Data Collection

Data collection is the foundation of any visualization project. For the EV Charge and Range Analysis platform, we need comprehensive datasets covering vehicle specifications, charging infrastructure, and environmental factors that affect range predictions.

Activity 1.1: Collect the Dataset or Create the Dataset

The following datasets will be collected or created for the project:

Dataset Category	Data Elements	Source / Method
EV Specifications	Model, Make, Year, Battery Capacity (kWh), EPA Range, Efficiency (mi/kWh), Charging Speed, Connector Type	EPA database, manufacturer websites, EV specification databases
Charging Stations	Station ID, Location (Lat/Long), Address, Charger Type, Power Output, Connector Types, Availability Status, Network Operator, Pricing	OpenChargeMap API, PlugShare, Alternative Fuels Data Center
Range Factors	Temperature Impact, Elevation Impact, Speed Impact, HVAC Usage Impact, Tire Pressure Impact, Wind Resistance Factors	Research papers, EV forums, real-world testing data
Weather Data	Temperature, Humidity, Wind Speed, Precipitation, Weather Conditions	OpenWeather API, WeatherAPI, historical weather databases

Dataset Category	Data Elements	Source / Method
Route/Elevation Data	Route Coordinates, Distance, Elevation Profile, Terrain Type, Traffic Patterns	Google Maps API, OpenStreetMap, OpenElevation API
Historical Usage	Trip Distance, Energy Consumed, Average Speed, Temperature, Start SOC, End SOC, Route Type	Synthetic data generation based on real-world patterns, EV telemetry datasets

Phase 2: Database / Spreadsheet Connection

This phase involves understanding the collected datasets, preparing them for analysis, and establishing connections between Tableau and the data sources. Proper data organization ensures efficient querying and visualization development.

Activity 2.1: Understand the Dataset

Before importing data, we need to thoroughly understand each dataset:

1. Data Dictionary Creation: Document each field name, data type, description, valid values, and relationships between tables.
2. Data Quality Assessment: Identify missing values, outliers, duplicates, and inconsistencies in the collected data.
3. Relationship Mapping: Define primary keys, foreign keys, and cardinality between related tables (EV models, charging stations, trips).
4. Business Rules Documentation: Identify any business logic that needs to be applied (e.g., range calculation formulas, efficiency thresholds).

Activity 2.2: Import Dataset into the Database

Data import process involves the following steps:

1. Database Schema Design: Create normalized table structures with appropriate data types, indexes, and constraints.
2. Data Cleaning: Apply transformations to handle missing values, standardize formats, and correct inconsistencies.
3. Data Loading: Import cleaned data into PostgreSQL/MySQL database using bulk insert operations or ETL tools.
4. Data Validation: Verify record counts, check referential integrity, and run sample queries to confirm successful import.

Database Schema Overview

Table Name	Key Fields	Purpose
ev_models	model_id (PK), make, model, year, battery_kwh, epa_range, efficiency	Store EV specifications for range calculations
charging_stations	station_id (PK), name, latitude, longitude, charger_type, power_kw, status	Charging infrastructure locations and details
trip_records	trip_id (PK), model_id (FK), distance_km, energy_used, avg_speed, temp_c, start_soc, end_soc	Historical trip data for analysis
range_factors	factor_id (PK), factor_name, temp_range, impact_percentage	Range adjustment factors by condition
weather_data	weather_id (PK), location, date, temp, humidity, wind_speed, condition	Weather conditions for range adjustments

Activity 2.3: Connect Tableau Desktop to Database Server

Establishing the connection between Tableau Desktop and the database:

1. Connection Setup: Open Tableau Desktop, select the appropriate connector (PostgreSQL/MySQL), enter server credentials, and test the connection.
2. Data Source Configuration: Select the database, choose relevant tables, and define joins between related tables.
3. Data Model Creation: Create relationships in Tableau's data model pane, defining cardinality and referential integrity.
4. Extract vs Live Connection: Configure data extract for better performance with large datasets, or use live connection for real-time data needs.

Phase 3: Visualizing and Analysing Data

This phase transforms raw data into meaningful visualizations that address specific business questions. Effective visualization helps users understand EV range factors, make informed decisions, and reduce range anxiety.

Activity 3.1: Understand the Data and the Business Questions

Key business questions that the visualizations will address:

BQ #	Business Question	Data Required
BQ-1	How does temperature affect EV range across different models?	Trip records, weather data, EV models, range factors
BQ-2	Which areas have insufficient charging infrastructure?	Charging stations, geographic data, trip patterns

BQ #	Business Question	Data Required
BQ-3	What is the real-world vs EPA range comparison?	EV models, trip records, efficiency data
BQ-4	How does driving speed impact energy consumption?	Trip records, speed data, energy consumption
BQ-5	What factors contribute most to range reduction?	Range factors, trip conditions, efficiency metrics
BQ-6	What are the optimal charging stop locations for long trips?	Charging stations, route data, EV range data

Activity 3.2: Based on the Business Questions Develop the Different Visualizations

The following visualizations will be developed to address the business questions:

Visualization Type	Chart Type	Purpose & Insights
Range Circle Map	Geographic Map	Visualize achievable driving distance from current location based on battery level and conditions
Temperature Impact Analysis	Line Chart / Heat Map	Show range variation across temperature ranges with model comparison capability
Charging Station Density	Filled Map / Heat Map	Identify charging infrastructure gaps and high-density charging areas
Range Factor Breakdown	Pie Chart / Bar Chart	Display percentage impact of each factor (weather, speed, terrain, HVAC) on range
Speed vs Efficiency	Scatter Plot / Line Chart	Correlation between driving speed and energy consumption with optimal speed indicator
EPA vs Real-World Range	Bar Chart / Bullet Chart	Compare manufacturer-rated range with actual observed range across conditions
Battery Health Trend	Area Chart / Line Chart	Track battery degradation over time and its impact on maximum achievable range
Charging Time Estimator	Gauge Chart / Combo Chart	Display estimated charging time based on current SOC, target SOC, and charger power
Elevation Impact Profile	Dual-Axis Line Chart	Show route elevation profile alongside predicted range consumption
Model Comparison Tool	Radar Chart / Parallel Coordinates	Compare multiple EV models across range, efficiency, charging speed, and price

Activity 3.3: Dashboard - Develop the Dashboard

The main dashboard will integrate multiple visualizations for comprehensive range analysis:

1. Primary Dashboard: Range Overview Dashboard - Central view showing current vehicle status, range circle map, battery gauge, and key range factors.
2. Secondary Dashboard: Charging Infrastructure Dashboard - Map-based view of charging stations with availability, pricing, and route integration.
3. Analytics Dashboard: Range Factor Analysis Dashboard - Detailed breakdown of factors affecting range with trend analysis and comparisons.
4. Interactive Filters: Model selector, temperature range slider, battery level input, route type filter, and date range picker.
5. Dashboard Actions: Implement URL actions for navigation between dashboards, filter actions for cross-dashboard interactivity, and highlight actions for data exploration.

Activity 3.4: Story - Develop the Storyboard

The storyboard will guide users through a narrative journey of understanding EV range:

1. Story Point 1: Introduction to Range Anxiety - Overview of the problem and why accurate range prediction matters.
2. Story Point 2: Understanding Your Range - Interactive demonstration of how different factors affect EV range.
3. Story Point 3: Temperature Impact Deep Dive - Seasonal variations and how to plan for weather conditions.
4. Story Point 4: Charging Infrastructure Landscape - Where to find chargers and how to plan charging stops.
5. Story Point 5: Route Planning Mastery - How to plan efficient routes considering range and charging.
6. Story Point 6: Battery Health Matters - Understanding degradation and maintaining battery longevity.
7. Story Point 7: Model Comparison Insights - Choosing the right EV based on range characteristics.
8. Story Point 8: Key Takeaways and Tips - Summary of best practices for maximizing EV range.

Phase 4: Publishing to Tableau Public & Web Application Integration

The final phase involves publishing the completed visualizations to Tableau Public and integrating them into a custom web application for end-user access.

Activity 4.1: Publish to Tableau Public Account

Steps to publish visualizations, dashboards, and stories:

- Account Setup: Create or log into Tableau Public account (free tier with public visibility).
- Workbook Preparation: Ensure all data sources are extract-based (live connections not supported in Public), optimize performance, and test interactivity.
- Publish Process: Select 'Save to Tableau Public' from Tableau Desktop, choose workbook name, set privacy options, and initiate upload.
- Verification: Confirm successful publish, test all visualizations in browser, and verify interactivity and filters work correctly.

Activity 4.2: Obtain Shareable Links

Once published, the following shareable resources will be available:

- Workbook Link: Direct URL to the complete workbook with all dashboards and stories.
- Individual Dashboard Links: Specific URLs for each dashboard for targeted embedding.
- Story Links: Direct links to the narrative storyboard for guided analysis.
- Embed Code: HTML iframe snippets for embedding visualizations in web pages with customizable dimensions.

Activity 4.3: Develop a Web Application Using HTML, CSS or Bootstrap

The web application will serve as the user-facing platform for the EV Range Visualization tool:

Web Application Structure

Page/Section	Content & Features
index.html (Home)	Project introduction, key features overview, quick access to dashboards, navigation menu with Bootstrap responsive design
range-dashboard.html	Embedded Range Overview Dashboard with iframe, contextual information, usage instructions
charging-map.html	Charging Infrastructure Dashboard embedded, legend explanations, station type filters
range-analysis.html	Range Factor Analysis Dashboard, factor explanations, tips for range optimization
story.html	Complete storyboard embedded with navigation controls, chapter overview sidebar
about.html	Project background, methodology, data sources, team information, contact details

Technology Stack for Web Application

- HTML5: Semantic markup for page structure and content organization.

- CSS3: Custom styling with responsive design, flexbox/grid layouts, animations, and transitions.
- Bootstrap 5: Framework for responsive navigation, cards, modals, buttons, and grid system.
- JavaScript: Interactive elements, dynamic content updates, and Tableau API integration.

Activity 4.4: Integrate the Visualizations, Dashboard and Story with the Web Application

Integration approach using Tableau's embedding capabilities:

Embedding Methods

- iframe Embedding: Simple HTML iframe tags with shareable link from Tableau Public.
- JavaScript API: Tableau JavaScript API for programmatic control, filtering, and event handling.
- Responsive Embedding: CSS-based responsive containers that adjust visualization size based on screen dimensions.

Integration Features

- Cross-Dashboard Navigation: Links between different dashboards within the web application.
- Parameter Passing: URL parameters to pre-filter visualizations based on user selection.
- Mobile Optimization: Touch-friendly interface and responsive layouts for smartphone and tablet users.
- Loading States: Visual feedback during visualization loading with spinners or placeholder content.

Activity Timeline Summary

Phase	Activities	Timeline
Phase 1	Data Collection - Collect/Create Dataset	Week 1-3
Phase 2	Database Connection - Understand, Import, Connect Tableau	Week 4-6
Phase 3	Visualization - Business Questions, Charts, Dashboard, Story	Week 7-9
Phase 4	Publishing & Integration - Tableau Public, Web Application	Week 10-12