School of Information and Communication Technology

Griffith University

7821ICT

Green City Situation Awareness

Project Proposal

Proof of Concept Demonstrator for Sustainable Transport

16/08/2024 T2 2024

Industry Partner: City of Gold Coast

Client: **Phillip Karfs and Vanessa Fernandes**

Team members:

Omkar Dhananjay Kulkarni (s5325810)

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Revision History

Date	Version	Author(s)	Comments
31/07/2024	1	Viet An Nguyen	v1.0
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01/09/2024	6	Omkar Dhananjay Kulkarni & Vlesetty Vishal Kumar	v1.6

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1. INTRODUCTION

1.1. Project Overview

This proposal aims to deliver a proof-of-concept demonstrator for the City of Gold Coast, analysing the impact of the Queensland Government's super-cheap public transport initiative on traffic patterns and CO_2 emissions. By leveraging existing big data, including IoT stream data, the project will provide real-time insights into changes in road and public transport usage. The outcome will be a dashboard, empowering the client with actionable information regarding sustainability and traffic management.

The key activities of the project include:

- **Road Traffic Situation Awareness:** Analyse Road traffic patterns before and after the implementation of the 50c transport fare.
- **Public Transport Usage Comparison:** Compare public transport data for the month of July before and after the initiative to understand shifts in commuter behaviour.
- **Prediction for Future Trends:** Utilise predictive models to forecast public transport usage and road traffic patterns over the next 5 months of the trial.
- **September Data Analysis:** Compare the predictions for September with actual data to evaluate the accuracy of our forecasts.
- **Prediction Fine-Tuning:** Based on the September comparison, refine and fine-tune the predictive models for the remaining 4 months of the initiative.

This approach will not only help assess the effectiveness of the public transport fare initiative but also support the city’s long-term planning efforts for sustainable transport solutions.

Client Organisation: City of Gold Coast
Client Name(s): Phillip Karfs
Designations: A/Coordinator Network Intelligence and Transport Systems
Email Addresses: pkarfs@goldcoast.qld.gov.au

1.2. Team Overview

Project Manager: Omkar Dhananjay Kulkarni (s5325810)
Omkar Kulkarni, as the Team Leader, holds primary responsibility for the project's strategic direction and execution. Omkar's role encompasses overseeing data analysis processes, ensuring effective utilisation of data, and developing data-driven solutions. As the primary client liaison, Omkar facilitates communication to understand client needs, gather feedback, and ensure that deliverables meet or exceed expectations. Additionally, Omkar coordinates all project activities, manages timelines, and ensures milestones are met, including resource allocation and risk management.

Data Scientist and Business Intelligence (BI) Specialist: Vishal Kumar (s5314434)
Reporting to Omkar, Vishal Kumar focuses on applying statistical methods and machine learning techniques to Analyse data, derive insights, and develop predictive models. Vishal is also responsible for designing and implementing Business Intelligence solutions, creating dashboards, reports, and visualisations that support decision-making processes. As a quality liaison, Vishal oversees the planning and execution of comprehensive testing strategies to ensure the quality and reliability of project deliverables.

Data Scientist and Assessor Liaison: Viet An Nguyen (s5321461)
Viet An Nguyen contributes to the analysis and interpretation of data, similar to Vishal Kumar, but with a focus on specific aspects or datasets as required by the project. Viet An also handles project documentation, including creating reports, data dictionaries, and user manuals, to ensure transparency and facilitate knowledge transfer within the team and to stakeholders.

Geospatial Analyst and Developer: Zhanrui Liao (s5290972)
Zhanrui Liao is responsible for conducting spatial analysis to integrate geospatial data into the project, analysing geographic patterns, relationships, and trends. Zhanrui also designs and creates interactive dashboards to visualise geospatial data and other project metrics, providing accessible and user-friendly formats for stakeholders and clients.

1.3. Definitions and Acronyms

Acronym	Definition
AI	Artificial Intelligence
BI	Business Intelligence
DBT	Data Build Tool – An open-source command line tool that helps transform data in a data warehouse.
QGIS	Quantum Geographic Information System – An open-source geospatial tool used for mapping and spatial analysis.
Python	A versatile programming language used for data analysis, modelling, and development.
Tableau	A data visualisation tool used for creating interactive and shareable dashboards.
Sidra	A traffic modelling and analysis tool for simulating traffic flows and evaluating intersection performance.
Paws DBT	A variant of DBT, used specifically for data transformation workflows.
Snowflake	A cloud-based data warehouse platform used for data storage and analytics.
IoT	Internet of Things – A network of interconnected devices that communicate and exchange data.
CO_2	Carbon Dioxide – A greenhouse gas primarily emitted through human activities like transportation and industrial processes.
City	The local government authority for Gold Coast, Queensland, Australia

2. PROJECT VISION

2.1 PRODUCT VISION

Green City Situation Awareness Dashboard **is**:

For: City of Gold Coast

Who: Need real-time insights and predictive analytics to support data-driven decisions for improving city operations and advancing sustainability goals

The: Green City Situation Awareness Dashboard

Is a: Interactive dashboard platform

That: Analyses current transport and infrastructure data, compare past and present trends, forecasts, and provides insights on changes in public transport usage and road congestion to support the city's green initiatives.

Unlike: Traditional monitoring systems

Our product: Integrates predictive analytics and data mining tools to identify and validate changes in key metrics and forecast future conditions, providing actionable insights that align with the city's environmental and sustainability objectives.

2.2 CUSTOMERS AND BENEFITS

Customer Problems:

1. **Limited Real-Time Insights:** City executives and planners lack a unified platform that provides comprehensive, real-time situational awareness, which hinders effective decision-making.
2. **Inability to Forecast Future Trends:** Current systems focus on historical data and immediate information but fail to provide accurate forecasts and predictive insights necessary for long-term planning.
3. **Data Overload and Complexity:** Planners struggle with the complexity and volume of big data, making it challenging to extract actionable insights aligned with sustainability and Green City objectives.
4. **Disconnected Data Sources:** Different departments (transport, environment, etc.) often work in silos, leading to inefficient cross-departmental communication and decision-making.

Solutions:

1. **Real-Time Data Integration and Geospatial Visualisation:** The Green City Situation Awareness Dashboard aggregates IoT data streams and infrastructure

utilisation data into a single platform, offering real-time situational awareness. The dashboard also displays geospatial data insights visually, simplifying complex data for easy interpretation and swift action.

2. **Forecasting and Predictive Analytics:** The platform leverages data mining tools to forecast trends and predict conditions for up to six months (duration of the reduced public transport fare), enabling proactive planning and decision-making. This is crucial for development of more intelligent and adaptive transport systems by anticipating future conditions.
3. **Green City Alignment:** The platform suggests potential solutions that align with the city's Green City initiatives, such as optimising public transport routes to reduce emissions or improving traffic flow for better energy efficiency.

Product Benefits:

1. **Improved Decision-Making:** The dashboard provides a holistic view of city operations, enabling quicker, more informed decisions.
2. **Proactive Planning:** Predictive analytics offer a forward-looking view, allowing planners to anticipate challenges and optimise solutions months in advance.
3. **Enhanced Coordination:** The platform breaks down silos by offering integrated insights, fostering collaboration across departments.
4. **Support for Green Initiatives:** Data-driven recommendations directly contribute to sustainability goals, aiding in the transition to a greener city.

Customer/User Groups:

1. **Urban Planners and Analysts:**
    a) **Primary Characteristics:** Professionals aged 30-50, often with backgrounds in urban planning, civil engineering, or environmental studies. They are experienced in data analysis and city planning, often holding degrees in related fields.
    b) **Benefits:** The ability to leverage real-time and predictive data for planning and optimising city infrastructure, transport, and environmental initiatives.
2. **Transport Division Staff:**
    a) **Primary Characteristics:** Operations managers and data analysts aged 30-50, with a focus on transport systems, infrastructure management, and traffic control.

b) **Benefits:** Enhanced tools for monitoring traffic flows, optimising transport routes, and reducing congestion, which contributes to more efficient and sustainable transport operations.

3. **Sustainability and Environmental Officers:**
    a) **Primary Characteristics:** Mid-career professionals aged 35-55, with expertise in environmental science, sustainability, and policy implementation. They are typically well-versed in using data for promoting eco-friendly initiatives.
    b) **Benefits:** Insights into how transport and infrastructure data can be utilised to meet environmental targets and support Green City initiatives, helping them craft data-driven sustainability strategies.

2.3 KEY FACTORS TO JUDGE QUALITY

The following are the key areas that define quality and differentiate the product:

1. **Real-Time Insights and Predictive Analysis**: The platform is capable of real-time data ensuring that the stakeholders have the most current information available. The solution can forecast trends up to six months in advance, helping decision-makers plan for future scenarios, whether it's managing traffic flow, optimising public transport, or supporting infrastructure planning. Forecasting models with a prediction accuracy above 85%, will help the city make informed long-term decisions.
2. **Data Integrity and Security**: High standards of data quality and security ensure that the insights provided are accurate and trustworthy, especially critical when dealing with sensitive city infrastructure data. Ensuring at least 95% accuracy in data aggregation and transformation processes is a way to quantify this factor.
3. **Intuitive Dashboard and User Interface**: A user-friendly interface with customisable dashboards that cater to different user groups (e.g., city planners, transport managers) improves user adoption and satisfaction.
4. **Competitive Differentiation**:
    - Geospatial Analysis: The platform offers advanced geospatial analytics and visualisation capabilities tailored to urban planning and transport management, providing a unique edge.
    - Alignment with Green City Initiatives: The platform uniquely aligns with the City of Gold Coast's Green City goals, offering data-driven recommendations specifically focused on sustainability, emission reduction, and resource efficiency.

- Scalability: The platform is easily scalable as the city's data needs evolve, making it future-proof and adaptable to changing requirements.

5. **Financial Capability**: By using open-source tools like QGIS, the platform is more cost-effective compared to proprietary systems while still delivering high performance and flexibility.
6. **Faster Implementation**: The platform will be deployed and be functional within 4-5 weeks showing real-time impact of the reduced fares, change in CO_2 levels and the correlation between emissions and use of public transport.

2.4 KEY FEATURES AND TECHNOLOGY

To successfully deliver the Green City Situation Awareness solution, a robust combination of advanced data technologies and geospatial tools is essential. The project aims to harness large volumes of real-time and historical data, leveraging these insights to predict trends, visualise transport patterns, and support decision-making for urban planning and sustainability. By integrating cloud-based infrastructure, machine learning, and geospatial analytics, the solution will offer city planners and decision-makers a comprehensive view of the city's transport dynamics, helping them to manage resources efficiently and meet Green City goals. Below is an overview of the key technologies and specific features required to achieve this vision.

Key Technologies:

- **Snowflake:** For cloud-based data warehousing, scalable storage, and real-time data processing.
- **SQL:** For data querying, analysis, and transformation.
- **Tableau:** For creating interactive, user-friendly dashboards and data visualisations.
- **QGIS:** For geospatial mapping and spatial analysis.
- **Python:** For machine learning, predictive analytics, and data manipulation.
- **Sidra:** For traffic flow modelling, intersection design analysis, and evaluating environmental impacts of transport systems.
- **Paws DBT:** For efficient data transformation and pipeline management.

Required Features:

- **Real-Time Data Processing:** Integration of IoT stream data for real-time situation awareness.
- **Predictive Analytics Module:** Predicting traffic trends and public transport utilisation over the next six months.
- **Geospatial Visualisation:** Displaying live and predictive data on interactive maps for city planners.

- **Customisable Dashboards:** Tailored views for different stakeholders, offering role-specific insights.
- **Historical Data Analysis:** Tracking and analysing historical data trends for informed decision-making.
- **Sustainability Metrics Tracking:** Monitoring environmental impacts like CO_2 emissions to support Green City initiatives.
- **Scalable Architecture:** Ensuring easy expansion as new data sources and IoT devices are integrated over time.

Product Backlog:

Real-Time Situation Awareness Dashboard:

- **Key Technology:** Geospatial visualisation (QGIS, Tableau) and real-time data processing (Snowflake, SQL).
- **Customer Benefit:** Provides city planners and transport managers with real-time visual insights into traffic flow, congestion hotspots, and public transport usage, enabling timely and data-driven decision-making for managing urban mobility.

Predictive Analytics and Trend Forecasting:

- **Key Technology:** Python for machine learning and statistical modelling.
- **Customer Benefit:** Predicts traffic trends and transport utilisation for the next six months, helping city planners anticipate challenges and optimise resource allocation, thereby improving long-term urban planning and reducing traffic-related issues.

Data Integration and Cloud-Based Solutions:

- **Key Technology:** Snowflake for scalable cloud data warehousing.
- **Customer Benefit:** Seamlessly integrates IoT data streams with existing cloud-based systems and the city's Digital City Program, ensuring scalability and compatibility while reducing operational silos and improving cross-departmental collaboration.

Sustainability and Green City Initiatives:

- **Key Technology:** Python-based sustainability metrics and Sidra to evaluate the impact of changing transport policies on traffic flow and CO_2 emissions.
- **Customer Benefit:** Aligns transport and infrastructure decisions with the city's Green City goals by providing data-driven recommendations for reducing emissions and improving resource efficiency, supporting sustainable urban development.

User-Friendly and Customisable Interface:

- **Key Technology:** Role-based access controls and customisable dashboards (Tableau).

- **Customer Benefit:** Enhances user experience by offering intuitive, role-specific dashboards that allow different stakeholders (city planners, transport managers) to access and analyse the data most relevant to them, improving usability and decision-making efficiency.

Historical Data Analysis:

- **Key Technology:** Time-series analysis in SQL and Python.
- **Customer Benefit:** Enables users to track historical trends in transport data, providing valuable insights for long-term planning, infrastructure improvements, and risk management.

Scalability and Modular Architecture:

- **Key Technology:** Snowflake and Sidra for design and data integration.
- **Customer Benefit:** Ensures the solution can grow alongside the city's expanding IoT infrastructure, easily handling increasing volumes of data and adding new features over time without disrupting existing operations.

2.5 GENERATIVE AI

1. Usage of Generative AI:

Yes, generative AI will be used in this project, but only in specific circumstances:

- **Documentation Support:** Generative AI will be utilised to assist with drafting reports, writing technical documentation, and preparing project summaries. This will include generating content outlines, enhancing language clarity, and ensuring consistency in technical documentation.
- **Data Manipulation and Analysis of Open-Source Data:** Generative AI tools will be employed to assist with processing and manipulating open-source datasets. This may include tasks like generating synthetic data for testing models, enhancing data readability, or offering data-driven insights based on preliminary analysis.

2. Privacy and Intellectual Property (IP) Concerns:

When using generative AI, several key privacy and IP issues need to be considered:

- **Data Privacy:** It's critical to ensure that no sensitive or proprietary data is input into generative AI models unless it has been anonymised or is permissible under data protection guidelines. This helps prevent unauthorised exposure of confidential data.
- **IP Rights and Ownership:** Any content generated using AI might present IP concerns, especially regarding the ownership of AI-generated content. It is important

to clarify ownership rights over generated materials, ensuring that the outputs remain the intellectual property of the project and the City of Gold Coast.

- **Compliance with Licensing:** When utilising open-source data or tools, we must ensure compliance with the associated licenses. Generative AI must be used in a way that respects these licenses, ensuring that no restrictions are violated when incorporating generated content into the project.

3. Ensuring Responsible and Ethical AI Usage:

To ensure responsible and ethical use of generative AI in the project, the following measures will be implemented:

- **Transparency and Accountability:** All uses of generative AI will be transparent to the client. AI-generated content will be reviewed to ensure accuracy, relevance, and alignment with project goals.
- **Data Integrity and Anonymisation:** Before inputting any data into generative AI tools, we will ensure that it is anonymised where necessary and complies with all privacy regulations to avoid unintended breaches.
- **Ethical Use Guidelines:** We will adhere to best practices for AI usage, ensuring that AI-generated outputs are ethical, unbiased, and free from harmful content. Regular checks will be in place to ensure that AI tools are not used in a manner that could result in unintended consequences or biased outcomes.
- **Clear Documentation of AI-Generated Work:** Any sections of the project documentation or data manipulation generated with AI assistance will be clearly noted, allowing full transparency in the development process.

2.6 OTHER PRODUCT FACTORS

Interaction with Associated Systems/Products: The solution must seamlessly integrate with existing platforms such as the city's Digital City Program, data portal, cloud infrastructure, and IoT systems, ensuring compatibility with other data management tools and dashboards used by city planners.

Physical Environment: The solution will be deployed in a cloud environment, but consideration must be given to how data is captured from physical urban environments, including sensors, traffic systems, and public transport networks.

Patent Infringement/Protection: Any algorithms, software components, or methodologies used must not infringe on existing patents. If new innovations arise from the project, there should be a strategy in place for protecting intellectual property.

Safety and Liability: The data and insights provided by the system must be accurate and reliable, especially if used for critical decision-making like traffic management or emergency

responses. Liability concerns must be addressed in the case of inaccurate predictions or faulty data leading to adverse decisions.

Ergonomics: The user interface must be intuitive and user-friendly, accommodating users with different levels of technical expertise. Accessibility features should be considered to ensure inclusivity.

Users' Abilities: The solution should be designed with diverse user groups in mind, including those with limited technical knowledge. Training and onboarding will be critical to ensure all stakeholders can effectively use the system.

Distribution: The system's outputs (e.g., dashboards, reports) must be easily distributed and shared across different departments within the City of Gold Coast. Considerations for secure data sharing with external partners should also be included.

Documentation, Training, Servicing, and Maintenance: Comprehensive documentation, including user manuals and technical guides, must be provided. Ongoing training, support, and servicing plans should be available for city employees and technical staff.

These non-functional factors are essential to ensure the long-term success, scalability, and usability of the Green City Situation Awareness solution.

2.7 SUCCESS CRITERIA FOR CLIENT

1. **Evaluate the Impact of Fare Change**
    A. **Description:** Assess the overall effect of the 50c fare reductions on public transport usage and road traffic patterns.
    B. **Priority:** High (1)
    C. **Measurement:**
        i. **Metric:** Change in public transport usage (number of trips), CO_2 emissions (grams per passenger-kilometre), and traffic flow (vehicles per hour).
        ii. **Target:** Detect any significant change (increase or decrease) in public transport ridership and road traffic flow.
    D. **Testable:** Conduct a comparative analysis of pre- and post-fare change data to identify shifts in public transport usage and road congestion. Deliver a report summarising the findings and validating the presence or absence of changes in these metrics.
2. **Prediction for Future Trends**
    A. **Description:** Utilise predictive models to forecast public transport usage and road traffic patterns over the next 5 months of the initiative.
    B. **Priority:** High (2)

C. **Measurement:**
   i. **Metric:** Utilise predictive models to forecast public transport usage and road traffic patterns over the next 5 months of the trial.
   ii. **Target:** Identify predicted trends (increase, decrease, or no change) in public transport usage and road traffic congestion over the forecasted period.

D. **Testable:** Generate predictive models and provide forecasted data, highlighting anticipated changes or stability in usage and congestion patterns.

3. **September Data Analysis**

A. **Description:** Compare the predictions for September with actual data to evaluate the accuracy of the forecasts.

B. **Priority:** Medium (3)

C. **Measurement:**
   i. **Metric:** Difference between predicted and actual values for public transport ridership and road traffic congestion.
   ii. **Target:** Determine whether the predictions align with actual data, indicating accurate or inaccurate forecasts.

D. **Testable:** Conduct a comparative analysis between predicted and actual September data to validate the predictive model's performance and identify areas of alignment or deviation.

4. **Prediction Fine Tuning**

A. **Description:** Refine and fine-tune the predictive models based on the September comparison to improve accuracy for the remaining 4 months of the initiative.

B. **Priority:** Medium (4)

C. **Measurement:**
   i. **Metric:** Updated predictions for public transport usage and road traffic congestion.
   ii. **Target:** Identify adjustments in the predictive model that result in improved or unchanged accuracy for future forecasts.

D. **Testable:** Implement model refinements based on September data and provide updated forecasts, evaluating the impact of changes made to the predictive approach.

3. REQUIREMENTS

Software Requirements:

1. **Snowflake:** The system must integrate with Snowflake for data warehousing and cloud-based data storage, ensuring scalable and efficient data management. We have received datasets related to transport and traffic from the existing Snowflake environment, ensuring scalable and efficient management of city-specific data.
2. **SQL:** Utilise SQL for querying and managing relational data (also in snowflake), facilitating robust data manipulation and extraction from various sources.
3. **Tableau:** Employ Tableau for data visualisation, enabling the creation of interactive and insightful dashboards to present key metrics and trends.
4. **QGIS:** Use QGIS for geospatial data analysis and mapping, supporting spatial data processing and visualisation.
5. **Python:** Utilise Python for data processing, analysis, and machine learning, leveraging its extensive libraries and flexibility.
6. **Sidra:** Integrate Sidra for traffic analysis and simulation, providing insights into traffic patterns and congestion.
7. **Paws DBT:** Use Paws DBT for data transformation and modelling, ensuring accurate and efficient data processing workflows.

Application Workflow:

1. **Data Acquisition:** Retrieve data from Snowflake and external sources, ensuring data integrity and compatibility for analysis.
2. **Data Pre-processing:** Conduct pre-processing tasks including cleaning, normalisation, and format conversion to prepare data for analysis.
3. **Data Analysis:** Analyse data using Python, Tableau, and Sidra to derive insights and generate actionable reports.
4. **Geospatial Mapping:** Use QGIS to create and manage geospatial maps that visualise traffic patterns and transport data.
5. **Modelling and Forecasting:** Implement predictive models using Python to forecast trends and simulate future scenarios.
6. **Dashboard Creation:** Develop interactive dashboards in Tableau to present real-time data and predictions to stakeholders.
7. **Reporting:** Generate comprehensive reports summarising findings, with detailed analysis and visualisations.

8. **Validation:** Validate data accuracy and model predictions against historical data to ensure reliability.

Functional Requirements:

1. **Data Handling:** Ability to read and process large datasets from Snowflake and SQL, ensuring efficient data management.
2. **Pre-processing Capabilities:** Conduct data cleaning and normalisation tasks to prepare data for analysis.
3. **Visualisation:** Create and manage interactive dashboards and geospatial maps using Tableau and QGIS.
4. **Predictive Modelling:** Develop and deploy predictive models using Python to forecast trends and support decision-making.
5. **Reporting:** Generate detailed reports with data insights and visualisations for stakeholder review.

Non-Functional Requirements:

1. **User Experience:** Provide an intuitive and user-friendly interface to enhance usability and accessibility.
2. **Scalability:** Design the system to handle increasing data volumes and user demands efficiently.
3. **Robustness:** Implement robust error handling and exception management to maintain system stability.
4. **Performance:** Optimise performance for fast data processing and real-time analytics.
5. **Security:** Ensure data privacy and security through secure access controls and data protection measures.
6. **Compatibility:** Ensure compatibility with various operating systems and platforms to maximise usability.
7. **Documentation:** Provide comprehensive documentation to support system deployment, use, and maintenance.

Priority	Requirements
High	Data Handling, Data Pre-processing, Predictive Modelling, Visualisation, Reporting
Medium	User Experience, Scalability, Validation
Low	Compatibility, Documentation, Performance Optimisation

4. PROJECT PLAN

1. **Project Planning**
   1.1. **Deadline:** Week 1-2
   1.2. **Tasks/Milestone:** Initial meeting to discuss project scope, objectives, and deliverables.
2. **Environment Setup**
   2.1. **Deadline:** Week 3-4
   2.2. **Tasks/Milestone:** Setting up environments with essential tools such as Snowflake, QGIS, Python, Sidra, Paws DBT, and Tableau. Ensure data access, configure tool integrations, and establish project repositories.
3. **Data Acquisition and Integration**
   3.1. **Deadline:** Week 4-6
   3.2. **Tasks/Milestone:** Retrieve and integrate transport and traffic data from Snowflake environment and Public Data about Public Transport from QLD Government Data Portal and TransLink.
4. **Data Pre-processing**
   4.1. **Deadline:** Week 6-7
   4.2. **Tasks/Milestone:** Perform data cleaning, normalisation, and format conversion.
5. **Data Analysis**
   5.1. **Deadline:** Week 7-8
   5.2. **Tasks/Milestone:** Analyse data using Python, Tableau, and Sidra to derive insights.
6. **Geospatial Mapping**
   6.1. **Deadline:** Week 8-9
   6.2. **Tasks/Milestone:** Create geospatial maps using QGIS to visualise traffic patterns and transport data.
7. **Predictive Modelling and Forecasting**
   7.1. **Deadline:** Week 9-10
   7.2. **Tasks/Milestone:** Develop and deploy predictive models to forecast trends using Python.
8. **Dashboard Creation**
   8.1. **Deadline:** Week 9-10
   8.2. **Tasks/Milestone:** Develop interactive dashboards in Tableau to present real-time data and predictions.
9. **Reporting**
   9.1. **Deadline:** Week 11-12
   9.2. **Tasks/Milestone:** Generate comprehensive reports summarising findings and analysis.
10. **Final Review and Delivery**
    10.1. **Deadline:** Week 12
        10.1.1. **Tasks/Milestone:** Present final deliverables, review project outcomes, and gather stakeholder feedback.

5. AGREEMENTS

All persons identified in this document sign the form below to indicate that they have read the Project Vision and Agreement and agree to the contents therein.

X 

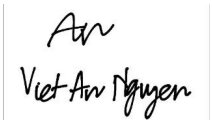
Client

X 

Omkar Dhananjay Kulkarni

X Vishal Kumar

Vlesetty Vishal Kumar

X 

Viet An Nguyen

X 

Zhanrui Liao