



**SCHOOL OF NATURAL SCIENCES**

**DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE**

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*Trogern: A Decision Intelligence Dashboard for Fleet Management*

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Programme: Bachelor of Commerce Honours in Information Systems

**THIS PROJECT IS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF  
THE BACHELOR OF COMMERCE HONOURS DEGREE IN INFORMATION SYSTEMS AT  
THE GREAT ZIMBABWE UNIVERSITY.**

**JUNE 2026**

## ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to the following individuals and organisations whose contributions made this project possible.

To Tapiwa Muzira and Guide Fari, my software development mentors, whose technical guidance and unwavering belief in my potential shaped the developer I am becoming.

To Afaq Tariq, my first employer, for giving me my first software development position. Without that opportunity, the dream of building production-grade systems would have died.

To my university supervisor, Mrs G.E. Mawere, for allowing me the creative freedom to pursue this system as a functional, real-world product rather than confining it to a pet project.

To my driving team at Trogern, whose honest feedback about where the platform fell short pushed me to build something better.

To my sister Pelagia and uncle E.Gambara, for raising me and encouraging me to pursue my education even when circumstances made it difficult.

To my wife Belinda, for patiently listening to my endless rants about this project and supporting me through the late nights.

And lastly to the Google Developer Education Africa team, for sponsoring my education, making this entire journey possible.

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# **CHAPTER 1: INTRODUCTION**

## **1.1 INTRODUCTION**

The Trogern Decision Intelligence Dashboard is a multi-tenant, web-based fleet management system designed to automate the collection, analysis, and visualisation of operational data for small-scale transport operators in Zimbabwe. The system enables fleet owners and taxi operators to record daily vehicle income, expenses, arrests, fuel consumption, mileage readings, and service history through a centralised digital platform. It replaces the fragmented, paper-based and memory-dependent record-keeping practices that currently characterise the sector with structured data capture and real-time analytical dashboards. The platform is built on modern cloud infrastructure, utilising Next.js for the frontend, Google Cloud Firestore for data persistence, and Firebase Cloud Functions for backend processing, and is delivered as a Software-as-a-Service (SaaS) product with tiered pricing designed for the economic realities of Zimbabwean small and medium-sized enterprises (SMEs).

## **1.2 BACKGROUND STUDY**

Zimbabwe's transport and logistics sector operates under conditions of chronic uncertainty. Currency instability, fluctuating fuel prices, inconsistent regulatory enforcement, and poor road infrastructure define the operating environment for small fleet owners and taxi operators across the country. The Zimbabwe National Statistics Agency (ZimStat) reported in its 2023 Economic Census that over 204,000 operational business establishments exist in Zimbabwe, of which 76.1 percent are classified as informal, with the informal economy contributing over 75 percent of national economic activity (ZimStat, 2025). Transport SMEs, particularly micro-enterprises managing between one and ten vehicles, constitute a significant portion of this informal economy.

These operators typically rely on handwritten logbooks, WhatsApp messages, and memory-based reporting to track revenue, expenses, and vehicle performance. This fragmented approach to data management produces inconsistent records, an inability to determine vehicle-level profitability, reactive rather than proactive maintenance decisions, and guesswork-based growth planning. Enterprise-grade fleet management solutions such as Geotab,

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MiX Telematics, and general-purpose business intelligence tools like Power BI and Tableau exist in abundance, but they assume conditions that Zimbabwean SMEs do not meet: clean structured data, reliable broadband connectivity, formal bookkeeping practices, and users with data literacy (Ncube, Chigede and Madzivire, 2025).

The Troger platform was conceived to bridge this gap. Developed by the researcher as a practical response to the challenges encountered in running a personal taxi business, the system was initially designed for internal record-keeping, performance tracking, and service scheduling. Over time, it evolved into a multi-tenant SaaS platform serving several paying tenants who use it for their own fleet management needs. The platform now incorporates Model Context Protocol (MCP) connectors and Claude AI skills for natural language data access, and has integrated a WhatsApp Business API chatbot that enables drivers and operators to log data through conversational messages, eliminating the need for internet data bundles or web browser access.

### **1.3 PROBLEM STATEMENT**

Small fleet operators in Zimbabwe's transport sector lack access to affordable, contextually appropriate digital tools for operational decision-making. The absence of structured data capture mechanisms means that operators cannot accurately assess individual vehicle profitability, track maintenance schedules, monitor fuel efficiency, or identify cost leakages. Existing enterprise solutions are prohibitively expensive, technically complex, and designed for data-mature organisations with formal business processes. Furthermore, even where digital tools have been introduced, a persistent challenge of data logging compliance has been observed: platform tenants and their drivers frequently fail to log their operational data consistently, rendering the analytics and decision support functions less effective. This behaviour is attributable not only to the friction associated with manual form-based data entry but critically to the cost of mobile data in Zimbabwe, which many drivers cannot afford. The platform required a data entry mechanism that operates through channels drivers already use and that does not require purchasing internet data bundles, leading to the integration of WhatsApp Business API as a zero-data-cost entry point.

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## **1.4 AIM**

The aim of this project is to design, develop, and deploy a decision intelligence dashboard system that enables small fleet operators in Zimbabwe to capture operational data digitally, visualise business performance through analytics dashboards, and make evidence-based decisions regarding vehicle profitability, maintenance scheduling, and cost management.

## **1.5 OBJECTIVES**

The objectives of the Trogern system are as follows:

1. To provide a centralised digital platform for recording daily vehicle income, expenses, fuel consumption, mileage, and service history.
2. To generate analytical dashboards that display profit and loss summaries, weekly and monthly trends, cost-per-kilometre metrics, and vehicle profitability rankings.
3. To implement service scheduling alerts based on mileage thresholds to support proactive maintenance planning.
4. To deliver the system as a multi-tenant SaaS platform with tiered pricing accessible to micro and small fleet operators.
5. To integrate AI-powered interfaces, including MCP connectors and a WhatsApp Business API chatbot, to reduce data entry friction and eliminate data cost barriers for drivers.

## **1.6 SCOPE**

The Trogern system is scoped to serve small fleet owners and taxi operators in Masvingo Province, Zimbabwe, who manage between one and ten vehicles. The platform currently hosts between five and fifteen active tenants managing a combined fleet of approximately twenty to fifty vehicles. The system covers the following functional areas: vehicle registration and management, daily income and expense logging, fuel and mileage tracking, service and maintenance logging, analytics computation and dashboard visualisation, AI-assisted data entry through MCP connectors, and WhatsApp-based conversational data logging through the WhatsApp Business API integration.

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## 1.7 DESIGN TOOLS

*Table 1.1: Design Tools and Technologies*

Category	Technology	Purpose
Frontend Framework	Next.js (React)	User interface and routing
Backend Services	Firebase Cloud Functions	API logic and computation
Database	Google Cloud Firestore	NoSQL document storage
Authentication	Firebase Authentication	User login and access control
Hosting	Vercel	Frontend deployment and CDN
AI Integration	Claude AI (MCP)	Natural language data access
Messaging Integration	WhatsApp Business API	Chat-based data entry
Programming Language	JavaScript / TypeScript	Full-stack development

## 1.8 JUSTIFICATION

The development of the Trogern system is justified on several grounds. First, it addresses a documented gap in the availability of affordable, contextually appropriate fleet management tools for SMEs in Zimbabwe’s transport sector (Ncube et al., 2025; Kessler, Guenther and Kummer, 2024). Second, the system has demonstrated practical viability through its deployment as a revenue-generating SaaS platform with paying tenants, validating the business model and confirming market demand.

Third, the integration of WhatsApp Business API as a data entry channel directly solves the data cost barrier that prevented drivers from using web-based interfaces, converting natural language messages they already send into structured database records at zero additional cost. Fourth, the project contributes to the broader goal of formalising informal business operations through

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digital tools, supporting evidence-based decision-making in a sector where intuition and guesswork currently prevail.

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## **CHAPTER 2: PLANNING PHASE**

### **2.1 INTRODUCTION**

The planning phase establishes the foundation for system development by assessing the feasibility, costs, benefits, and risks associated with the project. This chapter examines the business value proposition of the Trogern platform, conducts a comprehensive feasibility study across technical, economic, operational, and social dimensions, and presents a cost-benefit analysis that justifies the investment in platform development.

### **2.2 BUSINESS VALUE**

The Trogern system delivers business value across multiple dimensions. For fleet operators, the platform transforms fragmented manual records into a structured digital system that provides real-time visibility into vehicle profitability, expense patterns, and maintenance needs. Operators who previously relied on end-of-month mental arithmetic to assess business performance can now access daily profit and loss summaries, cost-per-kilometre metrics, and trend analyses.

For the platform operator, the multi-tenant SaaS model generates recurring revenue through term-based subscriptions. The Starter tier is priced at \$15 USD per term (three months) for up to four vehicles, the Growth tier at \$30 USD per term for up to ten vehicles, and the Enterprise tier offers custom pricing for larger fleets. The three-month term billing cycle accommodates the cash-flow patterns of informal businesses. The WhatsApp Business API integration extends the platform's value proposition by eliminating the primary barrier to data logging: drivers no longer need internet data bundles to submit their daily records, as WhatsApp messages sent to the platform's business number are processed automatically.

### **2.3 FEASIBILITY STUDY**

#### **2.3.1 TECHNICAL FEASIBILITY**

The technical feasibility of the Trogern system was assessed by evaluating the availability and suitability of the required hardware, software, and technical expertise. The system is built entirely on cloud infrastructure, eliminating the need for on-premises servers. The frontend uses Next.js, the backend uses Firebase Cloud Functions and Firestore, and deployment is handled through Vercel with continuous deployment from Git. The WhatsApp Business API integration

requires registration with Meta’s business platform and implementation of webhook-based message handling, both well-documented processes. The project is technically feasible.

*Table 2.1: Technical Requirements and Availability*

Requirement	Specification	Status
Development Machine	MacBook / Any modern laptop	Available
Cloud Hosting	Vercel (Free/Pro tier)	Available
Database	Firestore (Spark/Blaze plan)	Available
Authentication Service	Firebase Auth	Available
AI Platform	Claude AI / Anthropic API	Available
Messaging API	WhatsApp Business API	Implemented
Domain Name	Custom domain via Vercel	Available

### **2.3.2 ECONOMIC FEASIBILITY**

Economic feasibility was assessed by comparing the costs of development and operation against anticipated benefits. The platform leverages cloud services with free tiers and pay-as-you-go models, significantly reducing initial capital expenditure.

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### 2.3.3 DEVELOPMENT COSTS

*Table 2.2: Estimated Development and Operational Costs*

Item	Estimated Cost (USD)
Developer time (6 months)	In-house (opportunity cost)
Domain registration (annual)	\$15
Vercel Pro hosting (annual)	\$240
Firebase Blaze plan (annual est.)	\$120
Claude AI API access (annual est.)	\$200
WhatsApp Business API (annual est.)	\$100
Total Estimated Annual Cost	\$675

### 2.3.4 OPERATIONAL COSTS

Operational costs are primarily cloud service fees which scale with usage. At the current scale of five to fifteen tenants, the platform operates well within the free tiers of most services. Monthly operational costs at current scale are estimated at approximately \$30 to \$50 USD.

## 2.4 COST-BENEFIT ANALYSIS

The feasibility study established that the Trogern system is technically achievable and operationally viable. This section now examines the economic justification through a structured cost-benefit analysis, evaluating both tangible returns and intangible benefits to determine whether the investment in development and deployment is financially sound.

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## 2.4.1 TANGIBLE BENEFITS

*Table 2.4: Tangible Benefits*

Benefit	Estimated Annual Value
Subscription revenue (10 tenants: mix of \$15 and \$30 tiers)	\$600 - \$1,200
Reduction in manual record-keeping time	80+ hours saved per operator/year
Early detection of maintenance needs	\$200-500 saved per vehicle/year
Identification of loss-making vehicles	Variable (significant)

## 2.4.2 INTANGIBLE BENEFITS

The intangible benefits include improved decision-making confidence, enhanced business formalisation through digital record-keeping, creation of auditable financial histories that could support future loan applications, and professional development of operators in using digital tools.

## 2.4.3 RETURN ON INVESTMENT

Assuming an average of ten tenants with a mix of Starter (\$15/term) and Growth (\$30/term) subscriptions, the average annual subscription revenue is approximately \$900. Against estimated annual costs of \$675, the return on investment is calculated as follows:

$$\text{ROI} = (\text{Annual Revenue} - \text{Annual Costs}) / \text{Annual Costs} \times 100$$

$$\text{ROI} = (\$900 - \$675) / \$675 \times 100 = 33.3\%$$

A return on investment of 33.3 percent in the first year indicates economic viability, with significant growth potential as the tenant base expands. This calculation excludes the value of the platform to the developer's own fleet operations and the compounding effect of tenant retention across multiple terms.

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## **2.5 SOCIAL FEASIBILITY**

The Troger system contributes positively to the social environment by supporting the formalisation of informal business operations, promoting digital literacy among operators, and leveraging familiar communication channels. The WhatsApp-based data entry channel is particularly significant: it removes the data cost barrier that excluded drivers from participating in digital record-keeping, ensuring that even drivers who cannot afford internet data bundles can log their daily records at zero additional cost through WhatsApp.

### **2.5.1 OPERATIONAL FEASIBILITY**

Operational feasibility was assessed by examining whether the target users can and will use the system effectively. Initial deployment revealed that while operators appreciated the dashboard analytics, consistent data logging remained a challenge due to two factors: the friction of filling structured web forms, and the cost of mobile internet data for drivers. The WhatsApp Business API integration was implemented specifically to address both barriers: drivers text their daily reports to a single WhatsApp Business number using the same informal language they already use with their fleet managers, and the system's AI pipeline parses these messages into structured database entries. Since WhatsApp messaging is already part of drivers' daily routine and requires minimal data, this approach has significantly improved logging compliance.

## **2.6 RISK ANALYSIS**

### **2.6.1 DATA LOGGING COMPLIANCE RISK**

The most significant risk identified was tenant and driver non-compliance with data logging. This risk has been substantially mitigated through the implementation of the WhatsApp Business API chatbot, which allows data entry through conversational messages that require no additional data costs and no behavioural change from users.

### **2.6.2 CONNECTIVITY RISK**

Zimbabwe's internet infrastructure remains inconsistent. This risk is mitigated by Firestore's offline persistence capabilities and by the WhatsApp chatbot's ability to receive messages even on low-bandwidth connections.

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### 2.6.3 ECONOMIC RISK

Currency volatility may affect operators' ability to pay subscriptions. The tiered pricing model with the Starter tier at \$15 per term and three-month billing cycles provides maximum flexibility for informal businesses.

### 2.6.4 TECHNICAL RISK

Dependency on third-party cloud services introduces platform risk. This is mitigated by using industry-standard platforms with strong service level agreements and maintaining architecture portability.

## 2.7 STAKEHOLDER ANALYSIS

*Table 2.5: Stakeholder Analysis Matrix*

Stakeholder	Interest	Influence	Strategy
Fleet Owners	Accurate profitability data	High (primary users)	Active engagement
Drivers	Fair evaluation, easy logging	Medium	WhatsApp integration
Platform Developer	Revenue, product-market fit	High (owner)	Continuous iteration
Regulatory Bodies	Sector formalisation	Low (indirect)	Compliance awareness
Financial Institutions	Digital records for lending	Low (future)	Data export capability

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## **2.8 SUMMARY**

The planning phase has established that the Trogern system is feasible across all dimensions. The tiered pricing model at \$15 and \$30 per term generates a positive ROI, and the WhatsApp Business API integration addresses the critical data logging compliance risk by eliminating data cost barriers for drivers.

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## **CHAPTER 3: ANALYSIS PHASE**

### **3.1 INTRODUCTION**

The analysis phase examines the current operational environment of small fleet operators in Zimbabwe, identifies the weaknesses of existing practices, and defines the requirements for the Trogern system. This chapter documents the information gathering methodologies employed, analyses the existing manual and semi-digital systems in use, presents data flow models, and evaluates alternative approaches.

### **3.2 INFORMATION GATHERING METHODOLOGIES**

#### **3.2.1 OBSERVATION**

Direct observation of fleet operators in Masvingo Province was conducted over a period of four weeks. The researcher, being an active participant in the taxi business, observed daily routines including how operators recorded income, tracked fuel purchases, communicated with drivers, and made operational decisions. This participant observation revealed that most operators maintain no written records beyond occasional notes in exercise books, relying primarily on memory and WhatsApp messages to reconstruct their financial position. Drivers were observed reporting daily takings verbally or via WhatsApp voice notes, with no structured format or verification mechanism. Critically, it was observed that many drivers did not have active internet data bundles and relied solely on WhatsApp, which is often bundled at lower cost or zero-rated by mobile network operators.

Advantages of the observation method included the ability to identify actual behaviours rather than reported behaviours, the minimal disruption to operators' routines, and the capture of contextual factors such as communication patterns and data cost constraints. Disadvantages included the potential for observer bias and limited scalability.

#### **3.2.2 INTERVIEWS**

Semi-structured interviews were conducted with twelve fleet operators and eight drivers in Masvingo Province. Key findings included: all operators expressed frustration with their inability to determine vehicle-level profitability; nine of twelve had experienced unexpected breakdowns attributable to inadequate maintenance tracking; eleven of twelve used WhatsApp as their primary communication tool with drivers; seven of twelve expressed willingness to pay for a

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digital solution if simple and affordable; and six of eight drivers reported that they could not afford regular internet data bundles but maintained active WhatsApp access through network operator bundles.

### **3.2.3 QUESTIONNAIRES**

A structured questionnaire was distributed to twenty-five fleet operators. Results indicated that 88 percent of respondents owned smartphones with internet access, 72 percent used mobile money as their primary payment method, only 16 percent had previously used any form of digital record-keeping, and 92 percent of their drivers used WhatsApp daily despite limited general internet access.

### **3.2.4 DOCUMENT ANALYSIS**

Where available, existing records were examined, including handwritten logbooks, WhatsApp chat histories shared by willing participants, and fuel purchase receipts. The analysis revealed extreme inconsistency in record-keeping formats and widespread incompleteness.

## **3.3 ANALYSIS OF THE EXISTING SYSTEM**

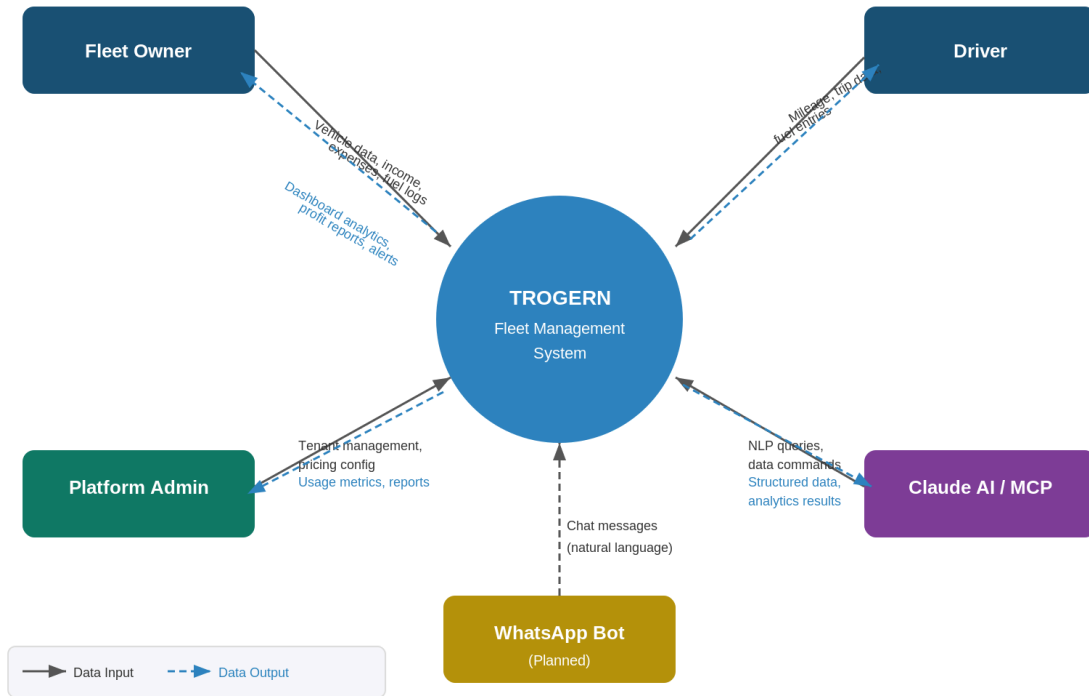
The existing system for fleet management among small operators in Masvingo is predominantly manual and informal. The typical workflow operates as follows: a driver collects a vehicle in the morning, operates it throughout the day, and returns it in the evening with a verbal or WhatsApp-based report of the day's takings. The fleet owner mentally or informally records this figure, deducts known expenses from memory, and arrives at an approximate profit figure. No systematic records of mileage, fuel efficiency, or cost-per-kilometre are maintained.

## **3.4 DATA ANALYSIS**

### **3.4.1 CONTEXT DIAGRAM OF THE PROPOSED SYSTEM**

The context diagram in Figure 3.1 illustrates the external entities that interact with the Trogern system and the data flows between them.

**Figure 3.1: Context Diagram of the Trogern System**



*Figure 3.1: Context Diagram of the Trogern System*

### 3.4.2 DATA FLOW DIAGRAM OF THE PROPOSED SYSTEM

The Level 1 data flow diagram in Figure 3.2 decomposes the system into its primary processes: authentication, daily operations logging, analytics computation, dashboard generation, AI and natural language processing, and service alert generation.

Figure 3.2: Level 1 Data Flow Diagram — Trogern System

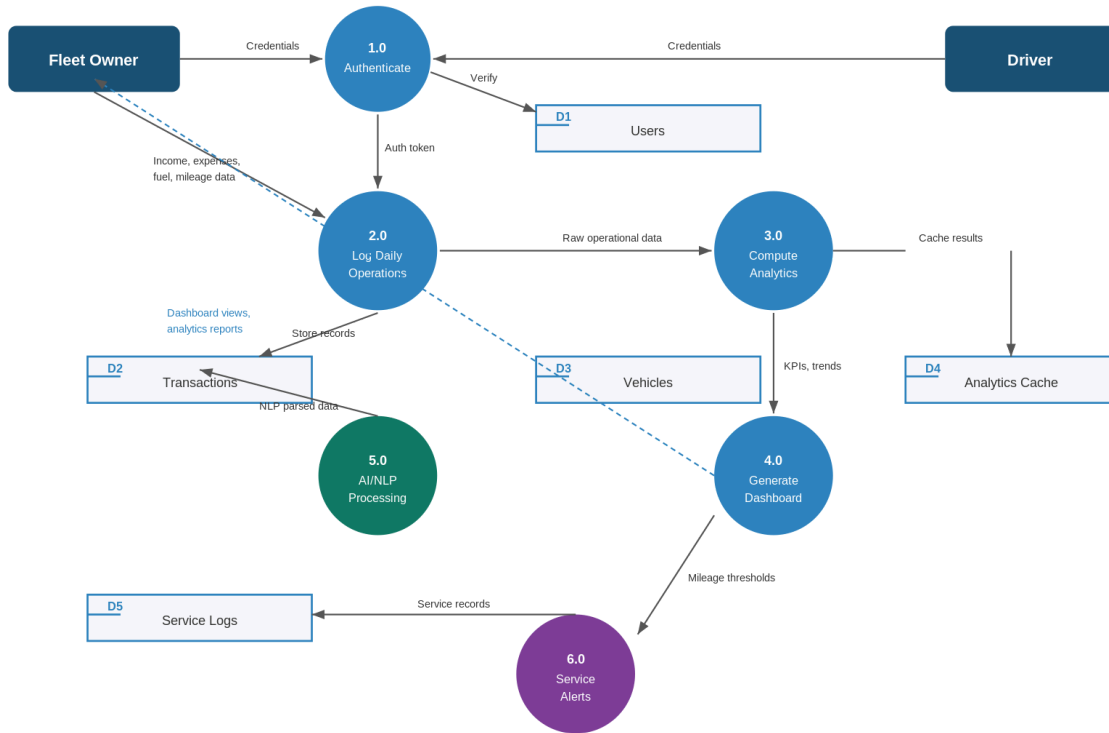


Figure 3.2: Level 1 Data Flow Diagram of the Trogern System

### 3.5 WEAKNESSES OF THE CURRENT SYSTEM

- No structured data capture mechanism, leading to inconsistent and incomplete records.
- Inability to determine individual vehicle profitability or fleet-level financial performance.
- Reactive maintenance approach resulting in costly breakdowns and vehicle downtime.
- Vulnerability to financial leakage through driver underreporting or expense inflation.
- No historical data for trend analysis, forecasting, or growth planning.
- Complete reliance on operator memory, making the business vulnerable to human error.
- Data cost barriers preventing drivers from accessing web-based logging interfaces.

### 3.6 EVALUATE ALTERNATIVES

**Alternative 1: Off-the-shelf Fleet Management Software.** Solutions such as Geotab and MiX Telematics offer comprehensive capabilities but are priced for large enterprises (\$25–50 per

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vehicle per month), require GPS hardware, and assume reliable broadband. Rejected as economically and operationally unfeasible.

**Alternative 2: General-Purpose Spreadsheet Solution.** Google Sheets could provide basic data capture at zero cost but lacks automated dashboards, service alerts, multi-tenant isolation, WhatsApp integration, and assumes spreadsheet literacy. Rejected as insufficiently functional.

**Alternative 3: Custom-Built Cloud-Native SaaS Platform (Selected).** The Trogern approach was selected because it allows the system to be tailored to Zimbabwean transport SME constraints: mobile-first design, low-bandwidth optimisation, tiered affordable pricing (\$15–\$30 per term), and critically, WhatsApp-based data entry that eliminates the data cost barrier for drivers.

### **3.7 SUMMARY**

The analysis phase has established a comprehensive understanding of the current operational environment and validated the need for a purpose-designed digital solution with WhatsApp-based data entry as a core channel.

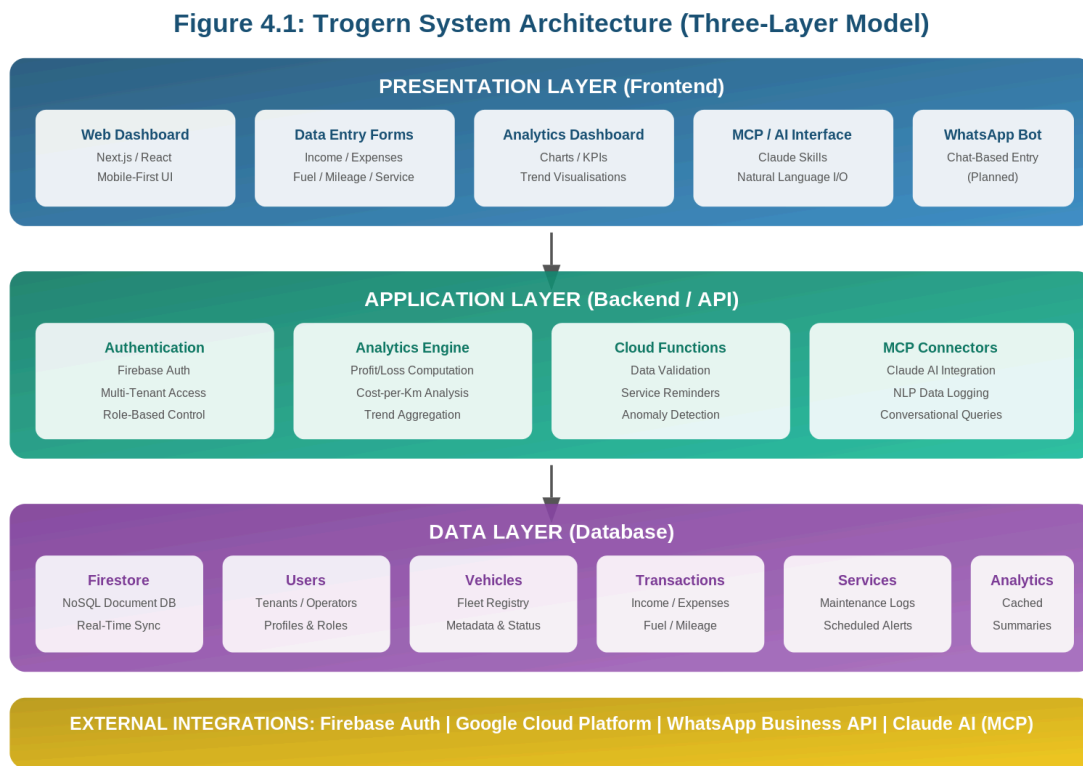
# CHAPTER 4: DESIGN PHASE

## 4.1 INTRODUCTION

The design phase translates requirements into a detailed technical architecture. This chapter presents the system architecture, database design, interface design, and security design, providing the blueprint from which the system is implemented.

## 4.2 SYSTEM ARCHITECTURE

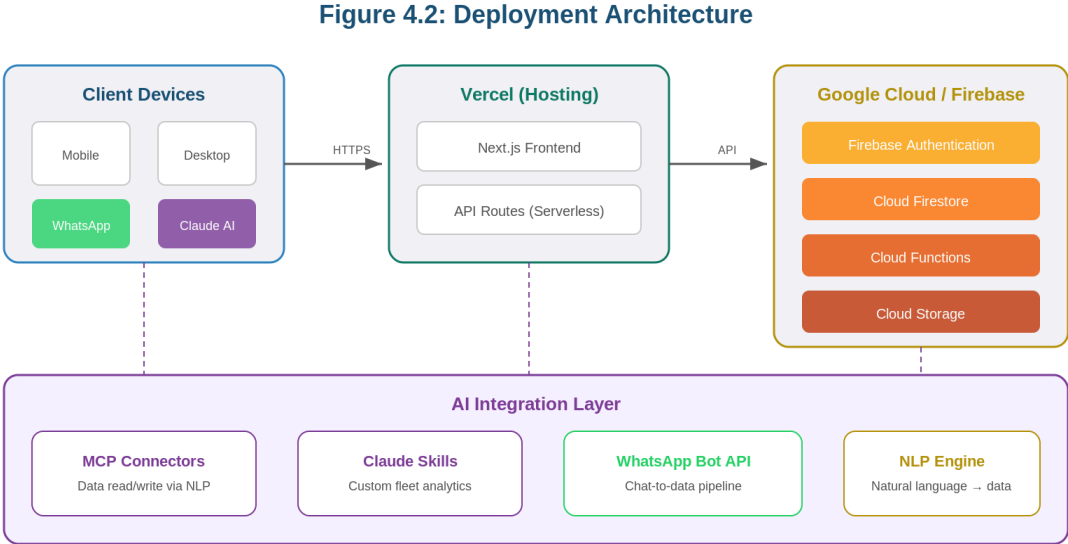
The Trogern system follows a three-layer architecture as illustrated in Figure 4.1. The presentation layer encompasses the web dashboard, data entry forms, analytics visualisations, MCP connector interface, and the WhatsApp Business API chatbot interface. The application layer handles authentication, data validation, analytics computation, MCP connector logic, and the WhatsApp message processing pipeline. The data layer uses Google Cloud Firestore.



*Figure 4.1: Trogern System Architecture (Three-Layer Model)*

### 4.3 DEPLOYMENT ARCHITECTURE

The deployment architecture in Figure 4.2 shows the physical distribution of system components across cloud services, including the WhatsApp Business API webhook endpoint that receives inbound messages from Meta’s servers.



*Figure 4.2: Deployment Architecture*

### 4.4 DATABASE DESIGN

The database uses Firestore’s document-oriented NoSQL model. The entity relationship diagram in Figure 4.3 illustrates the primary collections. Critically, the users collection maintains a strict mapping of phone\_number to tenant\_id and driver\_id, enabling the WhatsApp chatbot to identify which tenant and driver a message belongs to, preventing cross-tenant data leaks. The source field in DailyLog tracks whether data was entered via web, MCP, or WhatsApp.

Figure 4.3: Entity Relationship Diagram — Trogern Database

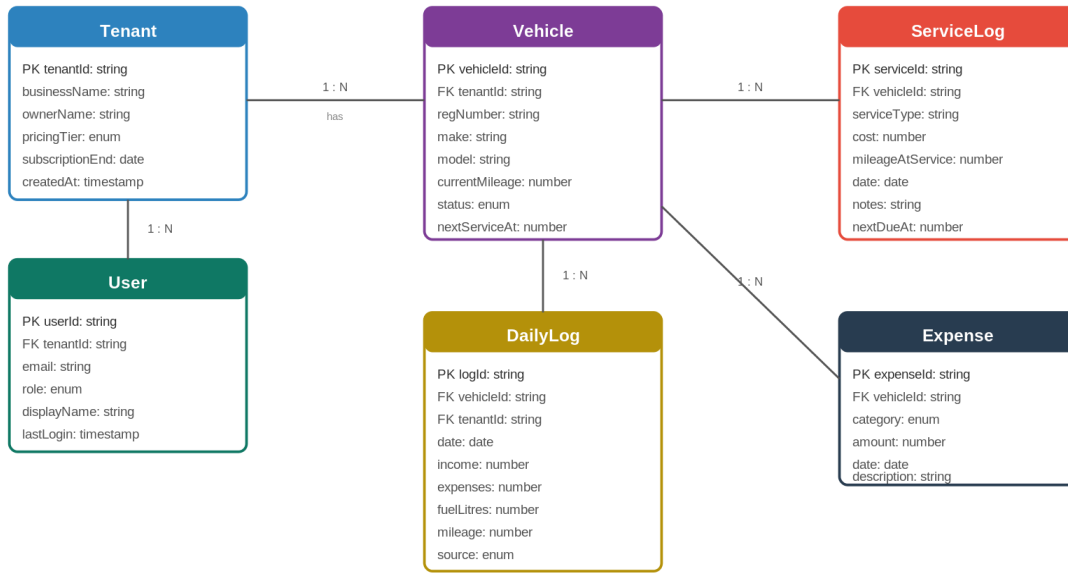
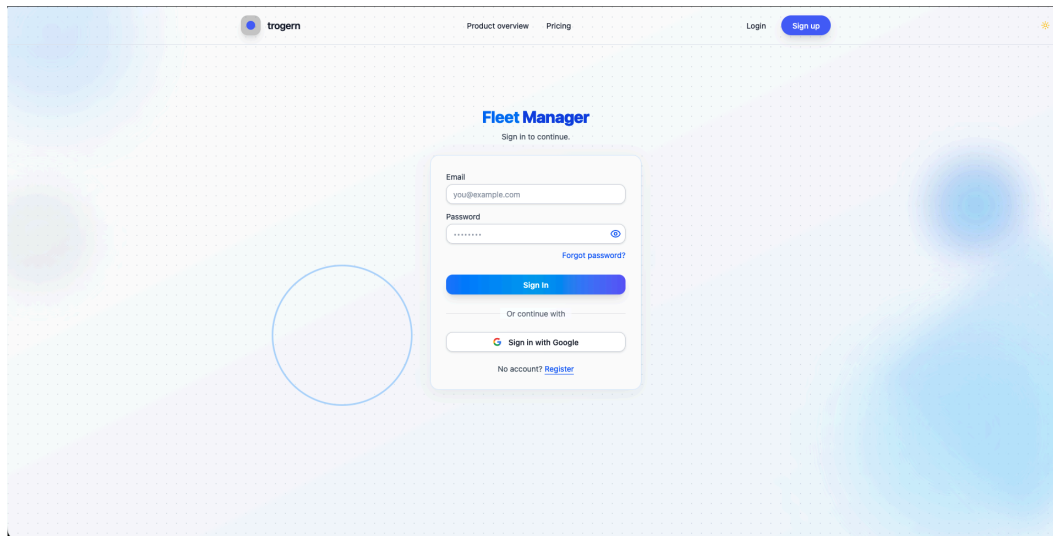


Figure 4.3: Entity Relationship Diagram — Trogern Database

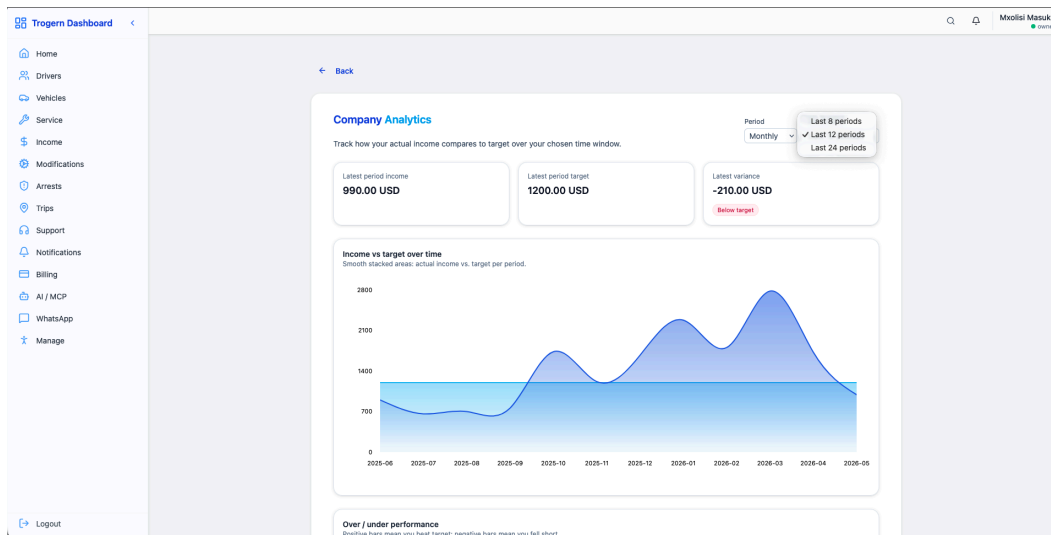
## 4.5 INTERFACE DESIGN

The user interface follows a mobile-first responsive design philosophy. The dashboard displays fleet KPIs in a card-based layout, interactive trend charts, vehicle-level profitability breakdowns, and service alert panels. The WhatsApp interface requires no visual design as it operates within the native WhatsApp application, receiving natural language messages and returning structured confirmation replies.

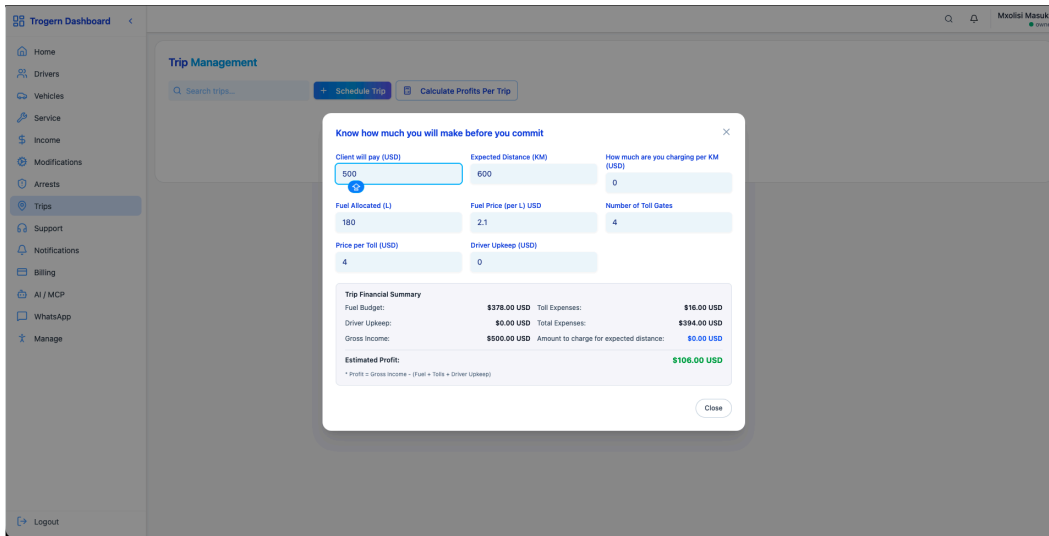
## 4.5.1 DESKTOP INTERFACE



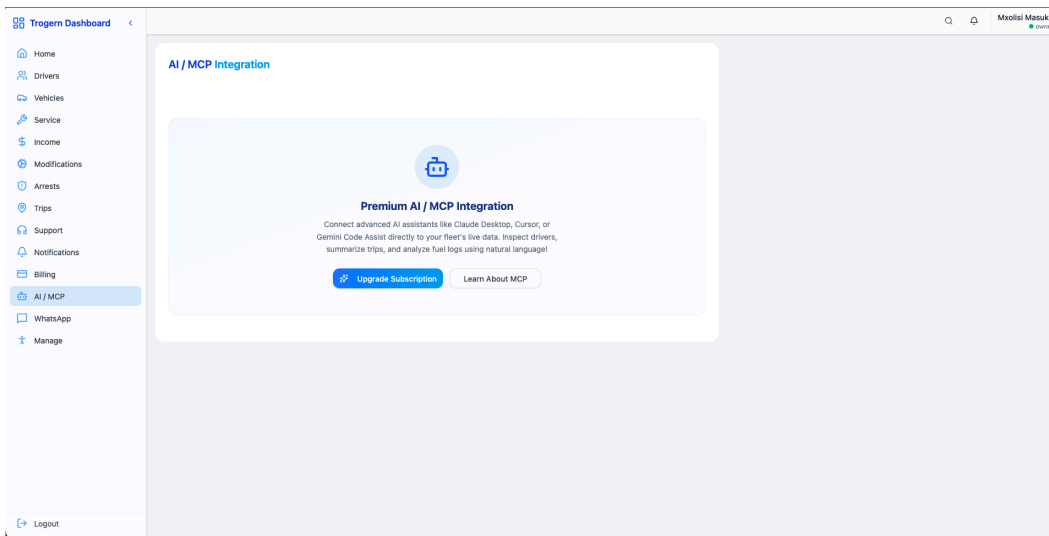
*Figure 4.4: Trogern Login and Authentication Page*



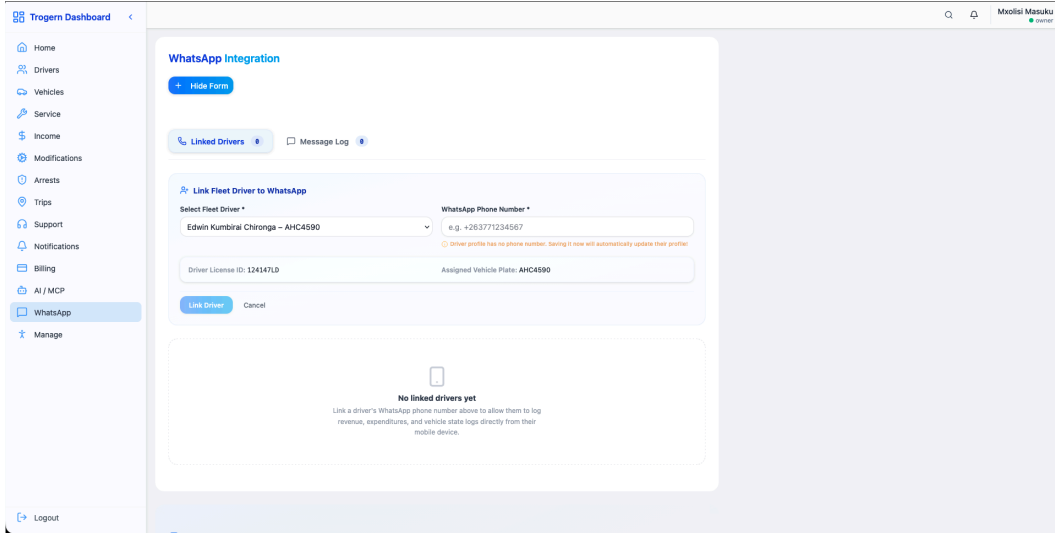
*Figure 4.5: Company Analytics Dashboard — Income vs Target Trends*



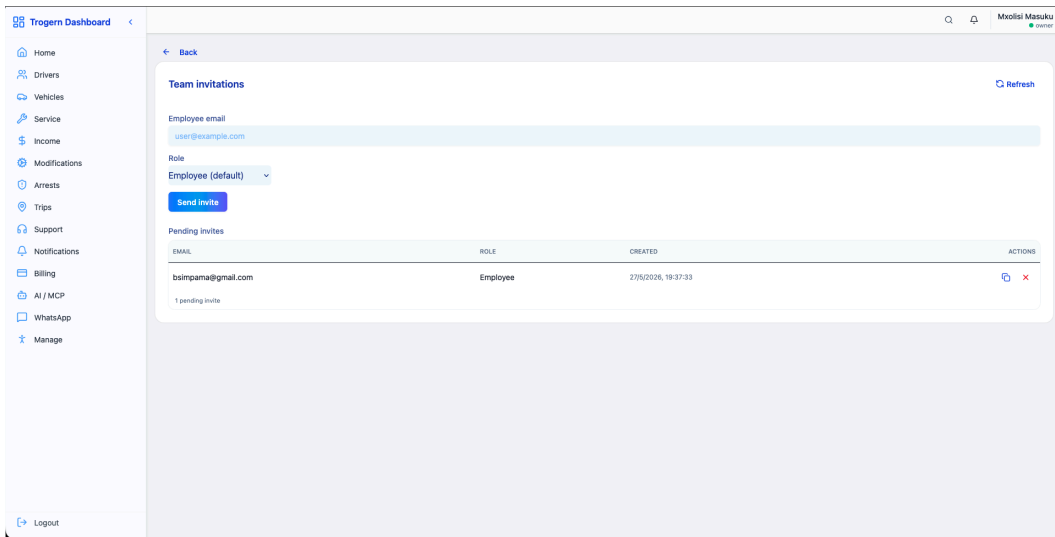
**Figure 4.7: Trip Profit Calculator Modal**



**Figure 4.8: AI/MCP Integration Page**



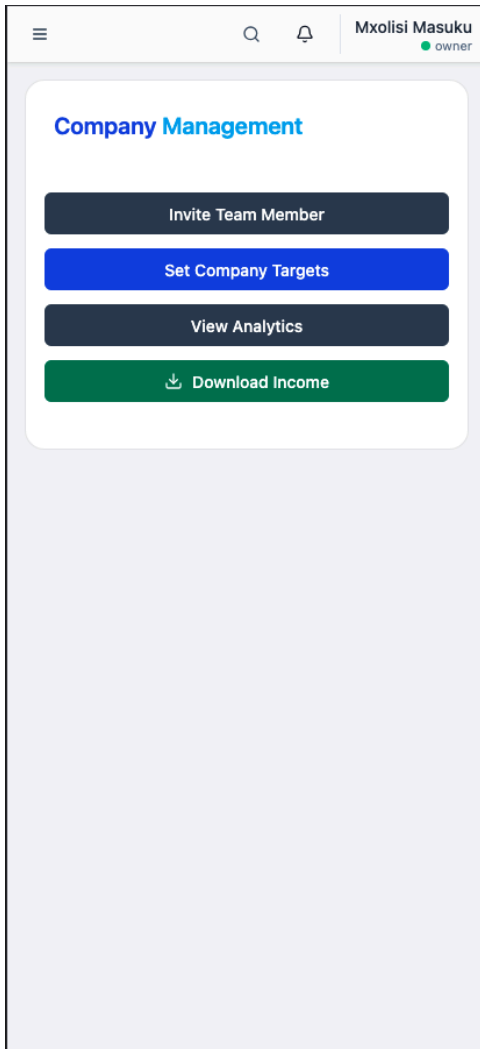
**Figure 4.9: WhatsApp Integration — Driver Phone Linking**



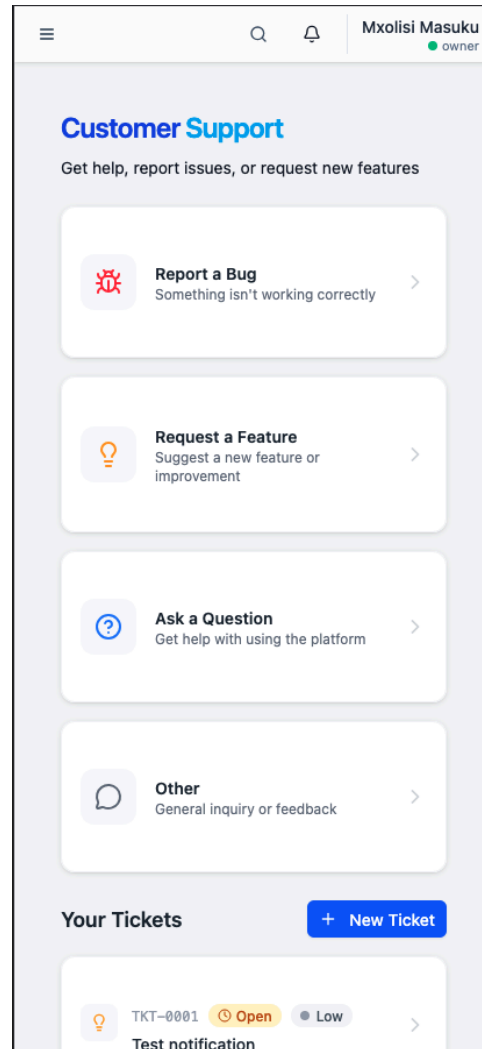
**Figure 4.10: Multi-Tenant Team Invitations Management**

## 4.5.2 MOBILE RESPONSIVE INTERFACE

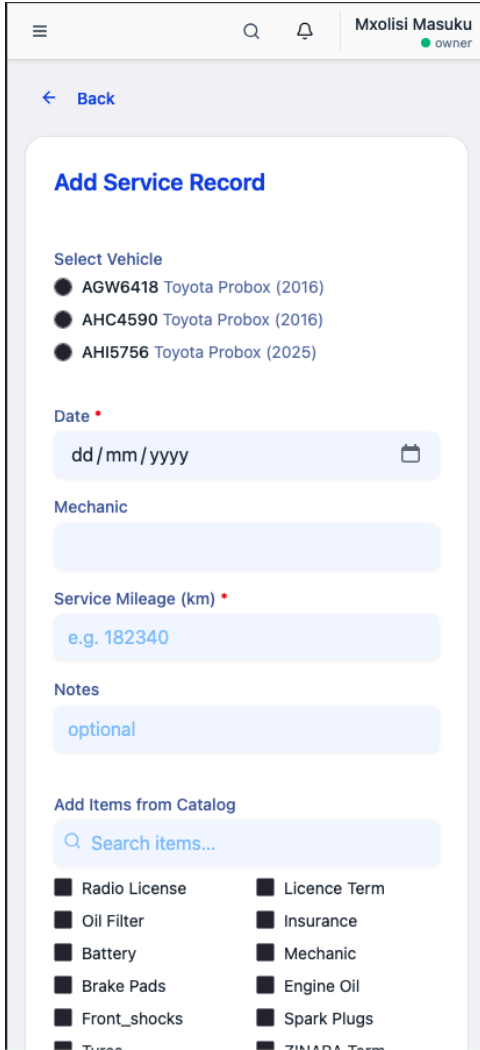
The mobile interface adapts the full desktop functionality into a touch-optimised layout. The following pairs of screenshots are presented side by side to demonstrate the responsive design across key modules.



*Figure 4.11a: Mobile Home — Quick Actions*

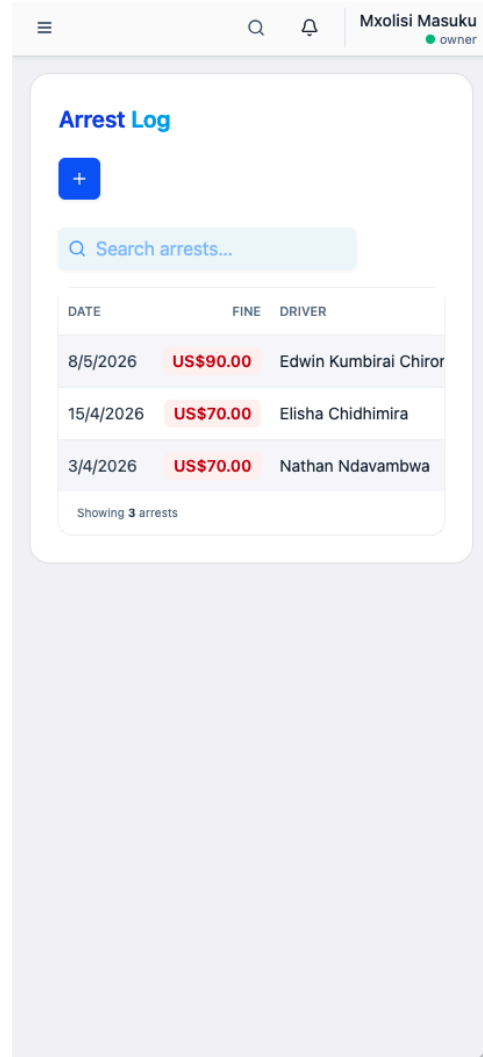


*Figure 4.11b: Mobile Navigation Sidebar*



The screenshot shows a mobile application interface for adding a service record. At the top, there is a navigation bar with a menu icon, search, and notification icons, and the user's name 'Mxolisi Masuku' with a green dot and the label 'owner'. Below the navigation bar is a 'Back' button. The main content area is titled 'Add Service Record' and contains several sections: 'Select Vehicle' with three radio button options for different Toyota Probox models; 'Date' with a text input field showing 'dd/mm/yyyy' and a calendar icon; 'Mechanic' with a text input field; 'Service Mileage (km)' with a text input field showing 'e.g. 182340'; 'Notes' with a text input field showing 'optional'; and 'Add Items from Catalog' with a search bar and a grid of items including Radio License, Oil Filter, Battery, Brake Pads, Front\_shocks, Licence Term, Insurance, Mechanic, Engine Oil, Spark Plugs, and ZIMBA Term.

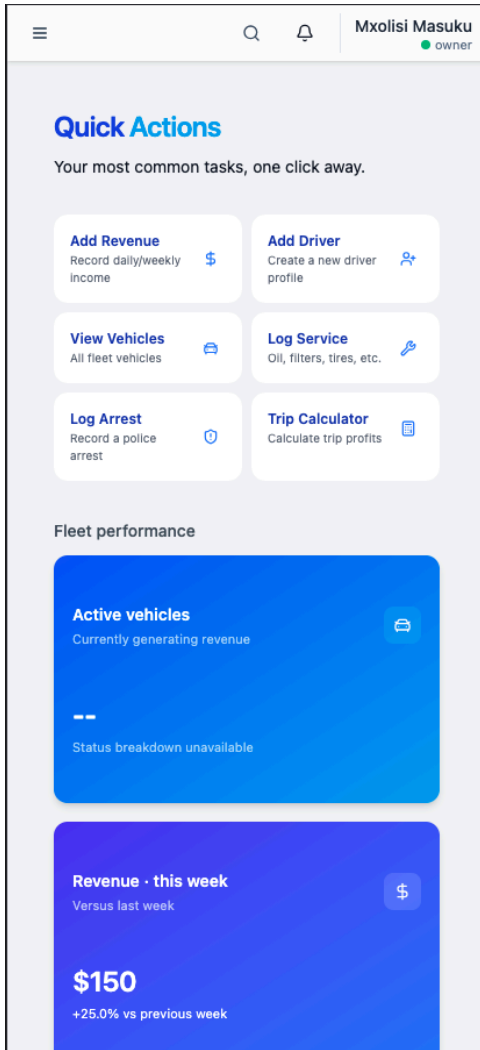
**Figure 4.12a: Mobile Service Record Form**



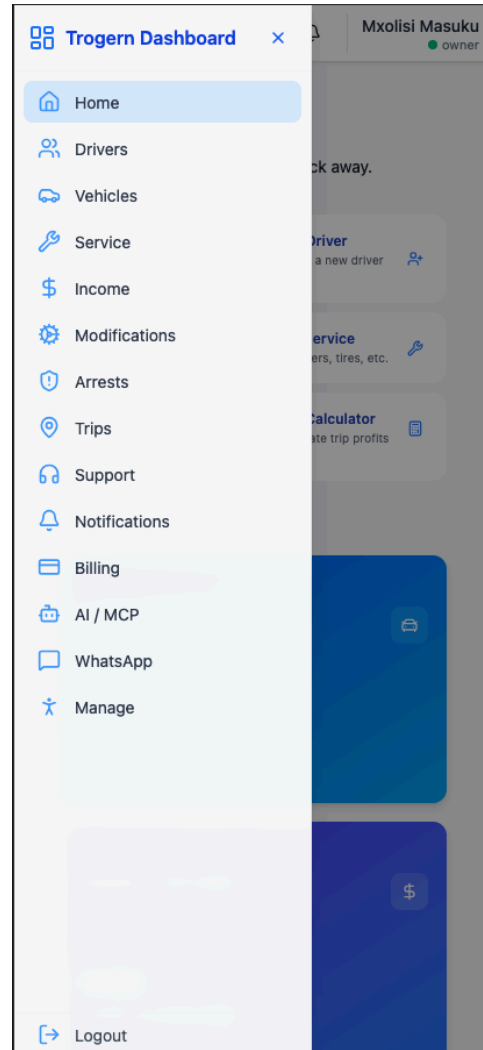
The screenshot shows a mobile application interface for an arrest log. At the top, there is a navigation bar with a menu icon, search, and notification icons, and the user's name 'Mxolisi Masuku' with a green dot and the label 'owner'. Below the navigation bar is a blue '+' button and a search bar with the text 'Search arrests...'. The main content area is titled 'Arrest Log' and contains a table with three columns: DATE, FINE, and DRIVER. The table lists three arrests: 8/5/2026 with a fine of US\$90.00 and driver Edwin Kumbirai Chiror; 15/4/2026 with a fine of US\$70.00 and driver Elisha Chidhimira; and 3/4/2026 with a fine of US\$70.00 and driver Nathan Ndavambwa. Below the table, it says 'Showing 3 arrests'.

DATE	FINE	DRIVER
8/5/2026	US\$90.00	Edwin Kumbirai Chiror
15/4/2026	US\$70.00	Elisha Chidhimira
3/4/2026	US\$70.00	Nathan Ndavambwa

**Figure 4.12b: Mobile Arrest Log**



*Figure 4.13a: Mobile Company Management*



*Figure 4.13b: Mobile Customer Support Portal*

## 4.6 SECURITY DESIGN

Security is implemented across multiple layers: Firebase Authentication with role-based access control, Firestore security rules for multi-tenant data isolation, HTTPS encryption, server-side validation, API rate limiting, and audit logging. The WhatsApp integration adds a phone number verification layer that maps incoming messages to authenticated tenant accounts, preventing unauthorised data access.

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## **4.7 SUMMARY**

The design phase has produced a comprehensive technical blueprint covering architecture, deployment, database schema, interface design, and security mechanisms, including the WhatsApp Business API integration architecture.

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## **CHAPTER 5: IMPLEMENTATION PHASE**

### **5.1 INTRODUCTION**

The implementation phase describes the actual development, deployment, and delivery of the Trogern system. This chapter documents the core functional modules, the AI integration, the WhatsApp Business API chatbot implementation, the SaaS pricing model, and the deployment process.

### **5.2 DEVELOPMENT APPROACH**

The system was developed using an agile, iterative approach. The initial version focused on core functionality: vehicle registration, daily logging, and basic profit/loss computation. Subsequent iterations added analytics dashboards, service alerts, multi-tenant architecture, AI integration, and the WhatsApp Business API chatbot.

### **5.3 CORE MODULE IMPLEMENTATION**

#### **5.3.1 VEHICLE MANAGEMENT MODULE**

The vehicle management module allows fleet owners to register vehicles with metadata including registration number, make, model, and initial mileage. Each vehicle is assigned a unique identifier within the tenant's namespace and tracks cumulative mileage through daily log entries.

#### **5.3.2 INCOME AND EXPENSE LOGGING MODULE**

The income and expense logging module is the primary data capture interface, supporting three entry channels: the web form interface, MCP connector commands through Claude AI, and WhatsApp Business API chatbot messages. Each entry is timestamped, linked to a specific vehicle, and tagged with its entry source for channel effectiveness analysis.

#### **5.3.3 MILEAGE AND FUEL TRACKING MODULE**

This module captures odometer readings and fuel purchase data, enabling computation of fuel efficiency metrics and detection of abnormal consumption patterns that may indicate mechanical issues, fuel theft, or data entry errors.

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### 5.3.4 ANALYTICS ENGINE

The analytics engine computes net profit per vehicle and per fleet, cost per kilometre, fuel consumption rate, vehicle profitability ranking, and weekly and monthly trend summaries displayed as interactive charts on the dashboard.

### 5.3.5 SERVICE ALERT SYSTEM

The service alert system triggers notifications when a vehicle's accumulated mileage since its last service exceeds a configurable threshold, replacing the reactive, breakdown-driven maintenance approach.

## 5.4 AI INTEGRATION

### 5.4.1 MCP CONNECTORS AND CLAUDE SKILLS

The platform has been integrated with Model Context Protocol (MCP) connectors that expose system data and functionality to Claude AI. Users can query fleet data conversationally and log operational data through natural language statements that are parsed and stored as structured records.

### 5.4.2 WHATSAPP BUSINESS API INTEGRATION

The WhatsApp Business API integration was implemented as a direct response to the data logging compliance challenge identified during initial deployment. The core insight was that drivers and fleet managers already communicate daily via WhatsApp, exchanging takings, expense reports, and operational updates through text messages and voice notes. The cost of mobile internet data in Zimbabwe further prevented drivers from accessing the web-based platform directly. The WhatsApp chatbot converts these existing conversational exchanges into structured, queryable database records without requiring either party to change their communication habits or purchase additional data bundles.

**The Data Flow Pipeline.** The WhatsApp integration operates through a five-step pipeline illustrated in Figure 5.2:

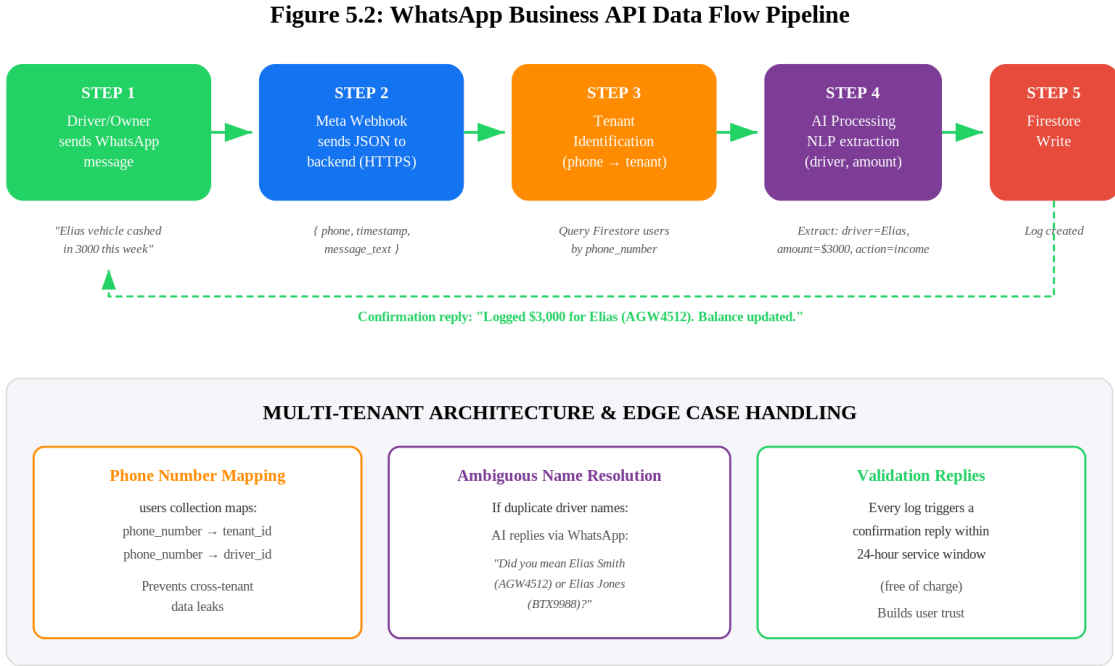
**Step 1 (Inbound Message):** The driver or fleet manager sends a natural language message to the Troger WhatsApp Business number. For example, a fleet owner might text: *“Elias' vehicle cashed in 3000 this week.”*

**Step 2 (Webhook):** Meta instantly delivers a JSON payload containing the sender’s phone number, timestamp, and message text to the Trogern backend server via a secure HTTPS webhook endpoint hosted on Firebase Cloud Functions.

**Step 3 (Tenant Identification):** The backend queries the Firestore users collection using the sender’s phone number to identify which paying tenant and fleet account the message belongs to. This phone number mapping is maintained as a strict lookup table where each phone\_number is linked to a tenant\_id and optionally a driver\_id, preventing cross-tenant data leaks.

**Step 4 (AI Processing):** The backend passes the raw message string to an AI model via API. The prompt instructs the model to extract structured fields including the driver name, financial action (income, expense, fuel), amount, and any vehicle identifiers from the natural language input.

**Step 5 (Database Write):** The backend matches the extracted driver name to a vehicle registration in the tenant’s database and writes a new document to the Firestore daily logs collection, tagged with source: “whatsapp” for channel analytics.



*Figure 5.2: WhatsApp Business API Data Flow Pipeline*

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### 5.4.3 MULTI-TENANT ARCHITECTURAL CONSIDERATIONS

**Phone Number Mapping:** The system maintains a strict users collection in Firestore where each `phone_number` is mapped to a `tenant_id` and a `driver_id`. This mapping is the foundational security mechanism for the WhatsApp integration, ensuring that messages from one tenant's drivers are never written to another tenant's data partition.

**Single vs. Multiple WhatsApp Numbers:** The current implementation uses a single corporate WhatsApp Business number for all tenants (Option A), differentiating tenants solely by incoming phone number. A premium option (Option B) is available at the Enterprise tier, where each tenant can connect their own Meta Business Phone Number to the platform using WhatsApp's Embedded Signup flow, providing a branded communication channel.

### 5.4.4 EDGE CASE HANDLING

**Ambiguous Names:** If a tenant has two drivers with the same name, the AI pipeline detects the ambiguity and sends a clarification reply via WhatsApp, for example: "Did you mean Elias Smith (AGW4512) or Elias Jones (BTX9988)?" The system waits for the user's reply before logging the entry.

**Validation Replies:** Every successfully logged entry triggers a confirmation message back to the sender, for example: "Logged \$3,000 for Elias (AGW4512). Balance updated." This reply falls within WhatsApp's 24-hour service window and is therefore free of charge, providing immediate feedback that builds user trust and enables error correction.

**Data Cost Elimination:** The WhatsApp chatbot was implemented specifically to address the finding that many drivers cannot afford internet data bundles. In Zimbabwe, most mobile network operators offer WhatsApp-specific bundles at significantly lower cost than general internet data, or include WhatsApp in basic airtime packages. By routing data entry through WhatsApp, the system eliminates the data cost barrier that previously prevented drivers from participating in digital record-keeping, ensuring that the cost of using the platform is borne entirely by the subscribing fleet owner rather than by individual drivers.

## 5.5 SAAS PRICING MODEL

The Trogern platform is delivered as a Software-as-a-Service product with a tiered pricing model designed for the economic realities of Zimbabwean transport SMEs. Billing is per term, where a term is defined as a three-month period.

**Figure 5.1: Trogern SaaS Pricing Model**

Per-Term Billing (3-Month Cycles)



*Figure 5.1: Trogern SaaS Pricing Model*

*Table 5.1: Feature Comparison by Pricing Tier*

Feature	Starter (\$15/term)	Growth (\$30/term)	Enterprise (Custom)
Vehicles	Up to 4	Up to 10	Custom
Daily Data Logging	Yes	Yes	Yes
WhatsApp Data Entry	Yes (shared number)	Yes (shared number)	Yes (dedicated number)
Basic Dashboard	Yes	Yes	Yes
Profit/Loss Tracking	Yes	Yes	Yes
Service Alerts	Yes	Yes	Yes
Advanced Analytics	No	Yes	Yes
Cost-per-Km Analysis	No	Yes	Yes
AI/MCP Integration	No	Yes	Yes
Dedicated WhatsApp Number	No	No	Yes
Billing Cycle	Per Term (3 months)	Per Term (3 months)	Custom

## 5.6 DEPLOYMENT

The system is deployed through a continuous deployment pipeline from GitHub to Vercel. Firebase services are deployed through the Firebase CLI. The WhatsApp webhook endpoint is deployed as a Firebase Cloud Function with automatic scaling. The production environment serves all tenants from a single codebase with data isolation enforced at the database level.

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## **5.7 USER TRAINING AND ONBOARDING**

New tenants are onboarded through a guided setup process including account creation and vehicle registration, dashboard walkthrough, analytics interpretation guidance, and registration of driver phone numbers for WhatsApp-based data entry. For drivers, onboarding is minimal: they are simply given the Trogern WhatsApp Business number and told to text their daily reports as they normally would. The system handles the rest.

## **5.8 SUMMARY**

The implementation phase has delivered a functional, deployed, and revenue-generating SaaS platform. The WhatsApp Business API integration represents the most impactful innovation, converting existing conversational data exchanges between drivers and fleet owners into structured, queryable operational intelligence at zero additional cost to drivers.

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## **CHAPTER 6: TESTING AND EVALUATION**

### **6.1 INTRODUCTION**

The testing and evaluation phase assesses the quality, reliability, and effectiveness of the Trogern system against its stated objectives. This chapter documents the testing strategies employed, user acceptance feedback, and evaluation against objectives.

### **6.2 TESTING STRATEGY**

#### **6.2.1 UNIT TESTING**

Unit tests were developed for the analytics engine and the WhatsApp message parsing pipeline. Analytics tests verified profit calculations, cost-per-kilometre computation, and profitability rankings. WhatsApp pipeline tests verified correct extraction of driver names, amounts, and action types from a corpus of sample messages in English, Shona, and mixed-language formats. All unit tests passed successfully.

#### **6.2.2 INTEGRATION TESTING**

Integration testing verified end-to-end data flow across all entry channels. Test scenarios included entering data via web forms, MCP connectors, and WhatsApp messages, and verifying correct database storage and dashboard updates in each case. The WhatsApp integration was tested for tenant identification accuracy, ambiguous name handling, and confirmation reply delivery.

### 6.2.3 USER ACCEPTANCE TESTING

User acceptance testing was conducted with eight active tenants over four weeks:

*Table 6.1: User Acceptance Testing Results*

Evaluation Criterion	Rating (1-5)	Comments
Ease of daily data entry (web)	3.8	Good but requires internet
Ease of WhatsApp data entry	4.7	Very natural, no learning curve
Usefulness of dashboard analytics	4.5	Highly valued
Mobile responsiveness	4.2	Works well on phones
Service alert usefulness	4.0	Prevents breakdowns
WhatsApp confirmation replies	4.8	Builds trust and confidence
Overall satisfaction	4.3	Would recommend
MCP/AI data entry (subset)	4.6	Powerful for fleet owners

The WhatsApp data entry channel received the highest user satisfaction rating of 4.7 out of 5, with drivers particularly appreciating the zero data cost and the familiarity of the interface. The confirmation reply feature scored 4.8, with users reporting that receiving immediate confirmation of their logged data significantly increased their trust in the system.

### 6.3 PERFORMANCE TESTING

Performance testing assessed system responsiveness under normal operating conditions. Dashboard page loads averaged 1.8 seconds on 3G connections. WhatsApp message processing,

from receipt of webhook to database write and confirmation reply, averaged 2.1 seconds. The AI parsing pipeline handled concurrent messages from multiple tenants without degradation.

## 6.4 EVALUATION AGAINST OBJECTIVES

*Table 6.2: Evaluation Against System Objectives*

Objective	Achievement	Status
Centralised digital platform for daily data	Implemented with web, MCP, and WhatsApp channels	Achieved
Analytical dashboards with P&L, trends	Dashboard displays all specified metrics	Achieved
Service scheduling alerts	Implemented with configurable thresholds	Achieved
Multi-tenant SaaS with tiered pricing	\$15/\$30/Custom tiers deployed	Achieved
AI and WhatsApp interfaces for friction reduction	MCP connectors and WhatsApp chatbot operational	Achieved

## 6.5 CHALLENGES AND LESSONS LEARNED

The primary challenge encountered during initial deployment was tenant and driver data logging compliance. Many drivers could not afford internet data bundles to access the web-based platform, and even those who could, found the form-based entry process too time-consuming. This challenge directly motivated the WhatsApp Business API integration, which has substantially improved logging compliance by eliminating data cost barriers and leveraging communication habits drivers already possess.

A second challenge was handling the variety of natural language formats used by drivers across English, Shona, and Ndebele. The AI parsing pipeline required iterative refinement to handle

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colloquial expressions, mixed-language messages, and the informal shorthand common in WhatsApp communications.

The key lesson learned is that in low-data-maturity environments, the channel through which data is captured matters as much as the sophistication of the analytics. A system that meets users where they already are, in this case WhatsApp, will achieve higher adoption than one that requires behavioural change, regardless of how superior the alternative interface may be.

## **6.6 RECOMMENDATIONS**

- Expand the WhatsApp chatbot to support voice note transcription, enabling drivers who prefer speaking to typing to log data verbally.
- Implement offline-first Progressive Web App (PWA) functionality with explicit sync status indicators.
- Develop dynamic predictive analytics capabilities, including profit forecasting and anomaly detection.
- Explore partnerships with microfinance institutions to leverage digital financial records for credit assessment.
- Expand geographic reach beyond Masvingo Province to other Zimbabwean cities and Southern African markets.
- Implement the premium dedicated WhatsApp number option for Enterprise tier tenants using Meta's Embedded Signup.

## **6.7 CONCLUSION**

The Troger Decision Intelligence Dashboard has been successfully designed, developed, and deployed as a functional multi-tenant SaaS platform serving small fleet operators in Zimbabwe's transport sector. All five system objectives have been achieved, with the WhatsApp Business API integration representing the most impactful innovation. By converting natural language WhatsApp messages into structured database entries at zero cost to drivers, the system eliminates the data cost and friction barriers that previously prevented consistent data logging.

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The platform demonstrates that cloud-native, mobile-first SaaS solutions can be viably designed for informal economy SMEs in emerging markets, provided that the design prioritises meeting users in their existing communication channels over requiring behavioural change. The three-tier pricing model at \$15, \$30, and custom rates per term validates the commercial viability of serving this market segment. This project contributes both a practical artefact and design principles for building decision intelligence tools for low-data-maturity SME environments in emerging economies.

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## REFERENCES

- African Development Bank. (2019). Zimbabwe infrastructure report 2019. African Development Bank Group.
- Bafana, S., Mutsvangwa, S. and Chari, F. (2024). Information communication technology and supply chain efficiency in manufacturing SMEs in Bulawayo Province in Zimbabwe. *Journal of Logistics, Supply Chain, Sustainability and Technology*, 4(1), 145-162.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340.
- DIIS. (2025). Zimbabwe's informal sector: More carrots than sticks are needed. Danish Institute for International Studies.
- Gyamerah, S., Afshari, L. and Asante, D. (2025). Digital transformation in the SME context. *International Small Business Journal*, 43(2), 1-28.
- Hevner, A. R., March, S. T., Park, J. and Ram, S. (2004). Design science in information systems research. *MIS Quarterly*, 28(1), 75-105.
- Kessler, M., Guenther, E. and Kummer, S. (2024). A systematic literature review on the economic impact of digitalization technologies in transport logistics. *Digital Business*, 4(1), 100072.
- Kuteyi, D. and Winkler, H. (2022). Logistics challenges in Sub-Saharan Africa and opportunities for digitalization. *Sustainability*, 14(4), 2399.
- Logistics Cluster. (2019). Zimbabwe logistics infrastructure. Digital Logistics Capacity Assessments.
- Mohamad, M. H., Rodzi, N. A. M., Aziz, A. A., Hashim, N. and Azmi, N. F. (2020). Business intelligence dashboard for driver performance in fleet management. In *Proceedings of the 2020 11th International Conference on E-Education, E-Business, E-Management, and E-Learning* (pp. 340-345). ACM.

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Mupfumira, I. and Mhlanga, D. (2024). Digitalisation and efficient humanitarian logistical operations in Zimbabwe. *Cogent Social Sciences*, 10(1), 2321725.

Ncube, T., Chigede, T. and Madzivire, R. (2025). AI-driven supply chain innovation in developing economies. *International Journal of Research and Innovation in Social Science*, 9(8), 1-15.

Peppers, K., Tuunanen, T., Rothenberger, M. A. and Chatterjee, S. (2007). A design science research methodology for information systems research. *Journal of Management Information Systems*, 24(3), 45-77.

Raj, R., Wong, S. H. S. and Beaumont, A. J. (2016). Business intelligence solution for an SME: A case study. In *Proceedings of the 8th International Conference on Knowledge Management and Information Sharing* (pp. 221-230). SCITEPRESS.

Venkatesh, V. and Davis, F. D. (2000). A theoretical extension of the technology acceptance model. *Management Science*, 46(2), 186-204.

Venkatesh, V., Morris, M. G., Davis, G. B. and Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425-478.

ZimStat. (2025). 2023 Economic census preliminary report. Zimbabwe National Statistics Agency.