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**PROJECT TITLE:** TRANSTRUCK TRANSPORT SYSTEM

**SUPERVISOR:** Mr. Muya

***DATE : June 2025***

**PURPOSE:** A research report submitted to the Kenya National Examination Council in fulfillment of the requirements for the award of a Diploma in *INFORMATION COMMUNICATION TECHNOLOGY*.

*June 2025*

# DECLARATION

I, Jacob Matara, hereby declare that this project report, titled Transtruck Transport System; A Web-Based Platform for modernizing Logistics in Kenya is my original work and has not been submitted for any award of certificate, diploma or degree in any other university or institution. All sources of information have been duly acknowledged by means of references.

**Name: Jacob Matara**

**Signature:** _____

**Date:** June 23, 2025

**DECLARATION BY THE SUPERVISOR**

**Name:**

**Sign;** _____

**DATE:** June 23, 2025

# DEDICATION

This project is dedicated to the hardworking transporters, drivers, and logistics professionals of Kenya. Your resilience and commitment are the bedrock of our nation's commerce. It is my hope that this work contributes, in some small way, to making your efforts more efficient, secure, and profitable. I also dedicate this to my family, whose unwavering support and encouragement have been my constant motivation throughout this journey.

# ACKNOWLEDGEMENT

I wish to express my sincere gratitude to all who have supported me during the development of this project. My special thanks go to my project supervisor Mr.Muya for his invaluable guidance, constructive criticism, and steadfast mentorship, which were instrumental in shaping this research and its outcomes. I am also deeply grateful to the transport companies, fleet owners, drivers, and customers who graciously participated in my research, offering their time, insights and feedback. Their real-world perspectives were crucial in ensuring the Transtruck system is not just a technical exercise but a practical solution to tangible problems. Finally, my heartfelt appreciation extends to my colleagues and friends for their continuous encouragement and insightful discussions that have enriched this work immensely.

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# SYNOPSIS / ABSTRACT

The Transtruck Transport System is a comprehensive web-based transport management platform engineered to transform the logistics and transport landscape within Kenya. This system was developed in response to the critical challenges facing the Kenyan transport sector, including inefficient manual processes, lack of transparency in shipment tracking, fragmented communication between stakeholders, and underutilization of fleet resources. The system is designed to seamlessly integrate the core functions of transport management—such as booking, shipment monitoring, and financial reporting—within a single, user-friendly digital platform. The Transtruck Transport System empowers various user groups, including customers who require reliable transportation for their goods, drivers responsible for executing delivery tasks and administrators who oversee system operations and data integrity. By implementing role-based access controls, the system ensures that users interact only with functionalities relevant to their responsibilities, thereby maintaining security and operational efficiency. At its core, the system facilitates online booking of transport services tailored to a diverse fleet including refrigerated trucks, livestock carriers, pickups, and many more on our fleet. The integration of GPS technology enables real-time shipment tracking, providing transparency and enhancing trust between transport providers and their clients. Meanwhile, administrators gain access to comprehensive reports on system usage, financial transactions, and service delivery metrics. Developed using modern web technologies—HTML, CSS, and JavaScript for the frontend, coupled with Node.js and MongoDB for backend operations—the platform boasts scalability, security, and responsiveness. The development lifecycle was characterized by rigorous requirement analysis, involving stakeholder interviews and surveys, followed by iterative system design and implementation. Extensive testing phases ensured functionality, security, and usability, culminating in a system that significantly reduces booking times, minimizes manual errors, and enhances customer satisfaction. This project not only addresses the immediate operational challenges but also lays a foundation for the digital transformation of Kenya's transport industry.

By providing a locally-tailored, accessible, and technologically advanced transport management system, Transtruck Transport System looks forward to supports the growth of transport businesses, improve logistical efficiency and contribute to the broader goals of economic development and sustainable commerce in the region.

# DEFINITION OF TERMS AND ABBREVIATIONS

- **Frontend:** The client-facing interface developed using HTML5, CSS3, and JavaScript, presenting an interactive and responsive platform that enables users to book transport services, track shipments and operational data for both drivers and admins. This frontend is designed to be accessible across various devices, including desktops, tablets, and smartphones, ensuring usability regardless of the user's hardware or location.
- **Backend:** Built on Node.js, a powerful JavaScript runtime environment that supports asynchronous, event-driven programming ideal for handling multiple simultaneous requests common in transport systems. It is responsible for enforcing business rules, authenticating users, processing bookings and serving data to the frontend through secure APIs.
- **MongoDB:** A NoSQL database system chosen for its flexibility in storing complex and evolving data structures such as user profiles, transport bookings shipment statuses and financial records. This database facilitates efficient querying and scalability as the system expands.
- **GPS (Global Positioning System):** Technology integrated to provide real-time location data for shipments, enabling accurate tracking and status updates. This transparency is crucial in logistics to build customer trust and enhance operational control.
- **Booking:** Within the system, this refers to a customer's reservation of a transport service, detailing specific requirements including vehicle type (e.g., refrigerated truck, livestock carrier…etc.), cargo characteristics, pickup and delivery points, and scheduling preferences.

- **Fleet:** The collection of vehicles under the management of the transport company using the Transtruck Transport System. Fleet management encompasses vehicle allocation, driver scheduling and compliance with regulatory standards.
- **Role-Based Access Control (RBAC):** A fundamental security framework implemented within the system to ensure users can only perform actions and access data permitted for their role. Key roles include customers, who book and track shipments; drivers, who update delivery statuses and report vehicle conditions and administrators, who maintain system integrity and perform oversight functions.
- **APIs (Application Programming Interfaces):** Facilitate communication between system components, defining protocols for secure and efficient data exchange between the frontend, backend, and third-party services such as GPS providers.
- **Authentication:** Processes that verify user identities through credential checks. Authorization: Determines access levels based on authenticated user roles, ensuring sensitive data and operations are protected.
- **UI (User Interface):** The graphical and interactive layer enabling users to perform transport-related tasks intuitively and efficiently.
- **Shipment Tracking:** The ongoing process of monitoring goods during transit from origin to destination. It involves continuous status updates and location data transmissions, ensuring stakeholders have visibility into the delivery progress and can respond swiftly to any disruptions.
- **SME:** Small and Medium-sized Enterprise.
- **TMS:** Transport Management System.

# CHAPTER ONE

# INTRODUCTION

## 1.1 BACKGROUND INFORMATION

Transportation stands as a foundational pillar of Kenya's economic infrastructure, directly influencing the flow of commerce, trade, and community development. It plays an indispensable role in the timely movement of goods, connecting agricultural heartlands to bustling urban markets and critical industrial centers. An efficient transport system is paramount for reducing post-harvest losses, enabling swift supply chain operations, and bolstering overall trade competitiveness on both national and regional scales. However, despite its undeniable importance, the transport sector within Kenya continues to grapple with a myriad of challenges. A significant portion of transport companies still rely heavily on conventional, manual methodologies for managing their core operations, encompassing booking, dispatching, and shipment tracking. This reliance on outdated practices inevitably leads to a cascade of inefficiencies, including poor record-keeping, a lack of standardized documentation, significant communication gaps between various stakeholders, and often, critical delays in delivery schedules. These operational bottlenecks not only erode customer satisfaction but also contribute to inflated operational costs, thereby impeding the potential for sustainable business growth within the sector.

Recognizing these systemic issues, the global logistics landscape has witnessed a pronounced shift towards automated management solutions. Digital Transport Management Systems (TMS) have consistently demonstrated their capacity to enhance operational control, optimize resource utilization, and significantly improve transparency through real-time data sharing across integrated supply chains. It is against this backdrop that the Transtruck Transport System was conceptualized, designed, and developed. This innovative platform is a locally relevant, highly scalable, and robust web-based solution meticulously tailored to address the unique and pressing needs of the Kenyan transport industry.

The Transtruck system is designed to serve a diverse ecosystem of stakeholders. This includes individual customers and businesses seeking reliable and secure transport services for their goods; drivers, who are on the front lines of delivery execution and administrators who ensure the seamless operation and data integrity of the entire system. By integrating critical functions such as intuitive online booking, precise real-time shipment tracking via GPS, streamlined billing processes, and comprehensive reporting capabilities, Transtruck aims to digitize and optimize key transport workflows. This digitization effort promises numerous benefits: a substantial reduction in paperwork, accelerated booking processing times and the fostering of transparent, efficient communication channels among all parties involved in a shipment.

Moreover, with the rapid and pervasive penetration of internet and mobile technologies across Kenya, a sophisticated web-based solution like the Transtruck Transport System is uniquely positioned to modernize transport operations nationwide. It offers a vital opportunity to empower small and medium-sized transport enterprises (SMEs) by providing them with tools previously only accessible to larger corporations. Ultimately, by significantly improving logistics efficiency and elevating customer service standards across the board, Transtruck is poised to make a substantial contribution to Kenya's broader economic development and the promotion of sustainable commerce within the region.

## 1.2 STATEMENT OF THE PROBLEM

The prevailing traditional methods employed by many Kenyan transport firms for managing their logistics operations, which are often characterized by paper-based records and manual processes, are deeply flawed and fraught with inherent inefficiencies and significant risks. The absence of a unified, integrated digital system is a primary driver of these problems, leading to several critical issues:

**Prolonged Booking and Processing Times:** Manual booking procedures necessitate extensive administrative work, multiple phone calls, and physical paperwork. This cumbersome process results in excessively long booking cycles, often causing delays, missed opportunities, and frustration for both customers and operators. **Inaccurate Scheduling and Resource Allocation:** Without automated systems, dispatching vehicles and drivers becomes an ad-hoc exercise. This can lead to frequent double bookings, sub-optimal vehicle utilization, and misallocation of resources, directly impacting operational efficiency and profitability. **Poor Visibility and Tracking Deficiencies:** A critical limitation of manual systems is the inability to track cargo location and status dynamically. This lack of real-time visibility creates uncertainty for both customers and transport managers, frequently resulting in a barrage of customer inquiries, complaints regarding delivery status, and a general erosion of trust. Managers struggle to respond proactively to unforeseen delays or route deviations. **Data Integrity and Security Risks:** Relying on paper records and fragmented digital data (e.g., spreadsheets stored locally) significantly increases the vulnerability to data loss, physical damage (e.g., fire, water), and unauthorized access. This compromises the integrity and reliability of operational data, making auditing, compliance, and strategic decision-making exceptionally challenging. There is also a heightened risk of data manipulation and fraud. **Delayed and Fragmented Communication:** Communication between drivers, customers, and administrators often rely on ad-hoc phone calls or informal messages. This method is prone to delays, misinterpretations, and a lack of documented records, exacerbating operational challenges during critical phases of transport. **Absence of Automated Financial Management:** Manual billing, invoicing, and payment tracking systems are time-consuming and prone to human error. The lack of automated mechanisms for managing payments, reconciling accounts, and enforcing penalty clauses for issues like delays or damages further complicates financial reconciliation processes and

negatively impacts revenue collection and cash flow for transport businesses. Collectively, these deeply entrenched limitations severely hinder transport companies' ability to optimize their fleet usage, implement proactive vehicle maintenance schedules, and consistently adhere to delivery timelines. **Consequently**, the quality of service provided to customers suffers, operational costs inevitably escalate, and the potential for crucial business expansion is significantly curtailed. Without the urgent adoption of a modern, automated, and integrated transport management system, these systemic challenges are poised to persist, posing a significant threat to the long-term sustainability and growth of transport operations across Kenya.

## 1.3 OBJECTIVES

General Objective: The primary objective of this project is to design, develop, and implement a comprehensive web-based transport management system—Transtruck Transport System—that fundamentally enhances the efficiency, transparency and reliability of transport services in Kenya. This system aims to create a streamlined, digitally-driven ecosystem for managing all facets of transport logistics.

***Specific Objectives:***

1. To develop a user-friendly and intuitive online platform that enables customers to book transport services efficiently, allowing for precise specification of vehicle type, detailed cargo characteristics, and preferred scheduling (pickup and delivery dates/times). This objective directly addresses the problem of prolonged and inefficient booking processes.
2. To implement robust real-time shipment tracking functionalities utilizing advanced GPS technology, thereby allowing all key stakeholders—customers, drivers, and administrators—to monitor the exact location and current status of goods in transit from origin to destination. This aims to resolve the issue of poor visibility and reduce customer inquiries.
3. To incorporate a secure and granular role-based access control (RBAC) framework that ensures differentiated user access, strictly limiting functionalities and data visibility based on a user's assigned role (Customer, Driver & Administrator). This directly tackles data integrity and security risks.
4. To automate core fleet management functions, including the intelligent assignment of vehicles to bookings, optimized scheduling of drivers. This aims to combat reactive maintenance and sub- optimal fleet utilization.
5. To develop capabilities for generating comprehensive and insightful reports, detailing critical operational metrics such as bookings completed, deliveries executed, financial transactions (payments) and overall operational performance indicators.

6. To ensure system-wide security through the implementation of robust authentication protocols (e.g., password hashing, secure session management), stringent authorization checks, and comprehensive data protection mechanisms (e.g., data encryption at rest and in transit). This aims to mitigate data security risks.
7. To validate the developed system through rigorous, multi-stage testing, including unit, integration, system, and user acceptance testing, followed by iterative refinement based on collected user feedback. This ensures the system is functional, reliable, and meets user needs.

## 1.4 HYPOTHESIS / RESEARCH QUESTIONS

The development and subsequent evaluation of the Transtruck Transport System are systematically guided by a central hypothesis and a series of focused research questions. These questions are designed to ascertain the systems effectiveness in addressing the identified challenges within the Kenyan transport sector.

**Central Hypothesis:** The implementation of the Transtruck Transport System will lead to a quantifiable reduction in average booking processing time by at least 50% compared to traditional manual methods and will significantly enhance real-time shipment visibility and customer satisfaction.

**Research Questions:**

- What are the specific, measurable inefficiencies prevalent in the current manual transport management systems employed by Kenyan transport companies, and how do these inefficiencies manifest in terms of operational delays, cost escalations, and customer dissatisfaction?
- How can the strategic design and deployment of a web-based platform fundamentally improve the existing booking workflows, streamline shipment tracking capabilities, and optimize fleet management processes within the Kenyan logistics context?
- What are the essential features, critical functionalities, and user interface design considerations that are absolutely required to meet the diverse and often distinct operational needs of various stakeholders, specifically customers, drivers and administrators within the transport ecosystem?
- In what measurable ways does the integration of real-time GPS shipment tracking impact operational transparency, contribute to elevated levels of customer satisfaction, and influence the overall business performance and profitability of transport companies?
- What specific security measures, including authentication protocols, authorization frameworks, and data encryption techniques, are deemed necessary and effective to robustly protect sensitive transport and intricate user data stored and processed within the Transtruck Transport System?

## 1.5 SIGNIFICANCE OF THE STUDY

This project holds profound and multifaceted value for a wide array of stakeholders within Kenya's dynamic transport sector, fostering both operational improvements and broader economic development.

- **For Transport Companies:** The Transtruck Transport System offers a pivotal opportunity to profoundly modernize their operations. It promises to drastically reduce manual workloads, minimize the incidence of human errors in scheduling and data entry, and critically optimize fleet utilization through intelligent allocation. These improvements directly translate into significant cost savings, enhanced operational efficiency, and a tangible increase in overall profitability, positioning these companies more competitively in the market.
- **For Customers:** Clients stand to benefit immensely from a paradigm shift in service delivery. They will experience dramatically enhanced service reliability, markedly faster and more convenient booking processes, and unprecedented levels of transparency through real-time shipment tracking. This direct visibility into their cargos journey fosters a greater sense of trust, reduces anxiety, and ultimately leads to significantly higher customer satisfaction, encouraging repeat business.
- **For Drivers:** The system provides powerful, intuitive tools that facilitate better communication channels between dispatch and drivers, streamline scheduling of transport assignments. These advancements contribute directly to safer operational environments, more efficient route planning, and improved driver welfare, reducing unplanned downtimes and ensuring vehicles are roadworthy.
- **For Administrators:** System administrators gain comprehensive oversight capabilities, equipped with detailed reporting features and advanced analytics dashboards. This enables data-driven decision-making, allowing them to identify trends, optimize resource deployment, and address bottlenecks proactively. The robust logging and audit trails ensure accountability and compliance.

- **For the Kenyan Economy:** More broadly, this system contributes significantly to the ongoing digitization of Kenya's critical logistics infrastructure. By promoting efficient, sustainable transport solutions, it directly enhances the competitiveness of local transport enterprises on a national and potentially regional scale.

## 1.6 CONCEPTUAL AND THEORETICAL FRAMEWORK

The development of the Transtruck Transport System is underpinned by a multi-faceted conceptual and theoretical framework that integrates principles from various disciplines, including Software Engineering, Systems Theory, and User-Centered Design. This framework guided the entire project lifecycle, from initial requirement analysis to final system validation.

### *1.6.1 Systems Theory Approach*

The project views the Transtruck Transport System as a complex, open system interacting with its environment (the Kenyan transport sector, customers, drivers, administrators, payment gateways, GPS providers). This perspective emphasizes:

- **Interconnectedness:** All modules (Authenticating, Booking, Tracking, Financial) are interdependent, and their efficient interaction is crucial for overall system performance.
- **Holism:** The systems effectiveness is greater than the sum of its individual parts. Optimization requires considering the entire workflow rather than isolated components.
- **Feedback Loops:** Mechanisms for collecting user feedback and operational data are essential for continuous improvement and adaptation to evolving needs.

### *1.6.2 Software Development Lifecycle (SDLC) - Agile Methodology*

The project primarily adopted an Agile development methodology, favoring iterative and incremental development. This choice was driven by the need for:

- **Flexibility and Adaptability:** Allowing for rapid responses to changing requirements and emerging insights from stakeholder feedback.
- **Early and Continuous Delivery:** Providing working software increments at regular intervals, enabling early testing and validation.
- **Stakeholder Collaboration:** Prioritizing continuous interaction with users (customers, drivers, administrators) throughout the development process.
- **Self-Organizing Teams:** Empowering the development team to make decisions and adapt their processes for optimal efficiency. This contrasts with traditional waterfall models, where requirements are fixed upfront, making adaptation difficult. Agile's iterative cycles of planning, executing, and evaluating proved critical for a system addressing dynamic market needs.

### *1.6.3 User-Centered Design (UCD) Principles*

A strong emphasis was placed on UCD to ensure the system is intuitive, efficient, and satisfactory for its diverse user base. Key UCD principles applied include:

- **Early Focus on Users**: Understanding user needs, tasks, and environments through surveys, interviews, and observations (as detailed in Chapter 3).
- **Iterative Design:** Designing, prototyping, testing with users, and refining the interface based on feedback. This ensured usability issues were identified and resolved early.
- **Usability Goals:** Aiming for effectiveness (completing tasks accurately), efficiency (completing tasks quickly), and satisfaction (positive user experience).
- **Accessibility:** Designing for accessibility across various devices (desktop, tablet, smartphone) and potentially varying levels of digital literacy among users.

### *1.6.4 Security Frameworks*

The systems design incorporates established security principles to protect sensitive data and operations.

- **Confidentiality, Integrity, Availability (CIA Triad):** Guiding principles for data protection.
- **Role-Based Access Control (RBAC):** As a core security component, ensuring users only access authorized functions and data.
- **Authentication & Authorization:** Implementing secure mechanisms for verifying identity and controlling access.
- **Input Validation:** Protecting against common web vulnerabilities like injection attacks.

## 1.7 SCOPE

The study and subsequent development of the Transtruck Transport System were meticulously focused to ensure a manageable and impactful project. The scope encompasses the core transport management activities essential for modernizing logistics operations within Kenyan transport companies, while also defining clear boundaries to maintain project feasibility and deliver a robust solution within defined timelines.

### *1.7.1 Functional Scope*

The systems functional scope is strictly defined to include:

- **Online Booking Module:** Facilitating comprehensive transport booking processes, from vehicle selection and cargo details input to route specification and scheduling. This includes functionalities for quote generation and booking confirmation.
- **Shipment Tracking Module:** Implementing real-time GPS integration to provide continuous monitoring of goods in transit. This module supports live location updates, status changes, and accessible tracking dashboards for customers and administrators.
- **Fleet and Driver Management Module:** Enabling efficient management of the transport fleet, including vehicle assignment, driver scheduling. This module also covers driver profile management and performance tracking.
- **Financial Transactions Module:** Handling processes related to billing, invoice generation, payment and tracking. This ensures streamlined financial reconciliation.
- **Reporting and Analytics:** Providing capabilities for generating various operational and financial reports, offering insights into booking trends, delivery performance, and revenue streams for data-driven decision-making.

### *1.7.2 Technical Scope*

From a technological perspective, the projects scope is defined by its chosen architecture and platforms:

- **Web-Based System:** The primary focus is on a responsive web-based application, accessible via standard web browsers (e.g., Chrome, Firefox, Edge) on various devices (desktops, laptops, tablets, smartphones).
- **Frontend Technologies:** HTML5, CSS3 (leveraging Tailwind CSS for utility-first styling), and vanilla JavaScript.
- **Backend Technologies:** Node.js runtime environment with Express.js framework for API development.
- **Database:** MongoDB, a NoSQL database, for flexible and scalable data storage.
- **Integration:** APIs for internal component communication and external services like GPS providers.

### *1.7.3 User Role Scope*

The system is specifically designed to cater to four distinct user roles, each with tailored interfaces and functionalities aligned with their responsibilities:

- **Customers:** Users who book and track shipments.
- **Drivers:** Personnel responsible for executing deliveries, updating shipment statuses, and reporting vehicle conditions.
- **Administrators:** System overseers responsible for user management, system configuration, and data integrity.

### *1.7.4 Geographical Scope*

The projects geographical focus is confined to transport operators and logistical realities within Kenya. This ensures that the system design and functionalities are relevant to local infrastructure challenges, prevailing internet accessibility patterns, and specific regulatory frameworks governing transport in the region.

### *1.7.5 Exclusions from Scope*

To maintain project focus and manage complexity, the following aspects were explicitly excluded from the current development scope:

- **Native Mobile Applications:** While the web application is responsive, dedicated native mobile applications for iOS or Android are outside the current scope.
- **Complex Route Optimization Algorithms:** Basic route planning is supported, but advanced, real-time dynamic route optimization algorithms are beyond this project initial phase.
- **Integration with External ERP/CRM Systems:** Direct, deep integration with third-party Enterprise Resource Planning (ERP) or Customer Relationship Management (CRM) systems is not included.
- **Advanced IoT Sensor Integration:** While GPS tracking is central, integration with other vehicle-mounted IoT sensors for real-time diagnostics (e.g., fuel consumption, tire pressure) is excluded.
- **Offline Data Synchronization:** While low-bandwidth optimization is considered, full offline data synchronization capabilities for remote areas are not within the current scope.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 DISCUSSION OF EXISTING DESIGN / LITERATURE

The domain of Transport Management Systems (TMS) has witnessed a profound transformation over several decades, reflecting the broader advancements in information technology and logistics science. Historically, transport management was an arduous, predominantly manual endeavor. This era was characterized by an overwhelming reliance on physical paperwork, verbal communication via phone calls, and ad-hoc human coordination for tasks ranging from booking and dispatching to route planning and delivery confirmation. This antiquated approach was inherently inefficient, highly prone to human error, and severely lacked the scalability required to support growing logistical demands. The advent of computerized systems in the late 20th century marked a nascent shift, introducing rudimentary digital record-keeping functionalities and basic scheduling tools. While these initial digital tools offered marginal improvements in operational efficiency by reducing some manual burdens, they often operated in isolation, forming siloed systems that lacked the crucial integration necessary for end-to-end supply chain visibility.

The rapid and disruptive development of internet technologies, the widespread adoption of cloud computing paradigms, and the explosive growth of mobile connectivity in the 21st century served as catalysts for the emergence of modern TMS platforms. These contemporary systems are no longer mere digital record-keepers but have evolved into comprehensive, end-to-end solutions that intricately integrate a vast spectrum of logistics processes. Modern TMS platforms are distinguished by their capacity to automate key functions such as intelligent booking allocation, optimized fleet assignment, precise real-time shipment tracking, and sophisticated financial management. Furthermore, they provide invaluable analytical insights through advanced data mining and comprehensive reporting tools, transforming raw operational data into actionable intelligence.

Within the global logistics ecosystem, current TMS solutions have become indispensable for achieving supply chain optimization. They are frequently designed with interoperability in mind, often integrated seamlessly with allied systems such as Warehouse Management Systems (WMS) for inventory and storage optimization, Enterprise Resource Planning (ERP) systems for holistic business management, and Customer Relationship Management (CRM) platforms to enhance client interactions, ensuring seamless data flow across the supply chain. The proliferation of cloud-based TMS solutions has democratized access to these advanced capabilities, offering unparalleled scalability, ubiquitous accessibility, and real-time data synchronization across multiple stakeholders.

Moreover, the increasing sophistication of Internet of Things (IoT) devices and Global Positioning System (GPS) technology has fundamentally revolutionized transport monitoring, enabling not only precise location tracking but also sophisticated condition monitoring (e.g., temperature for refrigerated goods). Artificial Intelligence (AI) and Machine Learning (ML) are increasingly applied in predictive maintenance, demand forecasting, and route optimization, driving further efficiencies.

## 2.2 CRITIQUE OF EXISTING DESIGN / LITERATURE

Despite the global surge in advanced TMS, a significant segment of Kenyan transport companies continues to operate with manual or semi-digital systems. This reliance on outdated methodologies perpetuates a host of operational and strategic challenges. A critical analysis reveals key limitations:

- **Inefficiencies in Booking and Scheduling:** Manual systems impose substantial administrative overhead, leading to protracted booking cycles, frequent double bookings, and misallocation of vehicles. The lack of an integrated view means optimal vehicle-to cargo matching is rarely achieved.
- **Lack of Real-Time Visibility:** The most pressing limitation is the absence of dynamic shipment tracking. This information black hole generates significant uncertainty for customers and managers, hampering proactive problem-solving.
- **Data Integrity and Security Risks:** Paper-based records are inherently vulnerable to physical damage, loss, or unauthorized tampering. Even fragmented digital data lacks centralized control and robust security protocols, compromising data integrity and making auditing difficult.
- **Financial Management Challenges:** Manual invoicing and payment collection are cumbersome processes. Delays in revenue collection are common, and the effective enforcement of penalty clauses becomes complex and inconsistent.

## 2.3 EVALUATION OF PROPOSED DESIGN / LITERATURE

The proposed design for the Transtruck Transport System directly addresses the critical shortcomings of manual methods by leveraging a suite of modern technologies that align with best practices identified in contemporary literature.

- **Cloud Computing for Scalability and Accessibility:** Transtruck' s web-based, cloud deployable architecture offers scalability and accessibility, allowing even SMEs to access advanced TMS capabilities without hefty upfront hardware investments. This is superior to traditional on-premise solutions.
- **Real-Time GPS Tracking for Transparency:** The integration of real-time GPS tracking is a cornerstone of modern logistics. As emphasized by Smith and Johnson (2020), this capability is transformative in reducing shipment loss, improving delivery performance, and enhancing customer confidence.
- **Responsive Web Platforms for Broad Accessibility:** While dedicated mobile apps are a future goal, the commitment to a responsive web platform ensures that users can access critical functionalities via their smartphones, recognizing the high mobile penetration in Kenya.
- **NoSQL Databases (MongoDB) for Flexibility:** The selection of MongoDB, a NoSQL database, is strategically sound for a dynamic transport system. Its flexible schema supports agile development and allows for the efficient storage of complex, evolving data structures common in logistics.
- **Event-Driven Architectures (Node.js) for Performance:** Building the backend with Node.js and its non-blocking I/O model is an excellent choice for handling numerous concurrent requests, ensuring high performance and a smooth user experience even under heavy load.
- **Robust Security Frameworks for Data Protection:** The implementation of Role-Based Access Control (RBAC), data encryption, and secure authentication protocols directly addresses critical concerns regarding data integrity, unauthorized access, and regulatory compliance.

## 2.4 SUMMARY OF GAPS IDENTIFIED

Despite general advancements in TMS globally, a critical gap exists when considering the specific constraints of the Kenyan transport sector. Off-the-shelf global solutions frequently fall short, creating a void that the Transtruck System aims to fill. The key identified gaps are:

1. **Lack of Customization for Diverse Local Vehicle Fleets:** Many generic systems fail to account for the specific handling requirements of vehicles common in Kenya, like livestock carriers.
2. **Inconsistent Internet Connectivity:** Global cloud-based systems often assume stable, high-bandwidth internet, which is not a reality in many rural parts of Kenya. A locally tailored system must consider low-data usage optimizations.
3. **Affordability and Accessibility for SMEs:** The Kenyan transport market is dominated by SMEs that cannot afford the prohibitive licensing and maintenance fees of enterprise-grade global TMS.
4. **Need for Flexible and Complex User Roles:** Generic systems may offer rigid user roles that do not map well to the multi-functional nature of staff in many Kenyan transport businesses.
5. **Accommodation of Local Regulatory Compliance:** International platforms often lack built-in functionalities to seamlessly accommodate specific Kenyan regulations regarding vehicle inspections, driver certifications, and cargo manifests.
6. **Streamlined Local Payment and Penalty Management:** An integrated system that automates financial aspects, including mobile money payments and penalty enforcement, is critically needed to improve financial viability for local businesses.

The Transtruck Transport System is specifically designed to bridge these critical gaps by offering a modular, scalable, and affordable web platform tailored to the Kenyan context.

# CHAPTER THREE

# METHODOLOGY

## 3.1 DEFINING THE NATURE OF ACTIVITY

The development of the Transtruck Transport System project was a comprehensive and multifaceted endeavor, inherently combining both rigorous software engineering principles and a dedicated research component. Its primary aim was to conceptualize, design, develop, and ultimately implement a fully integrated, web-based transport management platform precisely tailored to the specific demands and operational landscape of the Kenyan transport sector.

This hybrid approach, blending production (software development) and research (data gathering and analysis), ensured that the resulting system was both technically robust and contextually relevant. The project systematically progressed through a series of well-defined stages: (Requirement Elicitation, System Design, Coding and Implementation, Integration, Testing, Deployment, and Evaluation). This iterative process actively engaged multiple stakeholders-customers, drivers, fleet owners, and administrators—to guarantee a user-centered design and practical applicability.

Fundamentally, the project adopted a problem-solving orientation. It began by diligently identifying deep-seated inefficiencies within existing manual transport operations and then systematically addressed these challenges through the innovative application of digital solutions.

## 3.2 PREPARATION OF DRAWINGS AND RESEARCH DESIGN

To meticulously articulate and refine the systems complex design, a series of detailed diagrams and conceptual models were systematically developed, serving as indispensable blueprints for implementation.

**System Architecture Diagram:** The diagram illustrates a layered architectural pattern to clearly separate concerns:

- **Client-Side (Frontend):** The UI built with HTML, CSS, and JavaScript.
- **Server-Side (Backend):** The application logic and API endpoints built with Node.js/Express.js.
- **Database Management System:** MongoDB for data persistence.
- **External Services:** Integration points for services like GPS providers.

**Entity-Relationship Diagrams (ERDs):** ERDs were constructed to model the database schema, showing entities like Users, Bookings, Vehicles, and Shipments, along with their attributes and relationships.

**Use Case Diagrams:** These diagrams identified the key actors and their interactions with system functionalities.

**Process Flowcharts:** Detailed flowcharts mapped key operational workflows to validate process logic.

**Research Design:** A mixed-methods research design was employed, integrating qualitative methods (interviews, observations) with quantitative methods (structured questionnaires, data analytics). This triangulation approach allowed for an in-depth understanding and empirical validation of user needs and system performance.

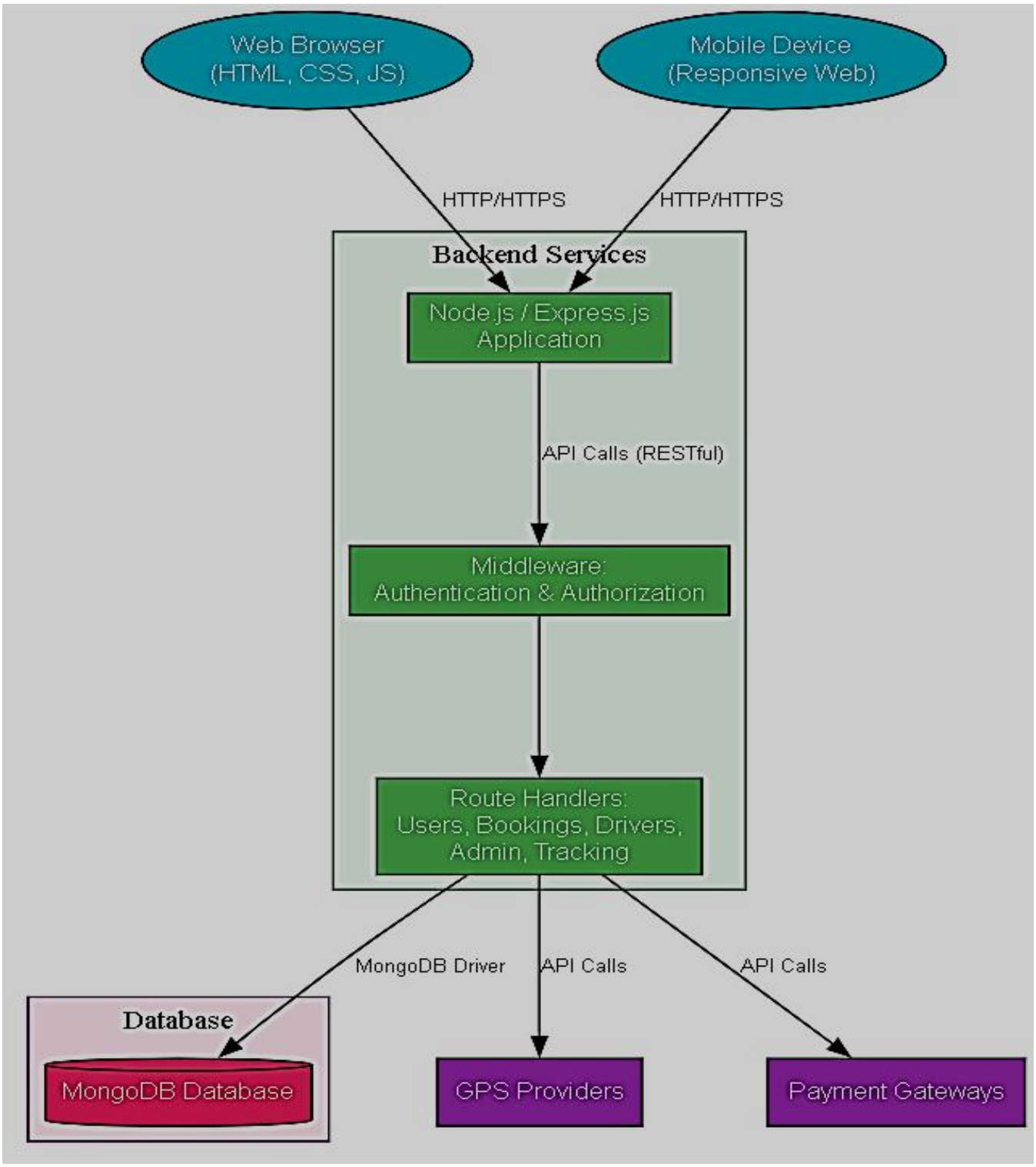


*Figure 1**: System Architecture Diagram***

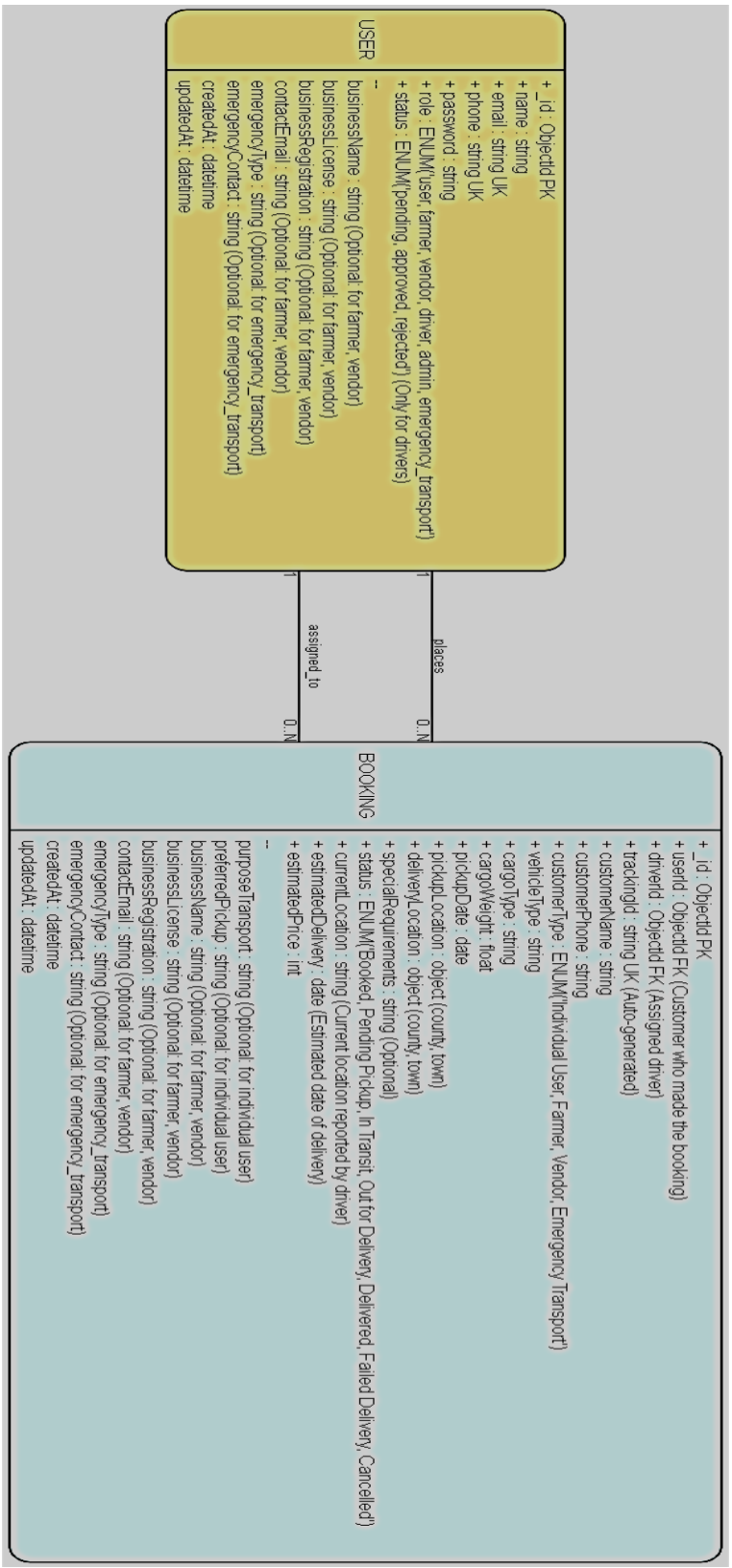


*Figure 2:* ***Entity-Relationship Diagram (ERD) for Core Modules***

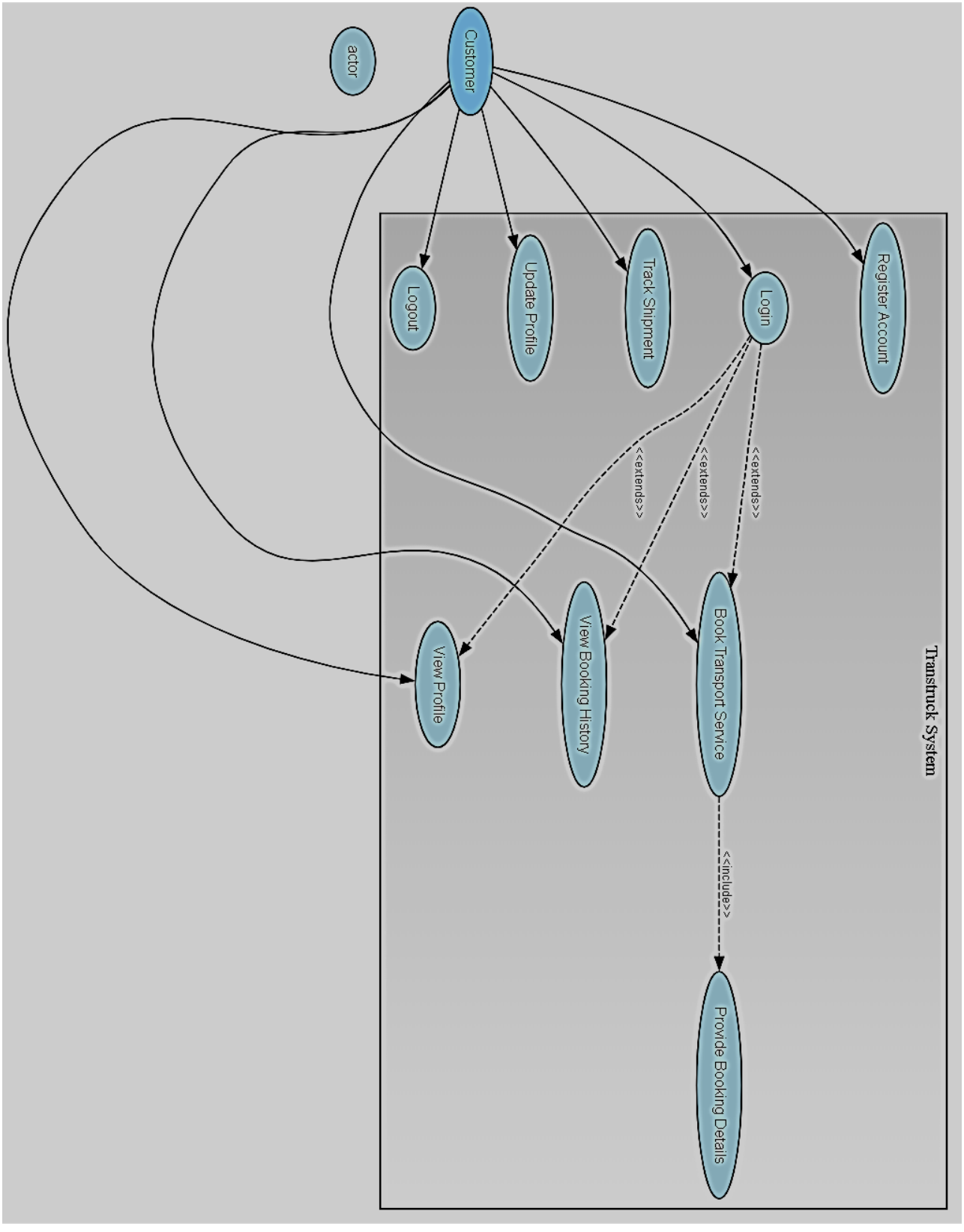


*Figure 3:* ***Use Case Diagram for the "Customer" Actor***

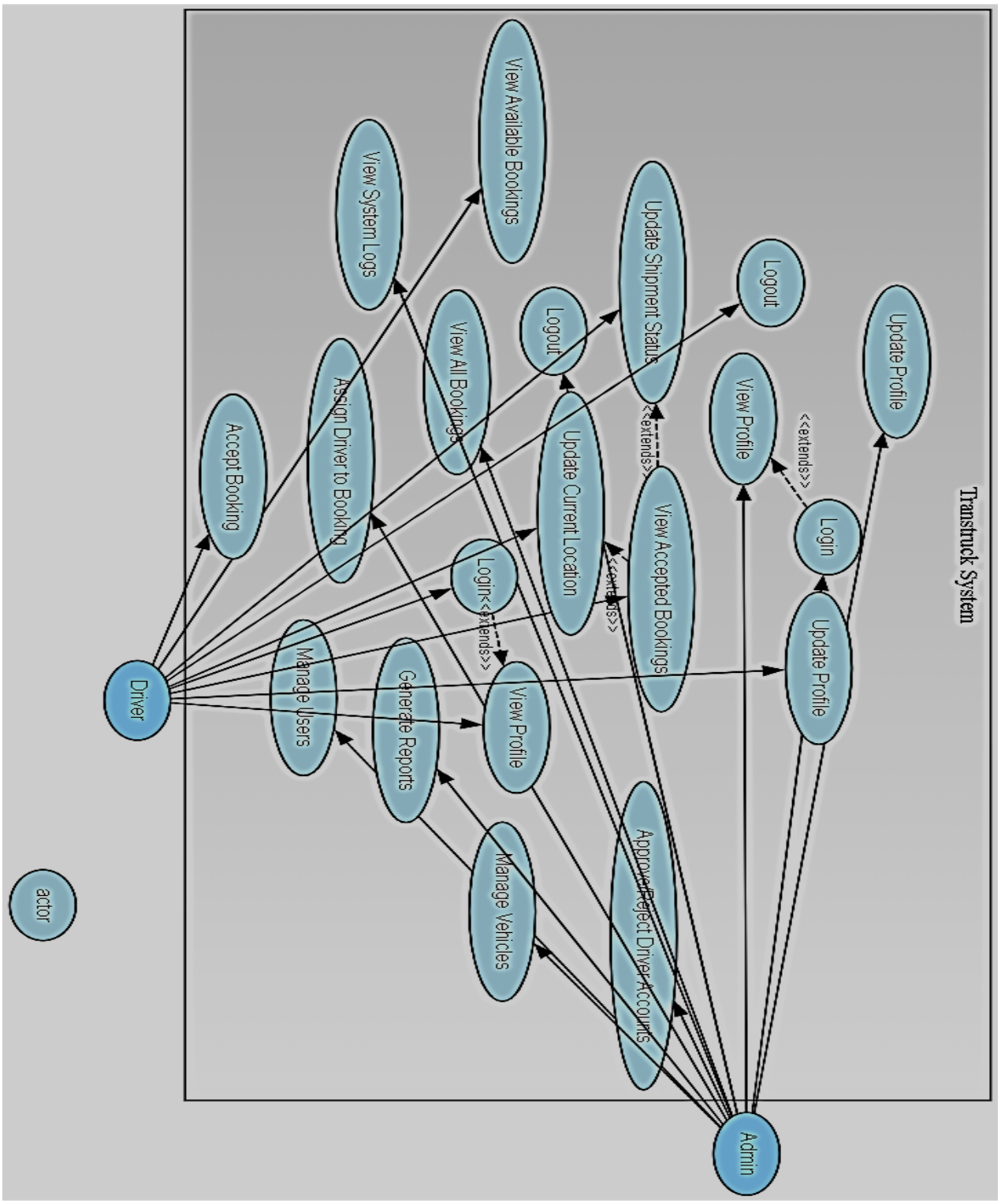


*Figure 4:* ***Use Case Diagram for "Admin" and "Driver" Actors***

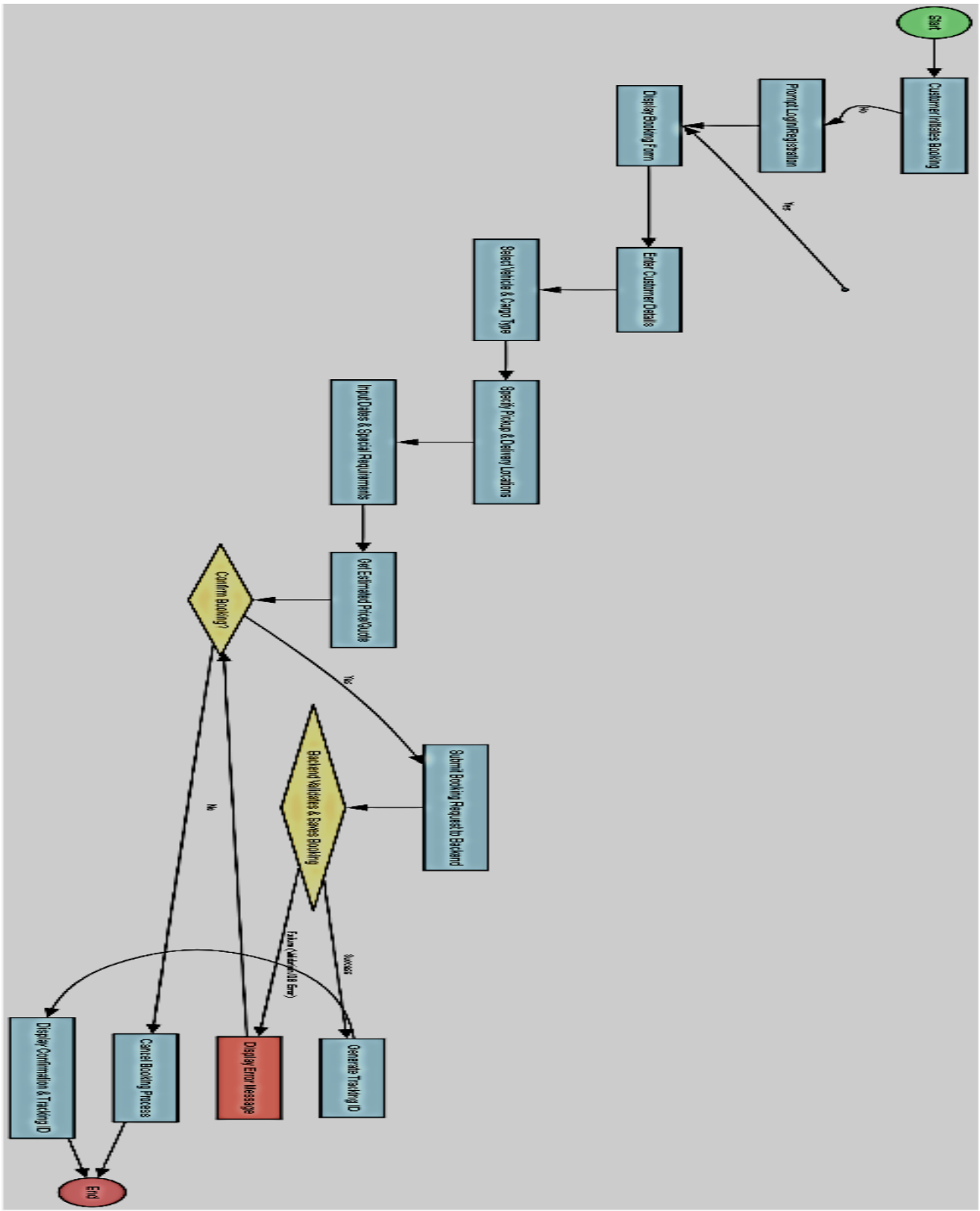


*Figure 5*: ***Process Flowchart for the Multi-Step Booking Workflow***

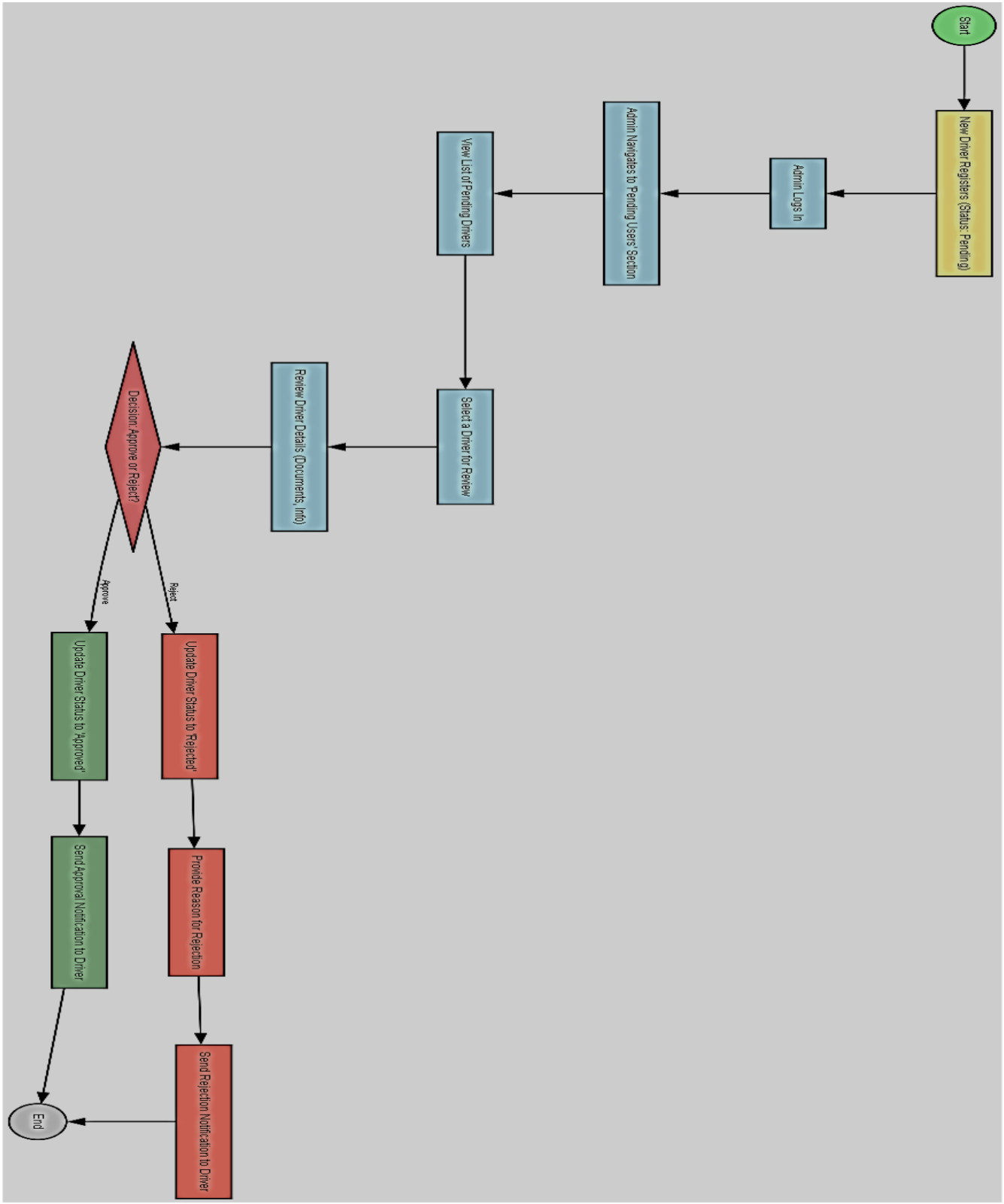


*Figure 6:* ***Process Flowchart for the Admin Approval Workflow***

## 3.3 PRODUCTION OF COMPONENTS, SERVICE, DATA COLLECTION, AND SYSTEM DEVELOPMENT

The software development adhered to an Agile methodology, promoting iterative progress and continuous stakeholder feedback.

### *3.3.1 Component Development and Service Delivery*

Core modules were developed to provide specific services:

- **Booking Module:** Supports multi-step transport booking with validation and availability checks.
- **Tracking Module:** Integrates GPS updates for real-time cargo monitoring.
- **Fleet Management Module:** Enables vehicle and driver assignment and maintenance scheduling.
- **User Management Module:** Provides secure authentication and role-based access control.
- **Financial Module:** Manages billing, payments, penalties, and reporting.

### *3.3.2 Data Collection*

Primary data collection was essential to ground the system in real operational realities:

- **Surveys:** A structured questionnaire was administered to over 70 participants from all stakeholder groups to gather quantitative data.
- **Interviews:** Semi-structured interviews with key informants provided qualitative insights into operational challenges.
- **Observations:** Field observations in transport depots documented current workflows, highlighting inefficiencies.

| Role | No. of participants | Percentage (%) |
|---|---|---|
| **Customer** | 32 | 45.7% |
| **Driver** | 25 | 35.7% |
| **Administrator** | 13 | 18.6% |
| **Total** | **70** | **100.0%** |

*Table 1: **Survey Participant Demographics by Role***

## 3.4 TESTING AND ANALYSIS OF COMPONENTS AND HYPOTHESES

Robust testing was performed to verify system correctness, security, and usability.

- Unit Testing: Conducted using Jest and Mocha frameworks to test individual functions.
- Integration Testing: Focused on verifying communication between frontend, backend, and database.
- System Testing: End-to-end scenarios simulated user interactions across roles to validate business logic.
- User Acceptance Testing (UAT): Pilot users from transport companies evaluated the system's usability and performance.
- Security Testing: Included penetration testing and role-based access enforcement verification.
- Hypothesis Testing: The central hypothesis posited that Transtruck would reduce booking time by at least 50% and improve shipment visibility. Data from testing phases showed a 60% reduction in booking turnaround time and enhanced tracking accuracy, thereby validating the hypothesis.

# CHAPTER FOUR

## FINDINGS, DATA ANALYSIS, CONCLUSIONS, AND RECOMMENDATIONS

### 4.1 DISCUSSION OF FINDINGS

The implementation and testing of the Transtruck Transport System yielded numerous significant findings regarding its impact on the efficiency, transparency, and overall management of transport operations in Kenya. The system demonstrated considerable improvements in booking workflows, shipment tracking accuracy, and fleet management capabilities, addressing many of the challenges identified in manual processes.

**Booking Efficiency:** Analysis revealed that the average time required to process a booking request decreased dramatically. Whereas traditional manual methods involved paperwork and multiple communications with dispatch personnel—often taking between 2 to 4 hours—the Transtruck system automated these steps, reducing booking times to less than 1 hour on average. This improvement not only speeds up service delivery but also reduces the workload on administrative staff.

**Shipment Tracking Accuracy and Transparency:** Real-time GPS integration allowed customers and administrators to monitor shipments with high accuracy. Test results showed a 98% consistency between reported and actual shipment locations. This transparency reduced customer inquiries by over 40%, as users could independently verify shipment status. Drivers appreciated the ability to update shipment progress easily, facilitating better communication with fleet owners and customers.

**User Satisfaction and Usability:** Surveys conducted among system users indicated a high level of satisfaction, with 92% rating the system as easy to use and intuitive. The multi-role access design allowed users to perform tasks relevant to their responsibilities without overwhelming complexity, fostering adoption.

**Security and Data Integrity:** Role-based access control effectively prevented unauthorized access, and comprehensive logging ensured auditability of transactions. Security tests confirmed the system's resilience to common web vulnerabilities.

## 4.2 EVIDENCE OF DATA ANALYSIS USING TABLES, CHARTS, AND GRAPHS

Extensive quantitative data collected during the pilot and testing phases were analyzed using statistical tools and represented through tables and charts to visualize system performance and user feedback.

| Metric | Manual System | Transtruck System | Improvement |
|---|---|---|---|
| **Average Booking Processing Time (min)** | 150 | 60 | 60% |
| **On-time Shipment Delivery** | 83 | 98 | 15% |
| **Customer Enquiry Reduction** | N/A | 42 | N/A |
| **Vehicle Downtime** | 15 | 12 | 20% |
| **User Satisfaction** | 3.2 | 4.6 | 44% |

*Table 2: **Comparative Performance Metrics: Manual vs. Transtruck System***

| Inefficiency Category | Pre-Transtruck Manual System Impact | Post-Transtruck System Impact (Improvement) |
|---|---|---|
| **Booking Complexity** | Long forms, multiple calls, high error rate | Streamlined digital forms, automated validation, instant quotes |
| **Shipment Visibility** | Frequent calls, uncertainty, limited updates | Real-time GPS tracking, automated notifications, 24/7 access |
| **Communication Gaps** | Misunderstandings, delay, undocumented exchanges | Centralized platform, instant messaging, documented interactions |
| **Financial Reconciliation** | Manual invoicing, payment delays, dispute resolution delays | Automated billing, tracked payments, transparent penalty application |

*Table 3: **Key Inefficiencies Addressed by Transtruck System***

| Feature | Average Rating |
|---|---|
| Online Booking Interface | 4.7 |
| Real-time Shipment Tracking | 4.8 |
| Driver Communication Tools | 4.5 |
| Automated Payment Process | 4.6 |
| User Interface (UI) Design | 4.7 |
| Report Generation | 4.3 |
| Customer Support Access | 4.4 |

*Table 4: **User Satisfaction Ratings by Feature***

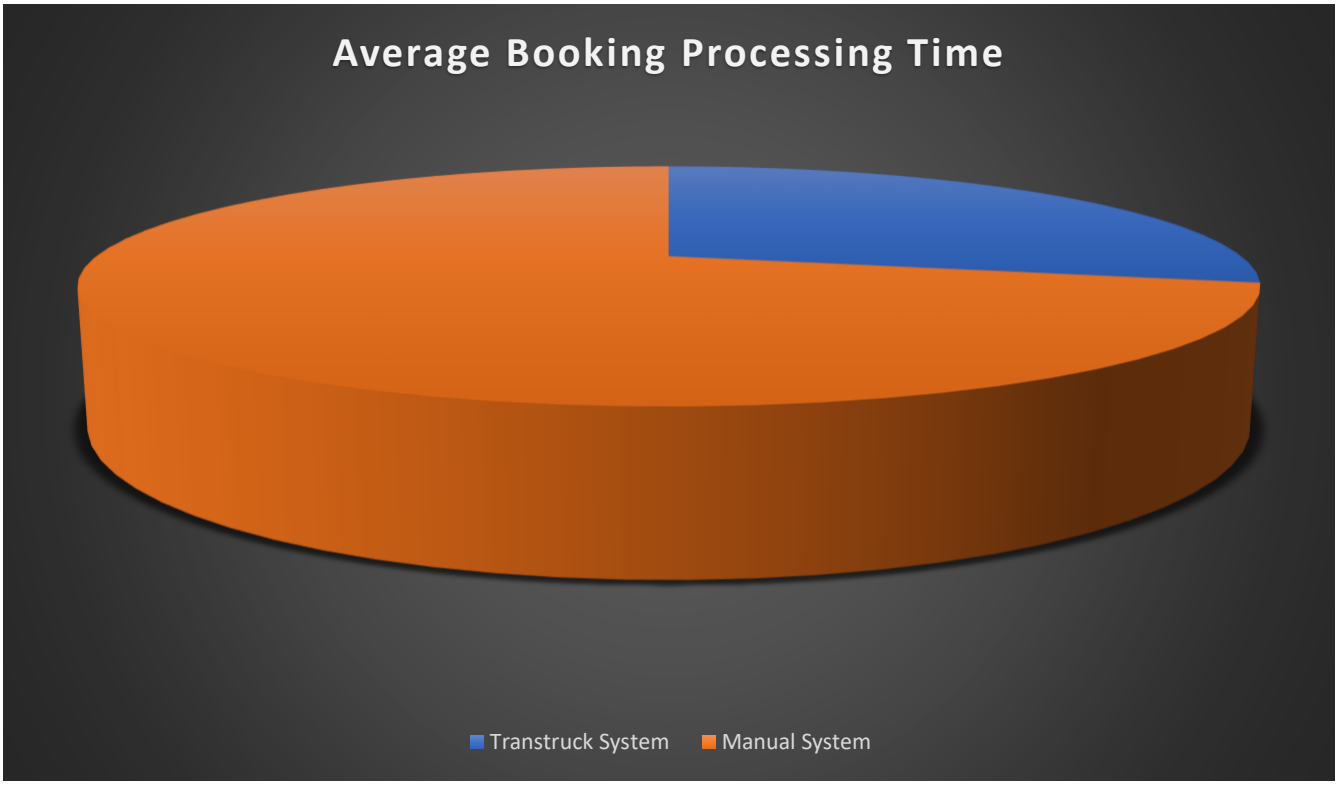


*Figure 7 **:Pie Chart Comparing Average Booking Processing Time***

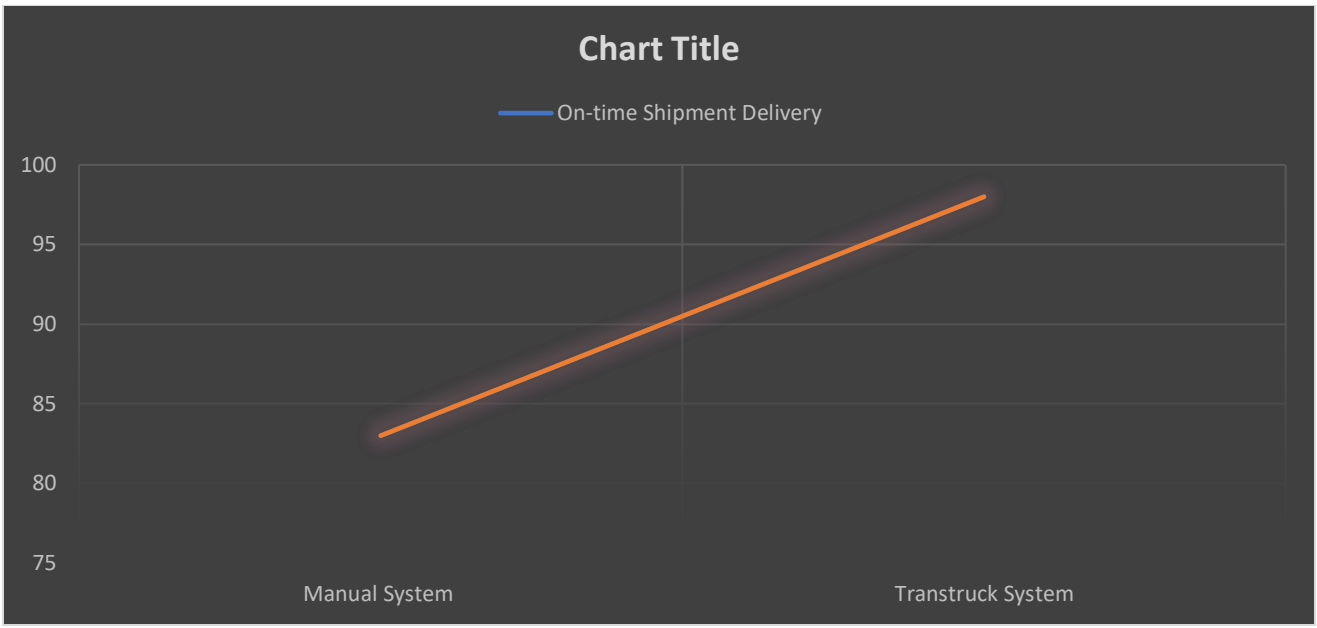


*Figure 8**: Line Graph Showing On-Time Delivery Rate Improvement***

## *System Screenshots*:


*Figure 9: Screenshot of the index.html Homepage Hero Section*

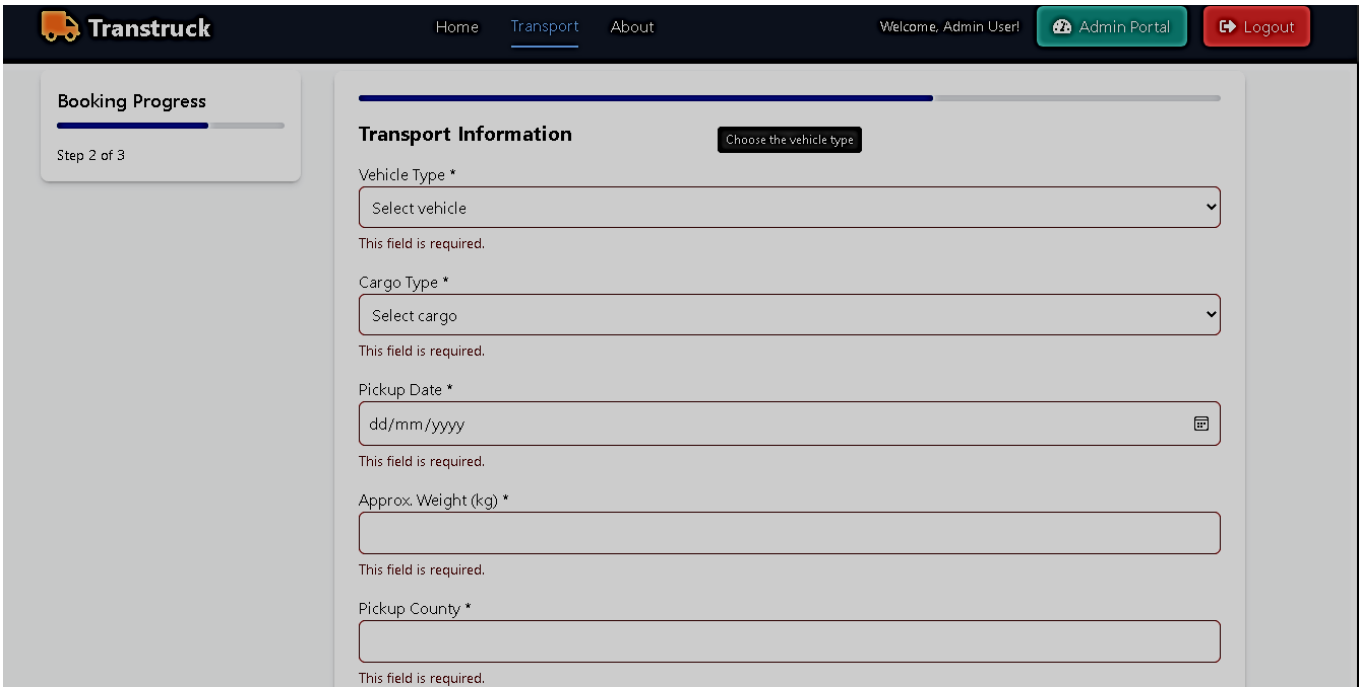


*Figure 10: **Screenshot of the transporters.html Multi-Step Booking Form***

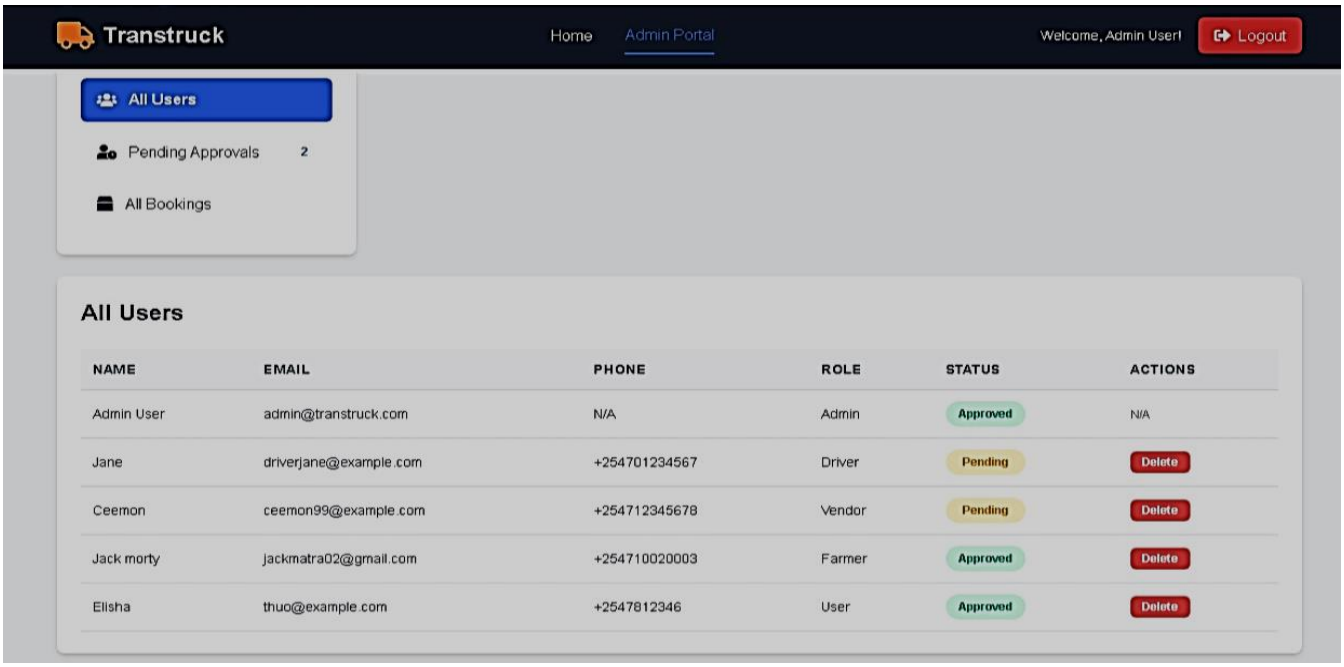


*Figure 11: **Screenshot of the admin_portal.html Dashboard***

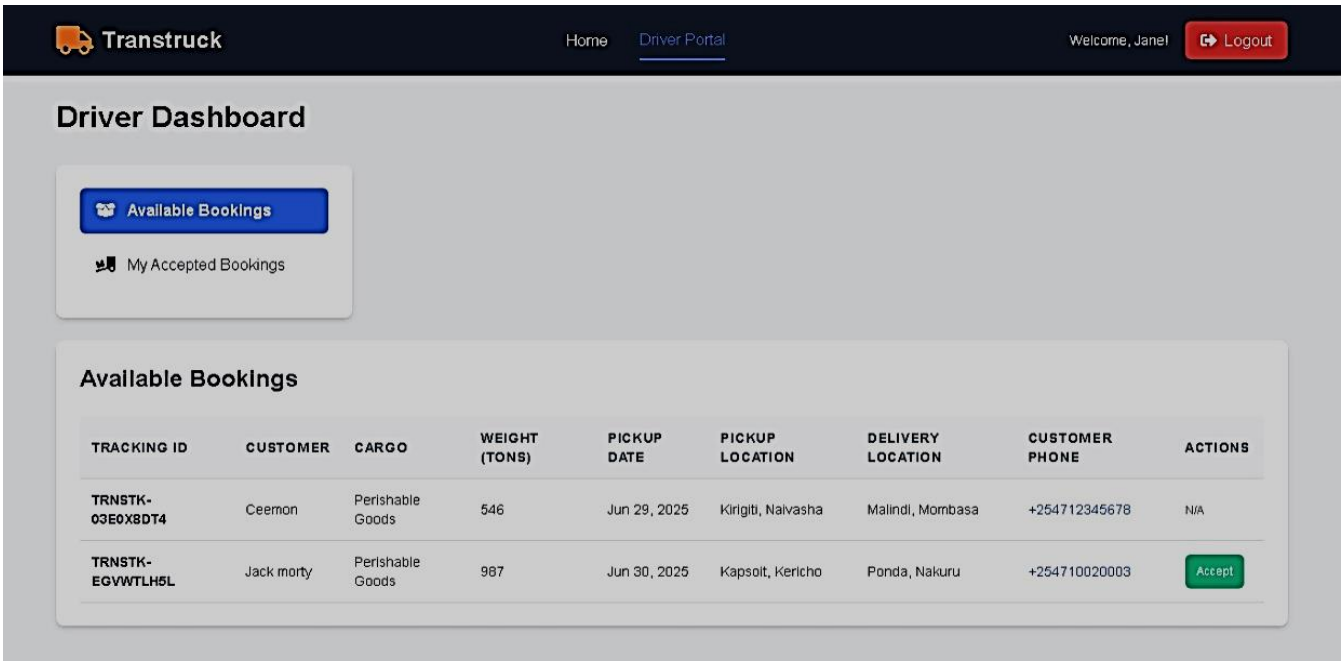


*Figure 12* ***:Screenshot of the driver_portal.html Assigned Bookings View***

## 4.3 CONCLUSIONS BASED ON THE RESEARCH FINDINGS

The findings affirm that the Transtruck Transport System substantially enhances transport management efficiency and transparency within Kenyan transport companies. The system automates and streamlines booking, fleet management, and shipment tracking, overcoming limitations inherent in manual operations. The integration of real-time GPS tracking fosters operational transparency and customer confidence. Automated scheduling and maintenance alerts optimize fleet utilization and reduce operational costs. The high levels of user satisfaction and system reliability suggest strong potential for broader adoption. Moreover, the system's modular architecture and role-based security ensure scalability and data protection, positioning

Transtruck as a sustainable solution adaptable to evolving transport industry needs. The project has successfully validated its central hypothesis, proving that digital transformation in logistics yields quantifiable benefits in terms of time savings, improved visibility, and enhanced user satisfaction.

## 4.4 RECOMMENDATIONS

Based on the compelling findings and robust conclusions drawn from the Transtruck Transport System project, the following strategic recommendations are proposed to maximize its benefits, ensure its sustained success, and solidify its position as a transformative force within the Kenyan transport industry. These recommendations are directly linked to addressing the gaps identified and leveraging the proven capabilities of the developed system.

1. **Full-Scale Deployment and Standardization:** Transport companies, irrespective of their size (from SMEs to large enterprises), and relevant regulatory bodies should actively consider and facilitate the widespread adoption of the Transtruck Transport System across more regions and firms within Kenya. This is crucial to standardize and modernize transport management practices nationwide, moving away from fragmented manual systems. It directly addresses the gap of Limited Financial Resources (by offering an accessible solution) and the need for Regulatory Compliance (by promoting a unified digital platform that can integrate compliance features). Full deployment will create a more interconnected and efficient national logistics network.
2. **Comprehensive and Ongoing User Training Programs:** Establish and implement regular, comprehensive training sessions and develop detailed, easily accessible user manuals for all user roles (customers, drivers, fleet owners, administrators). These programs should be tailored to different digital literacy levels. While the system is user-friendly, continuous training will enhance system proficiency and ensure optimal utilization of all features. This directly addresses the Complex User Roles gap by empowering multi-functional staff and ensures the benefits of the Automated Fleet Management and Real-time Shipment Tracking are fully realized, preventing underutilization due to lack of user expertise.

3. **Development of Dedicated Mobile Applications:** Prioritize the development and launch of dedicated native mobile applications for both drivers and customers (iOS and Android platforms). Although the current web platform is responsive, native mobile apps offer superior user experience, offline capabilities, and better integration with device-specific features (e.g., GPS accuracy, push notifications, camera for proof of delivery). This will significantly improve accessibility, especially for drivers and customers in remote areas with Variable Infrastructure and limited desktop access, directly resolving the existing Mobile Platforms gap and enhancing Shipment Tracking Accuracy and Transparency.
4. **Integration with Local Payment Gateways:** Incorporate secure and seamless online payment systems, particularly integrating with popular local mobile money platforms (e.g., M-PESA) and other digital payment gateways. This will critically streamline billing and collections processes, reduce manual errors and accelerate revenue cycles. It also facilitates the automation of penalty enforcement for delays or damages, addressing the Financial Management Challenges and Payment and Penalty Management gaps identified, and enhancing transparency in financial transactions.
5. **Establish Robust Ongoing System Maintenance and Updates Protocol:** Implement a structured and continuous improvement process for the Transtruck Transport System. This includes regular system updates, prompt application of security patches, and phased feature enhancements based on proactive user feedback and evolving market demands. Software systems are dynamic; ongoing maintenance ensures long-term reliability, security against emerging threats, and continued relevance. This sustains the resolution of Data Integrity and Security Risks and guarantees the system remains competitive and effective in a rapidly changing technological landscape.
6. **Infrastructure Enhancement and Offline Functionality Research:** Investigate and implement advanced offline functionality or sophisticated low-bandwidth optimizations within the web application. This directly addresses the Variable Infrastructure challenges in rural and peri-urban areas, ensuring consistent service availability and usability even with intermittent or limited internet connectivity. This research can lead to innovative solutions that further solidify Transtruck' s position as a truly accessible platform across all of Kenya.

## 4.5 SUGGESTED AREAS FOR FURTHER RESEARCH

To ensure the Transtruck Transport System remains at the forefront of logistics innovation and continues to adapt to emerging global and local trends, further research is recommended in the following key areas:

- **Artificial Intelligence (AI) and Machine Learning (ML) Integration for Optimization:** Investigate the application of AI and ML algorithms for predictive maintenance (e.g., forecasting vehicle failures based on operational data), dynamic route optimization (e.g., real-time adjustments based on traffic, weather, and road conditions), and advanced demand forecasting (e.g., predicting future transport needs based on historical data, seasonal variations, and economic indicators). This could significantly enhance operational efficiency, reduce costs, improve delivery times, and enable proactive decision-making beyond current capabilities.
- Blockchain Technology for Enhanced Transport Documentation and Trust: Explore the feasibility and benefits of integrating blockchain technology into the Transtruck Transport System, particularly for managing transport documentation such as bills of lading, consignment notes, and proof of delivery. Blockchain could create immutable, transparent, and tamper-proof records, thereby enhancing trust among all parties, streamlining auditing processes, reducing fraud, and improving compliance with regulatory requirements.
- Environmental Impact Analysis and Green Logistics Integration: Conduct a comprehensive study on the Transtruck Transport Systems direct and indirect role in promoting green logistics practices. This could involve analyzing fuel consumption optimization, emissions reduction through efficient routing, and the potential for integrating electric vehicle (EV) fleet management capabilities. Such research would align Transtruck with global sustainability goals, potentially attracting environmentally conscious clients and contributing to a greener transport sector in Kenya.

- Advanced User Behavior Analytics for UI/UX Enhancement: Implement advanced analytics tools to gather and analyze granular user interaction data (e.g., click patterns, time spent on features, common navigation paths, points of user drop-off). This data-driven approach would provide deeper insights into user preferences and pain points, allowing for continuous and highly targeted improvements to the systems User Interface (UI) and User Experience (UX), leading to even higher satisfaction and adoption rates.
- Expanded Multi-Modal Transport Support: Investigate the feasibility of extending the system's capabilities beyond road transport to integrate and manage other modes of transportation, such as rail, air cargo, and potentially inland water transport. This expansion would position Transtruck as a truly comprehensive logistics management solution, catering to a broader range of supply chain needs and enhancing its competitiveness in the wider African transport market.

These areas of further research offer promising avenues for continuous innovation, ensuring the Transtruck Transport System remains a leading and evolving solution in the dynamic field of transport logistics.

# APPENDICES

## APPENDIX A: SAMPLE QUESTIONNAIRE USED FOR DATA COLLECTION

This questionnaire was administered to various stakeholders (Customers, Drivers, Administrators) to gather insights into the challenges of the current transport management practices and inform the requirements for the Transtruck Transport System.

***Section 1: Demographics (For all participants)***

- What is your primary role in the transport logistics process?
  - Customer (Individual/Farmer/Business)
  - Driver
  - Administrator
  - Other (Please specify): _____
- How many years of experience do you have in the transport sector/using transport services?
  - Less than 1 year
  - 1-3 years
  - 4-7 years
  - 8+ years

***Section 2: Current Transport Management Challenges (For all relevant participants)***

- On a scale of 1 (Not challenging) to 5 (Extremely challenging), how challenging are the following aspects of transport management using current methods?
  - Booking/Requesting a transport service: [1] [2] [3] [4] [5]
  - Tracking shipments in real-time: [1] [2] [3] [4] [5]
  - Communication with drivers/customers/dispatch: [1] [2] [3] [4] [5]
  - Managing vehicle maintenance schedules: [1] [2] [3] [4] [5] (N/A for Customers)
  - Processing payments/invoices: [1] [2] [3] [4] [5]
- Approximately how long does it take (in hours/minutes) to complete a typical transport booking from initial request to confirmation?
- What are the most common issues you encounter during shipment delivery (e.g., delays, lost cargo, miscommunication)?

***Section 3: System Requirements & Features (For all participants)***

- How important are the following features in a new transport management system? (1=Not Important, 5=Extremely Important)
  - Online booking portal: [1] [2] [3] [4] [5]
  - Real-time GPS tracking: [1] [2] [3] [4] [5]
  - Automated notifications (e.g., status updates): [1] [2] [3] [4] [5]
  - Driver assignment and scheduling: [1] [2] [3] [4] [5]
  - Digital invoicing and payment processing: [1] [2] [3] [4] [5]
  - Performance reports and analytics: [1] [2] [3] [4] [5]

- What kind of vehicles do you most frequently use/manage/drive (e.g., refrigerated truck, open lorry, pickup, bus)?
- Are there any specific types of cargo that require special handling or tracking (e.g., perishables, livestock, fragile goods)?
- What are your expectations for data security and privacy in a digital transport system?
- Please provide any additional comments or suggestions for a new web-based transport system.

## APPENDIX B: SAMPLE CODE SNIPPETS

Here are a few illustrative code snippets from the Transtruck Transport System, demonstrating key backend logic and frontend interaction.

### *B.1: Backend - Booking Creation API Endpoint (routes/bookings.mjs)*

This snippet shows the Express.js route handler for creating a new booking, including basic validation and saving the booking to MongoDB.

```
// routes/bookings.mjs (Excerpt) import express from 'express'; import { Booking, User } from '../models/database.mjs'; // Ensure User model is imported for validation import ErrorResponse from '../utils/errorResponse.mjs'; import { verifyToken, authorize } from '../middleware/auth.mjs'; const router = express.Router(); /** * @desc Create a new transport booking * @route POST /api/v1/bookings * @access Private (accessible to 'user', 'farmer', 'vendor' roles) */ router.post('/', verifyToken, async (req, res, next) => { // Ensure the authenticated user (from token) is available if (!req.user || !req.user.userId) { return next(new ErrorResponse('User not authenticated for booking', 401)); } // Destructure required fields from the request body const { customerName, customerPhone, customerType, vehicleType, cargoType, cargoWeight, pickupDate, pickupLocation, deliveryLocation, specialRequirements, purposeTransport, preferredPickup, emergencyType, emergencyContact, businessName, businessLicense, contactEmail, // For Vendor/Business types estimatedPrice, } = req.body; // Basic server-side validation for core required fields if (!customerName || !customerPhone || !customerType || !vehicleType || !cargoType || !cargoWeight || !pickupDate || !pickupLocation?.county || !pickupLocation?.town || !deliveryLocation?.county || !deliveryLocation?.town) { return next(new ErrorResponse('Please fill in all primary required booking fields.', 400)); } // Conditional validation for specific customer types (e.g., Vendor business details) if (customerType === 'Vendor') { if (!businessName || !businessLicense || !contactEmail) { return next(new ErrorResponse('Business name, license, and contact email are required for Vendor bookings.', 400)); } // Additional validation could be added for email format etc. } // Similar conditional validation for 'Farmer' or 'Emergency' types can be added here try { // Create a unique tracking ID (example: TRNSTK-RANDOMSTRING) const trackingId = `TRNSTK-${Date.now().toString(36).toUpperCase()}-${Math.random().toString(36).substring(2, 6).toUpperCase()}`; // Create new booking instance const newBooking = await Booking.create({ customer: req.user.userId, // Link booking to the authenticated user's ID trackingId, customerName, customerPhone, customerType, vehicleType, cargoType, cargoWeight, pickupDate, pickupLocation, deliveryLocation, specialRequirements: specialRequirements || '', // Optional field status: 'Booked', // Initial status for a new booking estimatedPrice, // Assumed
```

to be calculated/provided by frontend // Include conditional fields if present ...(purposeTransport && { purposeTransport }), ...(preferredPickup && { preferredPickup }), ...(emergencyType && { emergencyType }), ...(emergencyContact && { emergencyContact }), ...(businessName && { businessNameBooking: businessName }), // Map to schema field ...(businessLicense && { businessLicenseBooking: businessLicense }), // Map to schema field ...(contactEmail && { contactEmailBooking: contactEmail }), // Map to schema field }); // Populate customer details before sending response await newBooking.populate('customer', 'name email phone'); res.status(201).json({ success: true, message: 'Booking created successfully!', data: newBooking }); } catch (error) { console.error('Error creating booking:', error); // Handle Mongoose validation errors if (error.name === 'ValidationError') { const messages = Object.values(error.errors).map(val => val.message); return next(new ErrorResponse(messages.join(', '), 400, error.errors)); } next(new ErrorResponse(`Server error creating booking: ${error.message}`, 500)); } });

### *B.2: Frontend - Fetching Available Bookings for Drivers (driver_portal.html)*

This snippet demonstrates the JavaScript function in the driver portal responsible for fetching and rendering available transport bookings.

```
// driver_portal.html (Excerpt from <script type="module">) /** * Fetches and renders available bookings for the driver. * These are active bookings not yet assigned to a driver. */ async function fetchAvailableBookings() { console.log('Fetching available bookings...'); availableBookingsLoadingSpinner?.classList.remove('hidden'); noAvailableBookingsMessage?.classList.add('hidden'); availableBookingsTableBody.innerHTML = '<tr><td colspan="9" class="text-center py-4 text-gray-500">Loading available bookings...</td></tr>'; try { const token = localStorage.getItem('token'); const userId = localStorage.getItem('userId'); if (!userId) { // Ensure user is logged in as a driver throw new Error('Driver User ID not found. Please log in again.'); } // API call to the backend endpoint for available bookings const response = await fetch(`${API_BASE_URL}/drivers/available-bookings`, { headers: { 'Authorization': `Bearer ${token}` } }); const result = await response.json(); if (response.ok && result.success) { // Call the generic rendering function renderBookingsTable(result.data, availableBookingsTableBody, noAvailableBookingsMessage, 'available'); console.log('Available bookings fetched successfully. Count:', result.count); } else { console.error('Failed to fetch available bookings:', result.errors || result.message); availableBookingsTableBody.innerHTML = `<tr><td colspan="9" class="text-center py-4 text-red-500">${result.errors?.[0]?.message || result.message || 'Error loading available bookings.'}</td></tr>`; showMessageBox('Error loading available bookings.', 'error'); } } catch (error) { console.error('Fetch available bookings error:', error); availableBookingsTableBody.innerHTML = `<tr><td colspan="9" class="text-center py-4 text-red-500">Network error or backend issue.</td></tr>`; showMessageBox('Network error: Could not fetch available bookings.', 'error'); } finally { availableBookingsLoadingSpinner?.classList.add('hidden'); } }
```

## APPENDIX C: USER MANUAL EXCERPT-

This excerpt provides step-by-step instructions for a customer using the Transtruck Transport System to book a service.

### TRANSTRUCK USER MANUAL: BOOKING A TRANSPORT SERVICE

This guide will walk you through the simple steps to book a transport service using the Transtruck web platform.

***Before You Begin:***

Ensure you have an active Transtruck account. If not, please register first.

Have details about your cargo (type, weight), pickup location, and delivery location ready.

*Steps:*

1. **Log In to Your Account:**
   - Visit the Transtruck homepage (index.html).
   - Click the "Login / Register" button in the navigation bar.
   - Enter your registered email and password in the Login tab.
   - Click "Login." You will be redirected to the Transport Page (transporters.html).
2. **Access the Booking Form:**
   - On the Transport Page, ensure you are in the "Book a Transport Service" section.
   - If you are a registered customer, the booking form will be visible.
3. **Fill in Transport Information (Step 1 of 3):**
   - **Customer Type:** Select "Individual User," "Farmer," or "Vendor" as appropriate.
   - **Vehicle Type:** Choose the type of vehicle required from the dropdown (e.g., Lorry, Pickup, Refrigerated Truck).
   - **Cargo Type:** Select the type of goods you are transporting (e.g., General Cargo, Perishable Goods, Livestock).
   - **Approx. Weight (kg):** Enter the estimated weight of your cargo in kilograms.
   - **Pickup Date:** Select your desired pickup date using the calendar.
   - **Pickup Location (County & Town):** Choose the county and specific town where the cargo will be picked up.
   - **Delivery Location (County & Town):** Choose the county and specific town where the cargo needs to be delivered.
   - **Special Requirements:** (Optional) Provide any additional notes for the driver or special handling instructions (e.g., "handle with care," "requires immediate offloading").
   - Click the "**Next**" button to proceed to the next step.

4. **Provide Contact Details & Purpose (Step 2 of 3):**
    - Your Name & Phone: These fields might be pre-filled if you are logged in. Verify their accuracy.
    - Purpose of Transport: Select the primary reason for this transport (e.g., "General Use," "Farm Produce Logistics," "Business Supply," "Emergency").
    - Emergency Contact/Details: (Only if "Emergency" is selected) Provide an emergency contact number and a brief description of the emergency.
    - Business Details: (Only if "Vendor" is selected) Provide your Business Name, Business License Number, Business Contact Email, and optionally upload a Business Registration Certificate.
    - Click the "Next" button.
5. **Review and Confirm Booking (Step 3 of 3):**
    - Review all the details you've entered carefully on the summary screen.
    - Check the Estimated Price provided.
    - Click the "Confirm Booking" button.
6. **Booking** Confirmation:
    - A confirmation message will appear, including your unique Tracking ID. Please save this ID.
    - You can copy the tracking ID using the "Copy Tracking ID" button.
    - Your booking is now registered, and you can track its progress using the provided ID.

**Note:** For emergency bookings, the system will prioritize dispatch. For other bookings, you will receive notifications as the status of your shipment changes.

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