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RESEARCH ARTICLE

Transport Management System for Africa University: A Web-Based Solution for Fleet Operations

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Abstract

Efficient transport management is essential for universities that coordinate vehicle fleets for academic and administrative purposes. At Africa University, reliance on manual systems caused delays, scheduling conflicts, and poor accountability. To address these issues, a web-based Transport Management System (TMS) was developed using ASP.NET, Visual Basic.NET, and SQL Server 2014. The system automates booking, approval, vehicle allocation, and reporting processes, providing secure access and real-time visibility for all users. Implementation of the TMS significantly improved efficiency by reducing processing time, minimizing paperwork, and enhancing coordination across departments. Automated workflows and audit trails strengthened accountability, while role-based access improved security and transparency. Users benefited from faster approvals, reliable scheduling, and accessible online services. For management, analytical dashboards enabled data-driven decisions on fleet utilization and resource optimization. Although challenges arose during implementation—such as system integration and user adaptation—ongoing training and technical support ensured successful adoption. The system's modular structure supports future enhancements like GPS tracking, predictive maintenance, and mobile access. Overall, the TMS demonstrates how digital transformation can enhance institutional logistics, reduce operational costs, and promote sustainable management practices at Africa University.

Keywords
Transport Management System; Automation; Institutional Efficiency; Web Application; Africa University.

1 | INTRODUCTION

Efficient transport management is a critical aspect of institutional operations, particularly for universities that coordinate vehicle fleets for academic, administrative, and logistical functions. At Africa University, the reliance on manual processes for transport scheduling, vehicle allocation, and driver coordination has resulted in significant inefficiencies, including delayed approvals, conflicting schedules, and fragmented record-keeping. Similar challenges have been documented in fleet management literature, where traditional paper-based systems have been found to impede accountability and hinder performance optimization (Zantout *et al*., 2009; Alnaanah & Aljaafreh, 2011). Technological advances in web-based applications, GPS integration, and database management have transformed the

management of institutional fleets by improving traceability, resource allocation, and decision-making (Lin & Ku, 2011; Rémy *et al*., 2012). For Africa University, the adoption of a Transport Management System (TMS) offers a pragmatic solution to existing administrative and operational burdens. By transitioning from manual coordination to a web-based platform, transport requests can be processed electronically, vehicle and driver assignments can be optimized, and all stages of trip management—from booking to security verification—can be tracked in real time. Such automation not only reduces staff workload but also enhances transparency and accountability across departments (Abdullahi, 2016; Chikafalimani, Kibwami, & Moyo, 2021). Furthermore, the shift toward digital systems aligns with broader efforts across African higher education institutions to modernize administrative frameworks and leverage technology for institutional efficiency (Arowosegbe, 2016; Netshakhuma, 2019). Implementing a structured TMS also supports Africa University's strategic objectives by addressing the growing demand for mobility and logistics coordination arising from campus expansion (Arowosegbe, 2023). The proposed web-based solution employs ASP.NET, Visual Basic.NET, and SQL Server 2014 to automate booking, approval, and reporting workflows while integrating key functionalities such as driver scheduling, fleet tracking, and performance analytics. Its core objectives include eliminating redundant paperwork, enabling real-time visibility of fleet operations, improving communication among requesters, approvers, and drivers, and promoting data-driven decisions for resource management. In effect, the TMS positions Africa University as a forward-looking institution that integrates information technology to strengthen operational effectiveness and enhance service delivery in transport logistics.

2 | SYSTEM SPECIFICATIONS

The Transport Management System (TMS) for Africa University is developed using a three-tier web application architecture designed to ensure scalability, reliability, and ease of maintenance. The presentation layer consists of a browser-based interface built with responsive design principles, allowing seamless access through desktop and mobile devices. It provides role-based dashboards that cater to different user categories—such as administrators, drivers, security personnel, and departmental staff—and includes user-friendly forms for booking, approval, and transport management activities. The business logic layer, implemented in ASP.NET and Visual Basic.NET, manages the system's core functionalities including user authentication, authorization, workflow automation, approval processes, and driver and vehicle assignments, while ensuring that operational rules and data validations are consistently applied. The data access layer employs Microsoft SQL Server 2014 to handle data storage and retrieval through structured stored procedures that maintain transactional integrity, manage database operations, and support data backup and recovery. Integration with Google Drive enables secure cloud-based document storage and sharing, Crystal Reports facilitates analytical and statistical report generation, and an email notification service ensures timely communication among system users. The system requires modest yet stable hardware resources for both server and client operations. On the server side, the recommended configuration includes an Intel Core i3 2500T processor (3.3 GHz or higher), at least 4 GB of RAM—preferably 8 GB for optimal performance—and a minimum of 500 GB of available storage space. A reliable network interface card and an internet connection speed of at least 1256 kbps are also required, along with standard input devices for administration. For client machines, the system supports Microsoft Windows 7 or later, as well as iOS and Android operating systems for mobile devices. The minimum specifications include a processor equivalent to Intel Celeron B820 or AMD E2-1800 (1.7 GHz or higher), 2 GB of RAM, an internet connection of at least 1256 kbps, and input devices such as a keyboard, mouse, or touchscreen interface.

From a software perspective, the server environment utilizes Microsoft Visual Studio 2013 (64-bit) with ASP.NET for application logic, JavaScript for client-side interactivity, and Cascading Style Sheets (CSS) for interface design. Visual Basic.NET provides the server-side logic, while Microsoft SQL Server 2014 (64-bit) supports database management. Crystal Reports (64-bit) is used for report generation, Google Drive integration enables cloud storage, and Internet Information Services (IIS) serves as the web hosting platform. The client-side software requirements include a modern web browser such as Google Chrome, Mozilla Firefox, Safari, or Microsoft Edge, along with .NET Framework version 3.5 or higher, Microsoft Office 2013 for document processing, and a PDF reader for viewing generated reports. The database design incorporates several interrelated entities to ensure comprehensive data management and reporting capabilities. The **Users** table regulates system access and stores credentials and personal details, including encrypted passwords, user roles (faculty, approver, driver, security, or administrator), and account status. The **Vehicles** table maintains information on each unit in the fleet, including registration numbers, type, capacity, operational status, and service records. The Drivers table contains personnel information such as license numbers, contact details, and assignment status. Transport requests are logged in the Bookings table, which captures details such as requester identity, travel purpose, number of passengers, and approval status. Actual travel data are stored in the Trips table, recording parameters such as departure and arrival times, mileage, and trip outcomes. Additionally, the SecurityCheckpoints table documents vehicle entries and exits across university premises, with timestamps and officer verification. These tables are linked through primary and foreign key relationships, preserving referential integrity and enabling detailed performance and utilization reports across the system.

3 | SYSTEM FEATURES AND FUNCTIONALITIES

The Transport Management System (TMS) for Africa University integrates a series of interconnected modules designed to ensure efficient coordination of transport operations across all departments. Secure user management and authentication mechanisms form the foundation of the system. Each user logs in with encrypted credentials, and access privileges are defined according to role categories—Faculty Members, Approvers, Drivers, Security Officers, and Administrators. Faculty members can submit and monitor their booking requests, while approvers review, validate, and authorize requests based on departmental needs and available resources. Drivers are granted access to view assigned trips and update trip statuses, whereas security officers can verify scheduled movements at campus checkpoints. Administrators maintain overall control of the system through features that allow them to create and manage accounts, assign roles, configure workflows, and generate institutional reports. To ensure data integrity and system security, the TMS implements automatic session timeouts, activity logging, and single sign-on functionality, enabling traceable and secure user activity.

The online booking feature serves as the operational core of the system, enabling authorized users to submit transport requests through an interactive web form. Each request includes essential details such as travel date, time, destination, number of passengers, purpose, and preferred vehicle type. Upon submission, the system validates the information for completeness and consistency, automatically checking the availability of vehicles and drivers to prevent scheduling conflicts. Once verified, requests are routed to approvers, who review and act on them according to institutional transport policies. Requesters receive a confirmation containing a unique booking reference number, enabling them to track approval progress and receive automated updates. This design ensures transparency, minimizes delays, and promotes accountability. The system also accommodates cancellations or modifications for pending requests, enhancing flexibility and user autonomy.

After approval, the TMS automatically transitions the request into the allocation stage, where logistics officers assign vehicles and drivers. The allocation module displays real-time data on vehicle status—such as available, in use, or under maintenance—and indicates driver availability, qualifications, and workloads. The system recommends the most suitable pairing between vehicles and drivers based on trip distance, passenger load, and route conditions. Once assignments are confirmed, drivers are notified through their dashboards, which display trip details including destination, departure schedule, requester contact information, and assigned vehicle. Drivers can update their trip status in real time (Departed, In Transit, Arrived, Completed), record mileage, and report any incidents. Upon trip completion, the recorded data automatically update vehicle availability and driver workload within the database.

Security checkpoint management is another integral component of the TMS. Security officers stationed at entry and exit points access daily trip schedules through the system interface, which displays departure and arrival times, registration numbers, driver details, and destinations. When a vehicle arrives, the officer verifies authorization, logs check-in and check-out times, and records driver credentials. This process creates an auditable record of vehicle movement and strengthens operational accountability. Unauthorized movements can be flagged instantly, allowing logistics staff to respond promptly to irregularities. The module thereby enhances campus security, supports efficient resource tracking, and maintains comprehensive documentation of transport activities.

To support data-driven management, the TMS includes an extensive reporting and analytics feature accessible to administrators and senior management. The reporting tool generates summaries of bookings by department, status, and timeframe, as well as vehicle utilization analyses that capture efficiency levels and idle periods. Driver performance reports track punctuality, total trips, and mileage, while departmental usage reports present transport demand and consumption trends. Cost analysis reports estimate operational expenses and budget performance. Users can filter and export these reports into multiple formats such as PDF, Excel, or Word, and schedule automatic report generation for regular distribution. Complementing these features, the system's visual dashboards use interactive charts and key performance indicators (KPIs) to present real-time trends in fleet performance, workload distribution, and resource efficiency.

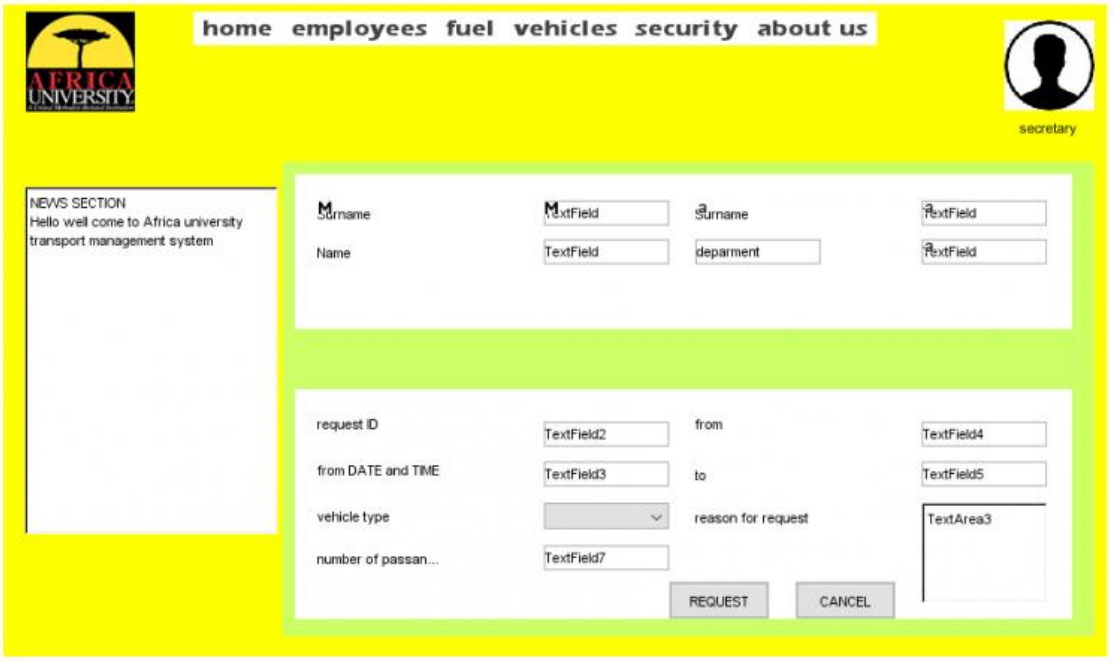

Figure 1. Main Application Interface

4 | RESULTS AND DISCUSSION

4.1 Results

4.1.1 Operational Efficiency

The implementation of the Transport Management System (TMS) at Africa University has led to substantial gains in operational efficiency across the transport department. The automation of booking, approval, and scheduling processes reduced request processing times from several hours—or even days—to only a few minutes. Manual documentation and repetitive data entry were replaced with electronic workflows, minimizing administrative workload and the likelihood of human error. Automated notifications and reminders reduced communication delays between departments, while centralized access to information improved coordination among requesters, approvers, drivers, and security officers. These improvements have resulted in more reliable scheduling, faster service delivery, and better utilization of vehicles and personnel. Overall, the system's ability to manage requests digitally has transformed day-to-day logistics management into a more efficient, transparent, and data-driven process.

4.1.2 Enhanced Accountability and Transparency

Accountability and transparency have been significantly strengthened through the integration of traceable digital records within the TMS. Every transaction—ranging from the submission of requests to trip completion—is automatically logged with timestamps and user identifiers. These digital audit trails provide verifiable evidence in the event of disputes and ensure clear attribution of responsibility at each stage of the transport process. Real-time visibility of booking statuses, vehicle allocations, and driver activities ensures that all stakeholders can access accurate and current information. Such transparency fosters trust among users, supports equitable resource allocation, and enhances institutional oversight. The introduction of a consistent, verifiable data structure also empowers the university to monitor staff performance, enforce compliance, and establish a culture of operational integrity.

4.1.3 Improved Service Quality

The system has notably improved the quality of transport services provided to the university community. Faculty and staff now benefit from convenient, round-the-clock access to online booking tools that enable immediate request submission, approval tracking, and trip confirmation. The automated workflow eliminates scheduling conflicts and reduces cancellations, while users receive timely notifications and updates throughout the booking cycle. Drivers benefit from clearer trip information, better workload balance, and recognition for punctuality and performance. Meanwhile, security personnel have gained more effective tools for verifying vehicle

movements, maintaining digital checkpoint records, and enhancing overall campus safety. By integrating all stakeholders within a single platform, the TMS ensures that communication is efficient, responsibilities are clearly defined, and service reliability is consistently maintained.

4.1.4 Strategic Decision Support

From a strategic management perspective, the TMS provides valuable analytical insights that support evidence-based decision-making. Comprehensive data on vehicle usage patterns, peak demand periods, and departmental transport needs allow administrators to assess performance trends and make informed adjustments to fleet operations. The system's reporting tools generate detailed analyses of driver performance, vehicle utilization, and departmental consumption, supporting accurate cost estimation and budget planning. Visual dashboards and automated reports offer quick access to performance indicators, facilitating strategic discussions and policy evaluation. Over time, these data-driven insights contribute to improved asset management, extended vehicle lifespans, and reduced operational costs. The system therefore not only addresses current logistical challenges but also provides a foundation for sustainable, long-term resource planning aligned with institutional objectives.

4.2 Discussion

Despite the measurable benefits achieved through implementation, several challenges were identified during the adoption of the Transport Management System. On the technical side, ensuring stable internet connectivity across campus facilities proved crucial for maintaining consistent system access, particularly during peak operational hours. Integration with existing IT infrastructure—such as student information, human resources, and financial systems—required additional development and testing to ensure interoperability. Maintaining reliable data backup and recovery procedures also remained a key concern for long-term sustainability. From an organizational perspective, the transition from manual to digital workflows introduced a period of adaptation. Resistance to change among some users was initially evident, emphasizing the importance of effective training and communication strategies. Continuous user education was essential to promote accurate data entry, as the system's analytical reliability depended heavily on the quality of input information. Institutional policies were revised to align with automated workflows, clarifying approval hierarchies, service-level expectations, and accountability structures. Security and compliance considerations were prioritized throughout implementation.

The TMS incorporates HTTPS encryption, password hashing, user access controls, and audit logging to protect data integrity and confidentiality. Regular software updates and security reviews ensure adherence to institutional data protection standards and regulatory frameworks. Backup systems and disaster recovery plans further safeguard against information loss or cyber incidents, reinforcing confidence in the system's resilience. Looking toward the future, the scalability and modular design of the TMS present opportunities for continued enhancement. Planned upgrades include the integration of GPS-based vehicle tracking, predictive maintenance scheduling, and mobile applications for iOS and Android to improve accessibility and real-time coordination. Advanced analytics powered by machine learning could enable demand forecasting and route optimization, while API integrations may allow seamless connectivity with financial, academic, and administrative systems. As the university continues to expand, the TMS architecture can be scaled to accommodate additional users, vehicles, and campuses, ensuring long-term adaptability. Ultimately, the TMS at Africa University demonstrates how a well-designed digital solution can redefine institutional logistics by combining automation, accountability, and analytical insight. With sustained commitment to maintenance, training, and iterative improvement, the system has the potential not only to support the university's operational goals but also to serve as a replicable model for similar institutions across the region.

5 | CONCLUSION AND RECOMMENDATIONS

The Transport Management System (TMS) developed for Africa University provides an integrated digital framework that addresses the long-standing inefficiencies and coordination challenges faced by the institution's transport department. By shifting from manual procedures to an automated web-based platform, the university has significantly improved the management of its logistics operations through enhanced efficiency, accountability, and service reliability. Built using established technologies such as ASP.NET and SQL Server, the system ensures robust performance, scalability, and ease of maintenance, while its modular architecture supports future enhancements and seamless integration with other institutional systems. The system effectively streamlines the entire transport management process, covering online booking, approval workflows, vehicle and driver assignment, trip monitoring, and reporting. Automation reduces administrative workload, minimizes scheduling errors, and accelerates request processing. Through role-based access control, each user—whether faculty, approver, driver, or administrator—interacts with relevant functions, ensuring operational order, data security,

and efficient task execution. Furthermore, detailed audit trails, real-time data visibility, and centralized documentation strengthen transparency and accountability across all operational levels. Beyond improving operational processes, the TMS empowers decision-makers with analytical insights that support evidence-based planning and resource optimization. Comprehensive reports and performance dashboards allow management to evaluate vehicle utilization, cost trends, and departmental transport demands, thus facilitating better policy formulation and budg*et al*location. In this sense, the TMS not only enhances daily logistics management but also contributes strategically to the university's broader goals of institutional effectiveness, sustainability, and technological modernization.

To ensure long-term success and sustainability, several strategic actions are recommended. The university should maintain a dedicated multidisciplinary project team comprising IT personnel, logistics officers, and departmental representatives to oversee ongoing system improvement and user engagement. Continuous stakeholder consultation is essential to ensure that the system evolves in alignment with operational needs. Investment in reliable infrastructure—including secure servers, stable internet connectivity, and comprehensive data backup systems—must be prioritized to guarantee uninterrupted service delivery and data security. Equally important is the development of extensive user training and support programs tailored to different roles within the system. Implementing a phased adoption approach, beginning with pilot testing and incremental rollout, allows for refinement based on user feedback before full deployment. Clear institutional policies and procedures must also be established to govern transport requests, approval hierarchies, vehicle utilization, and reporting responsibilities. Performance indicators such as response times, resource utilization rates, and user satisfaction should be regularly monitored to assess efficiency and identify areas for improvement. Moreover, continuous improvement should be embedded into system management practices through periodic evaluation, software updates, and feature upgrades informed by user experience and emerging technological trends. Comprehensive documentation of system architecture, configuration, workflows, and training materials is necessary to support knowledge transfer and ensure operational continuity. Finally, visible leadership support and institutional commitment are critical for sustaining user engagement and overcoming resistance to change. In summary, the Transport Management System at Africa University represents a successful example of how digital innovation can transform institutional logistics by integrating technology, data, and management processes. With ongoing investment, strong governance, and a culture of continuous improvement, the system is well-positioned to enhance operational excellence, strengthen accountability, and serve as a replicable model for other educational institutions and organizations seeking to modernize their transport operations.

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