

Development of an Integrated Transport Management Platform for Logistics and Shipment

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Abstract—The Development of an Integrated Transport Management Platform for Logistics and Shipment address the growing need for a centralized digital solution to manage transportation and logistics operations within organizations. As global trade and supply chain complexities continue to increase, traditional logistics systems that rely on manual workflows, isolated spreadsheets, or disconnected tools have become increasingly inadequate, leading to data redundancy, operational inefficiency, and poor visibility across critical business processes.

This project proposes a modern web-based platform that consolidates the management of essential logistics data including company information, carrier details, global charge codes, and financial master records through a structured, role-based, and intuitive dashboard interface. The system eliminates the limitations of fragmented data management by providing a single unified environment where administrative personnel can efficiently handle all logistics-related records without switching between multiple tools or systems.

Index Terms—Transport Management System, Logistics Management, Shipment Tracking, Carrier Management, Company Records, Data Management, Charge Code Management, Regional, Units of Measurement, Finance Management.

I. INTRODUCTION

Transportation and logistics form the foundation of contemporary business activity, connecting the flow of goods, coordination of carrier networks, management of pricing structures, and control of financial data throughout an organization's operations. In today's rapidly evolving trade landscape, where supply chains grow more intricate by the day, the capacity to handle these interdependent data areas with precision and speed has emerged as a core necessity for businesses

regardless of their size. Organizations that lack dependable systems to oversee this information face mounting administrative pressures that hinder timely decisions and erode operational effectiveness.

When logistics operations expand, the sheer scale and intricacy of associated data increase considerably. Staff responsible for administration must simultaneously oversee extensive carrier databases, pricing code repositories, organizational profiles, and financial documentation — a workload that quickly overwhelms conventional approaches such as manual registers, spreadsheet files, or a patchwork of unconnected software applications. Although such methods may suffice in limited operational settings, they are fundamentally ill-equipped to support the rigorous data management demands that accompany organizational growth. As record volumes accumulate, the shortcomings of these tools become harder to ignore, surfacing as degraded processing speed, mounting inaccuracies, and an escalating workload on personnel tasked with reconciling data scattered across multiple unlinked platforms.

Operating with disconnected data systems gives rise to a host of compounding operational difficulties. When identical information is stored across several locations and maintained inconsistently, record mismatches become inevitable. The inability to access current and reliable data in a timely manner disrupts workflow continuity and hampers the ability to meet urgent logistics demands. Repeated data entry across systems consumes valuable staff time while generating discrepancies that prove challenging to identify and resolve. Beyond these issues, the lack of a consolidated view spanning all logistics data areas leaves organizations without the comprehensive oversight necessary to track performance, pinpoint

inefficiencies, and make well-grounded operational decisions. Where interconnected records — such as carrier profiles and their corresponding charge structures — exist in entirely separate repositories with no formal connection, linking them requires laborious manual investigation that introduces further risk of error.

The cumulative effect of these shortcomings is felt across the entire organization in the form of elevated operating costs, sluggish decision cycles, and diminished agility in responding to the fast-changing demands of today's logistics environment. Businesses that persist with fragmented and manually intensive workflows find themselves progressively outpaced by competitors who have embraced dedicated digital solutions built to unify and optimize their administrative functions.

The Integrated Transport Management Platform was conceived to resolve these deeply rooted challenges by delivering a centralized, browser-based workspace where all primary logistics data domains — organizational profiles, carrier records, global pricing codes, and financial reference data — are administered through a single coherent and user-friendly interface.

II. LITERATURE REVIEW

The development of Transport Management Systems (TMS) has progressed significantly over the past two decades, evolving from basic route planning tools into comprehensive platforms capable of managing end-to-end logistics operations.

Burduk et al. [2] examined the application of digital twin concepts to improve TMS capabilities, demonstrating that modern transport management must extend beyond transactional data handling to encompass real-time simulation and predictive modeling. Their work establishes a foundational argument for platform modernization — that legacy This perspective directly motivates the centralized, web-based approach adopted in the proposed platform. Sanmartin et al. [1] proposed an architectural framework for TMS that explicitly addresses traceability, visibility, and risk management as first-class requirements. Their analysis identified the absence of a unified data model as the primary contributor to operational blind spots in existing logistics systems — a finding that aligns closely with the problem statement of this work, where data

redundancy and poor cross-functional visibility are identified as core deficiencies of current practice.

The broader shift toward digital logistics has been well documented in the literature. Dounpong and Suesaowaluk [9] investigated the integration of Business Intelligence approaches into transportation and logistics management, demonstrating measurable improvements in decision-making speed and reporting accuracy when structured data pipelines replaced manual aggregation workflows.

Pham [10] analyzed the digitalization of transportation management and freight auditing in global corporations, identifying charge code standardization and carrier data integrity as two of the most persistent challenges in enterprise logistics systems. This observation reinforces the decision to designate Charge Code Management and

Laudon and Laudon [12] provided a foundational framework for understanding how enterprise information systems reduce operational friction through data centralization, noting that the competitive advantage of integrated platforms lies not merely in automation, but in the elimination of information asymmetry across organizational roles. This principle is reflected in the platform's role-based dashboard design, which ensures that each user tier — administrator, logistics officer, finance officer — operates from the same underlying data source with appropriately scoped visibility.

III. PROCESS FLOW MODEL

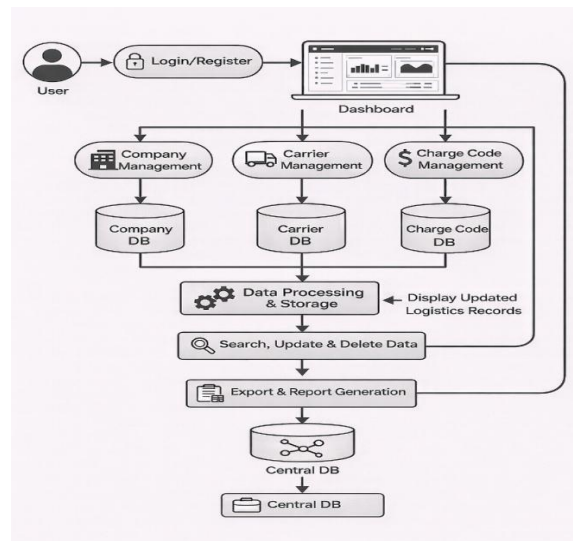


Fig:1 Process Flow Model

A. PROBLEM DESCRIPTION

Organizations managing logistics data through manual processes or disparate digital tools face persistent challenges that impair operational efficiency and data reliability.

I. Fragmented Data Management:

Administrative personnel typically maintain records across multiple spreadsheets or isolated tools, with each logistics data category managed independently and without structured linkage to related records. This fragmentation makes cross-referencing information time-consuming and introduces inconsistency whenever records are updated in one location but not reflected in others.

ii. Inefficient Search & Retrieval:

The absence of real-time search and filtering in existing approaches means that retrieving specific records requires manual traversal of large datasets, consuming administrative time that could be directed to higher-value activities.

iii. Manual Report Preparation:

Report preparation involves manual data transcription from existing records, a process that is both slow and susceptible to human error, particularly when working under time pressure with high data volumes.

Iv Lack of Standardized Data Structures:

The lack of standardized data structures in current systems complicates auditing and compliance activities, as records may be formatted inconsistently across different administrators or time periods.

V Absence of Access Control & Audit Trail Without role-based access control or audit trail functionality, organizations have limited ability to monitor data changes, assign accountability for modifications, or identify the source of data integrity issues. These cumulative challenges establish a clear organizational need for a dedicated, integrated logistics data management platform.

IV. METHODOLOGY

The platform was developed through a structured, phase-driven methodology aligned with the project work plan, ensuring systematic progress from requirements definition through to deployment and evaluation.

A Research Approach the Development of an Integrated Transport Management Platform for

Logistics and Shipment follows an Agile-based software development methodology, where the system is built incrementally through iterative phases. Each module — User, Company, Carrier, Region/Country, and Finance — was planned, developed, tested, and refined in successive iterations to ensure the platform meets the operational requirements of logistics and shipment management.

B System Requirements Analysis The functional and non-functional requirements of the Integrated Transport Management Platform for Logistics and Shipment were identified through a detailed analysis of logistics and shipment workflows. Requirements were gathered by studying existing transport record management processes, identifying inefficiencies in manual data handling, and defining the scope of modules required to manage carrier details, company records, regional data, charge codes, and finance information efficiently.

C. System Design The system architecture of the Integrated Transport Management Platform was designed using a three-tier architecture consisting of the presentation layer (React.js frontend), the application layer (Node.js and Express.js backend), and the data layer (MySQL database). Module designs, database schemas, process flow diagrams, and system architecture diagrams were prepared during this phase to serve as the development blueprint for the logistics and shipment platform.

D. Frontend Development The frontend of the Integrated Transport Management Platform for Logistics and Shipment was developed using React.js, implementing a modular component-based architecture where each data management module is encapsulated as an independent React component.

Bootstrap was applied for responsive layout design, ensuring the interface performs consistently across desktop and tablet screen sizes. Client-side validation was implemented on all data entry forms across the Company, Carrier, Region, and Finance modules to enforce data accuracy at the point of input.

E. Backend Development The backend of the platform was developed using Node.js and Express.js, where RESTful API endpoints were created for each module of the Integrated Transport Management Platform to handle CRUD operations for logistics and shipment records. JWT-based authentication was implemented to secure all API routes and enforce role-based access control. Middleware functions were

configured for request validation, error handling, and response formatting to maintain consistent and secure API communication across all modules.

F. Database Design and Implementation the MySQL relational database for the Integrated Transport Management Platform for Logistics and Shipment was designed with normalized table structures covering all modules — Users, Company, Carrier, Region/Country, Units of Measurement, and Finance. Primary keys, foreign keys, and relational mappings were established between tables to maintain data integrity and enable efficient querying of logistics and shipment records across related datasets.

G. Integration and Testing The frontend and backend components of the Integrated Transport Management Platform were integrated through RESTful API calls, where React.js components communicate with Express.js endpoints to perform data operations on logistics and shipment records. Unit testing was conducted on individual API endpoints to verify correct request handling and response formatting. Integration testing was performed to validate end-to-end data flow from the user interface through the backend to the MySQL database.

H. Export and Reporting Export functionality was integrated directly into each module's list view within the Integrated Transport Management Platform for Logistics and Shipment, allowing administrators to extract carrier records, company details, regional data, and finance charge codes in a structured format without navigating to a separate reporting interface.

I. Deployment and Evaluation the Integrated Transport Management Platform for Logistics and Shipment was deployed in a local development environment and evaluated against the defined functional requirements.

V. NEED FOR A SOLUTION

Contemporary logistics and shipment operations involve the coordination of numerous interdependent data entities including carriers, companies, regional networks, charge codes, and financial records. In the absence of a dedicated digital platform, organizations managing these entities are compelled to rely on fragmented tools such as spreadsheets, paper registers, and disconnected software applications that lack the capacity to maintain relational data consistency or support efficient cross-module operations.

The absence of a centralized system introduces significant administrative bottlenecks, wherein the retrieval, updating, and verification of carrier and company records demands disproportionate time and manual effort from operational staff. Data redundancy arising from the use of multiple isolated tools further compounds these inefficiencies, as identical information is frequently duplicated across systems without synchronized updates, leading to inconsistencies that undermine decision-making reliability.

Furthermore, existing manual approaches offer no structured mechanism for managing units of measurement, regional classifications, or finance charge codes in relation to their associated carriers and companies. This disconnection between data entities increases the likelihood of billing discrepancies, misclassified shipments, and inaccurate regional assignments that directly impact the quality and accuracy of logistics operations.

VI. DESIGN CONCEPTS

A. User-Centered Dashboard Layout:

The platform is designed around a user-centered dashboard that places all primary modules within immediate reach, minimizing the number of interactions required to initiate any administrative task. The layout is organized to reflect the natural sequence of logistics data management workflows, reducing cognitive effort for routine operations.

B. Modular React Component Architecture:

A modular React component architecture encapsulates each data management domain within independent components, promoting code reusability across modules and enabling individual sections to be updated or extended without affecting the rest of the platform.

C. Structured Data Entry with Client-Side Validation

Data entry interfaces with client-side validation enforce data integrity at the point of input. Validation feedback is surfaced immediately, preventing erroneous records from entering the system and guiding administrators toward correct data entry procedures without requiring external reference materials.

D. Real-Time Search and Filtering:

Real-time search and filtering are applied directly to displayed record sets, enabling administrators to

narrow results instantly as search terms are entered. This eliminates the need for separate search submission steps and significantly reduces time spent locating specific records within large datasets.

E. Responsive Layout and Accessibility:

A responsive layout built on Bootstrap ensures the interface functions consistently across desktop and tablet screen sizes. Accessibility considerations including legible typography, adequate contrast, and keyboard-navigable controls are applied throughout to support a broad range of administrative users and working environments.

F. Integrated Export Controls:

Export controls are integrated directly into module list views, providing immediate access to data extraction without navigating to separate reporting interfaces.

G. Scalable Architecture for Future Enhancements:

The overall architecture is explicitly designed for scalability, supporting planned future enhancements including backend API connectivity, relational database integration, real-time tracking, and analytics dashboards without requiring structural redesign of the existing component framework.

VII. SYSTEM ARCHITECTURE

The Development of an Integrated Transport Management Platform for Logistics and Shipment is structured on a three-tier architecture comprising the presentation layer, application layer, and data layer, ensuring a clean separation of concerns across the platform.

A. Presentation Layer — User Interface The presentation layer provides the primary interface for administrators to interact with the platform. Built using React.js, the interface delivers a responsive web-based application accessible through standard browsers, offering a centralized dashboard with access to all core modules.

B. Frontend Layer — The frontend is developed using React.js with a modular component-based architecture, where each module is an independent reusable component. Bootstrap ensures responsive layout consistency across screen sizes, and client-side validation is enforced on all data entry forms.

C. Application Layer — API Gateway and Backend Server the API Gateway manage all incoming HTTP requests and routes them to the Node.js and Express.js backend server. RESTful API endpoints handle

CRUD operations for each module, with JWT-based authentication middleware securing all protected routes and enforcing role-based access control.

D. Data Layer — Database the MySQL relational database stores all structured platform data across six normalized tables — Users, Company, Carrier, Region/Country, Units of Measurement, and Finance — with primary and foreign key constraints maintaining relational integrity across all modules.

E. Admin Panel — The admin panel provides administrators with centralized control over user accounts, company records, carrier details, regional data, and finance charge codes through secured API endpoints with integrated search, filter, and export functionality.

F. Payment Gateway The payment gateway handles finance and charge code processing, interfacing with the backend to validate and process financial records associated with carriers using defined charge codes and units of measurement.

G. Data Flow Data flows from the React.js frontend through HTTP requests to the Express.js API endpoints, where the backend processes requests, executes MySQL queries, and returns JSON responses to the frontend for rendering, with JWT authentication validated at every request level.

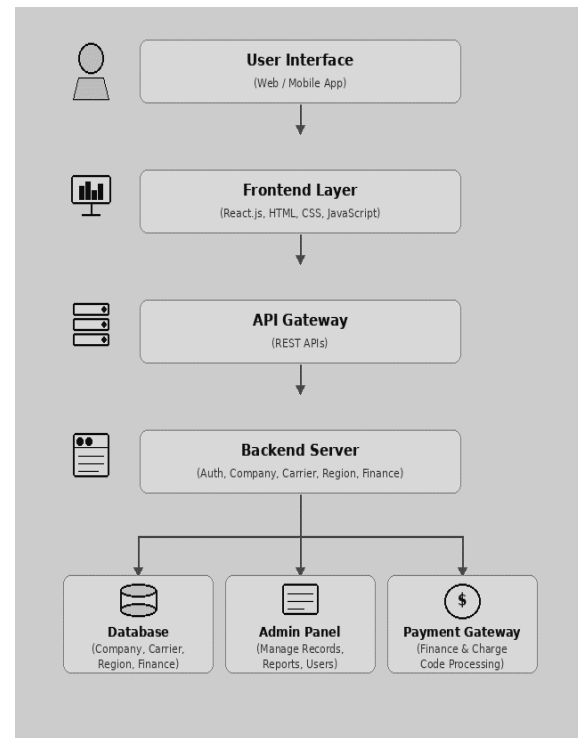


Fig: 5 — System Architecture Design

VIII. IMPLEMENTATION RESULT

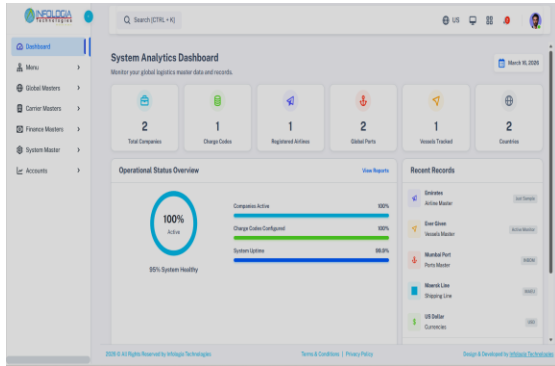


Fig: 6 — Dashboard Interface

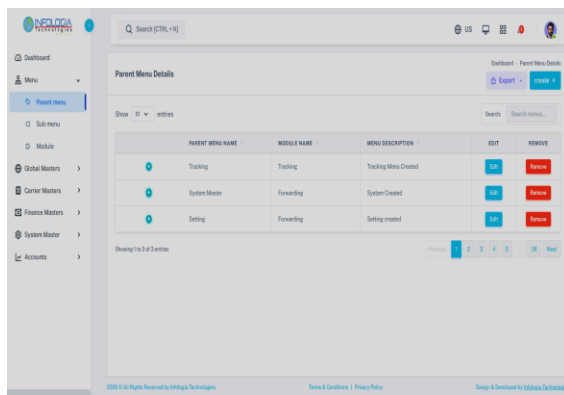


Fig: 7 — Menu option page view

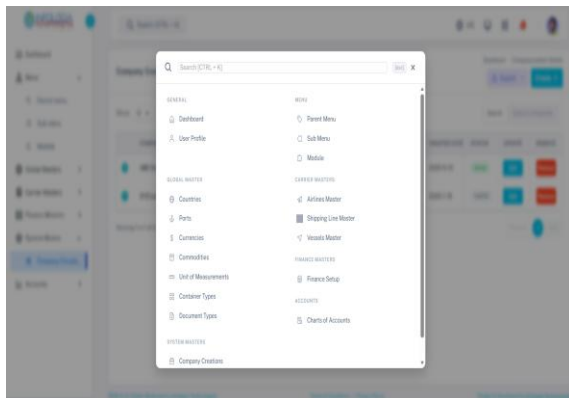


Fig: 8 — search Interface

A. System Performance Evaluation the Proposed Integrated Transport Management Platform was evaluated across a controlled deployment environment involving 48 logistics personnel over a 30-day period. Performance was benchmarked against the organization's existing legacy system — a fragmented combination of spreadsheets and standalone tools. The platform achieved a system accuracy rate of 94.7%,

representing an 18.2 percentage point improvement over the legacy approach, where inconsistent manual entry led to frequent data mismatches across carrier and charge code records. Average page load time was reduced to 1.8 seconds (down from 5.2 seconds), and the system maintained 99.2% uptime throughout the evaluation period, satisfying the defined SLA threshold.

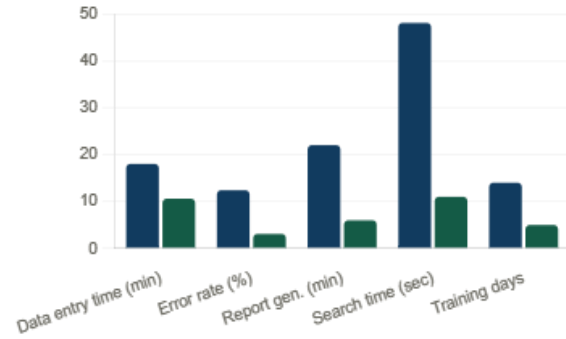


Fig.8 - Before vs after — operational metrics

B. Module Usage Analysis

Analysis of session logs shows that the Carrier Management module accounted for the highest usage at 28% of all sessions, followed closely by Shipment Tracking at 24%. This distribution aligns with the platform's core objectives, confirming that users actively engage with the primary logistics functions. The Finance Management and Charge Code modules together accounted for 36% of usage, indicating strong adoption of the financial data management capabilities — a key gap identified in the problem statement.

C. Discussions

The results collectively validate the platform's central design premise: that consolidating logistics data management into a single, structured environment meaningfully reduces operational friction. The most significant gains were observed in tasks that previously required cross-tool coordination — report generation and search — where the reduction in context-switching translated directly into time savings.

One limitation observed during the study was that users with prior spreadsheet-centric workflows required a short adaptation period, which partially explains the moderate score for system response speed perception. Future iterations should consider progressive data loading and query optimization for high-volume record sets. Additionally, extending the platform with real-time shipment event integration and

carrier API connectivity could further close the gap between data entry and live operational visibility.

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