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**KABARAK UNIVERSITY**

**SCHOOL OF SCIENCE ENGINEERING AND TECHNOLOGY**

**INTE 414: IT PROJECT**

**ACMS: A WEB-BASED SYSTEM AIR-CARGO MANAGEMENT SYSTEM**

**PRESENTED BY:**

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**PROJECT SUBMITTED TO THE DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY (UNDER THE SCHOOL OF SCIENCE ENGINEERING AND TECHNOLOGY) IN PARTIAL FULFILLMENT OF DEGREE IN INFORMATION TECHNOLOGY**

**NOVEMBER 2024**

# DECLARATION

I hereby declare that this project, titled "ACMS: A system for managing air cargos," is my original work and has not been submitted previously for any academic degree or diploma. All sources of information have been acknowledged.

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# RECOMMENDATION

This project is being submitted for examination with our approval as university supervisors.

**Signature** **Date**

**…………………………….** **..…………………………..**

[SUPERVISOR’S NAME]

**DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY**

**KABARAK UNIVERSITY**

# DEDICATION

This project is dedicated to my family and friends for their unwavering support and encouragement, and to all the citizens and law enforcement officers who work tirelessly to ensure community safety.

# ACKNOWLEDGMENT

I would like to express my sincere gratitude to my supervisor for their guidance, support, and encouragement throughout the development of this project. Special thanks to my colleagues and friends for their valuable input and feedback. I am also grateful to my family for their patience and support. Finally, I extend my appreciation to all those who contributed, directly or indirectly, to the success of this project.

# ABSTRACT

The global air cargo industry serves as a critical component of international trade, enabling the swift and efficient transportation of goods across borders. Despite its significance, the industry faces persistent challenges, including inefficient manual booking systems, lack of real-time cargo tracking, and labor-intensive documentation processes. These challenges often result in high operational costs, limited transparency, and reduced customer satisfaction. In response, this project proposes the development and implementation of a Web-Based Air Cargo Management System (ACMS) to address these issues through digital transformation and automation.

The ACMS is designed to streamline air cargo operations by integrating essential functionalities such as online booking, real-time cargo tracking, automated documentation, billing, and reporting into a unified platform. Built on a three-tier architecture using PHP, MySQL, JavaScript, HTML, and CSS, the system leverages modern web technologies to ensure a seamless and user-friendly experience. Key modules, including User Management, Cargo Booking, Documentation Management, and Reporting and Analytics, are structured to provide scalability, flexibility, and compliance with international air cargo regulations.

This study employs a mixed-methods research methodology to gather insights from diverse stakeholders in the air cargo industry, including operators, regulators, and end-users. Quantitative data is analyzed to identify operational inefficiencies and trends, while qualitative feedback highlights user pain points and preferences. The Agile System Development Life Cycle (SDLC) guides the iterative development of ACMS, ensuring continuous improvement based on user feedback and testing.

The system’s features are tailored to enhance operational efficiency, improve customer satisfaction, and reduce operational costs. Additionally, the ACMS promotes environmental sustainability by reducing reliance on paper-based processes. Testing methodologies, including unit, integration, and user acceptance testing, validate the system’s functionality, performance, and usability.

Through this study, the ACMS demonstrates significant potential to transform air cargo operations by providing an innovative, cost-effective, and scalable solution. By addressing key challenges and leveraging advanced technologies, the system contributes to improving industry-wide efficiency, supporting regulatory compliance, and fostering innovation in logistics management. The findings of this project are not only applicable to air cargo but also offer a framework for digital transformation in other logistics domains.

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# CHAPTER ONE

## Introduction

### **1.1 Background of the Study**

The global air cargo industry plays a pivotal role in the movement of goods across borders, contributing significantly to international trade and economic development. However, traditional methods of cargo management often suffer from inefficiencies, including manual processes, lack of real-time tracking, and inadequate coordination among stakeholders. As technological advancements redefine logistics, a web-based air cargo management system emerges as a necessary solution to address these challenges.

### **1.2 Statement of the Problem**

The air cargo industry faces several challenges, including:

* Inefficient Booking Processes: Manual booking systems are time-consuming and prone to errors.
* Lack of Transparency: Limited tracking options hinder customer trust and satisfaction.
* Data Management Issues: Paper-based documentation leads to inefficiencies and data loss.
* High Operating Costs: Redundant processes increase costs for operators. These issues highlight the need for a web-based system that integrates booking, tracking, and documentation into a unified platform.

### **1.3 Objectives**

### **1.3.1 General Objective**

To develop a web-based air cargo management system that improves efficiency, enhances customer satisfaction, and reduces operational costs through automation and real-time data accessibility.

### **1.3.2 Specific Objectives**

1. To design and implement an online booking platform for cargo services.
2. To provide real-time cargo tracking for customers and operators.
3. To automate the generation and management of essential cargo documentation.
4. To integrate billing and payment functionalities for seamless financial transactions.
5. To generate comprehensive reports for operational insights and decision-making.

### **1.4 Research Questions**

1. How can a web-based system improve the efficiency of air cargo operations?
2. What features are most critical for user satisfaction in an air cargo management system?
3. How does real-time tracking impact customer trust and retention?
4. What are the technical challenges in implementing a scalable web-based platform for air cargo management?
5. How can the system ensure compliance with international air cargo regulations?

### **1.5 Proposed System:**

The proposed web-based system is a management platform designed to address the inefficiencies in current air cargo operations. This system centralizes the management of core functionalities, such as cargo booking, tracking, documentation, billing, and reporting. By leveraging modern web technologies, it provides an intuitive interface for both operators and customers, enabling seamless interactions and real-time data accessibility.

The system aims to automate repetitive tasks, reduce manual errors, and enhance transparency across all stages of the cargo lifecycle. Unlike traditional systems, which rely heavily on paper-based workflows, the proposed system emphasizes digitalization and automation to improve operational efficiency and customer satisfaction. Furthermore, its modular design ensures scalability and adaptability to meet the diverse needs of small and large-scale operators.

With features like online booking and tracking, automated document generation, and integrated payment solutions, the system addresses key pain points in the air cargo industry. It also supports regulatory compliance by automating the creation of essential documents such as air waybills (AWB) and customs clearance forms, ensuring smooth operations in international logistics.

#### **1.6 System Modules:**

The system is composed of several modules, each designed to address specific aspects of air cargo management. Below is a detailed description of the key modules:

#### **1.6.1 User Management Module**

This module provides role-based access control to ensure that different users have access to functionalities relevant to their roles. The system accommodates three primary roles:

* Administrators: Manage system configurations, monitor user activities, and generate reports.
* Cargo Agents: Handle bookings, manage shipments, and coordinate with other stakeholders.
* Customers: Book cargo services, track shipments, and access invoices.

The user management module ensures data security and confidentiality through multi-factor authentication and activity logging.

#### **1.6.2 Cargo Booking Module**

This module simplifies the process of booking air cargo services. Customers can log in to the system, provide shipment details (such as cargo type, weight, and destination), and select available schedules. Once the booking is confirmed, an air waybill (AWB) is generated automatically.

Key features include:

* User-friendly booking interface.
* Real-time availability of cargo space and schedules.
* Automatic generation of booking confirmations and documentation.

#### **1.6.3 Cargo Tracking Module**

The tracking module offers real-time visibility into the status and location of shipments. Customers and agents can track shipments through a unique tracking number provided at the time of booking. Updates are made at every checkpoint, providing transparency and improving customer trust.

Features include:

* Real-time GPS integration for shipment location.
* Notifications for key events, such as departure, arrival, and delivery.
* Historical tracking data for reference.

#### **1.6.4 Documentation Management Module**

This module automates the generation and management of essential air cargo documents, including:

* Air Waybills (AWB)
* Invoices
* Customs clearance forms
* Cargo manifests

It reduces paperwork, minimizes errors, and ensures compliance with international standards such as those set by IATA.

#### **1.6.5 Billing and Payments Module**

The billing module automates the generation of invoices for completed services. Customers can review and settle payments through integrated payment gateways. This module supports multiple payment methods, including credit/debit cards, bank transfers, and online payment platforms.

Features include:

* Automated invoicing based on shipment details.
* Integration with secure payment gateways.
* Support for multiple currencies and tax calculations.

#### **1.6.6 Reporting and Analytics Module**

This module provides valuable insights into operational performance through customizable reports. Key stakeholders can access metrics related to bookings, revenue, cargo status, and customer feedback. This module supports decision-making by presenting data in an easily digestible format through charts and dashboards.

Key functionalities include:

* Generation of operational, financial, and customer satisfaction reports.
* Visualization of data through dashboards.
* Export options in various formats

This design also allows for future enhancements, ensuring the system remains adaptable to the evolving needs of the industry.

### **1.7 Justification for the Study**

The justification for developing a web-based air cargo management system lies in addressing critical challenges faced by the air cargo industry and harnessing the potential benefits of technology. The air cargo sector is a cornerstone of global trade, enabling the rapid movement of goods across continents. However, many operators continue to rely on outdated systems, which hinders their ability to meet the increasing demands for efficiency, transparency, and scalability.

Key reasons justifying the need for this study include:

1. Growing Demand for Speed and Efficiency:  
   The globalization of trade has increased the demand for faster delivery of goods. Customers expect real-time updates and seamless interactions, which traditional systems fail to provide. A web-based solution meets these demands by automating processes and providing real-time tracking and updates.
2. Reducing Operational Costs:  
   Inefficient manual processes lead to increased labor costs and errors that result in financial losses. Automating cargo booking, documentation, and billing reduces these costs, offering a cost-effective alternative for operators.
3. Enhancing Customer Experience:  
   Customers are more likely to choose services that are easy to use and offer transparency. Features like online booking, shipment tracking, and automated notifications improve customer satisfaction and loyalty.
4. Regulatory Compliance:  
   Air cargo operations are subject to stringent international regulations, including documentation and customs requirements. The proposed system ensures compliance by automating the creation and storage of required documents, reducing the risk of penalties and delays.
5. Environmental Considerations:  
   Digitalizing operations reduces reliance on paper-based processes, contributing to more sustainable and environmentally friendly practices.
6. Scalability for Future Growth:  
   As the volume of air cargo continues to grow, systems must be able to handle increased demand. A web-based system offers scalability, ensuring that operators can expand their services without significant overhauls.

### **1.8 Feasibility Study**

This study assesses the practicality, viability, and potential success of the project from various perspectives.

* + - * 1. Technical Feasibility: The technical feasibility evaluates whether the proposed system, SafeWatch, can be developed using current technology and infrastructure. It considers factors such as the availability of web application frameworks, compatibility with existing browser platforms and integration capabilities with necessary data analytics tools and mapping APIs. ACMS is technically feasible, leveraging robust web technologies and scalable architectures to support its features and functionalities.
        2. Economic Feasibility: The economic feasibility evaluates the financial viability of developing and maintaining ACMS. It includes cost benefit analysis, budget allocations for development, deployment, and maintenance, as well as potential return on investment (ROI) through improved crime management and public safety outcomes. ACMS exhibits positive economic feasibility, with projected cost savings from streamlined crime reporting processes, enhanced resource allocation efficiency, and potential revenue streams from partnerships or premium features.
        3. Operational Feasibility: The operational feasibility assesses whether ACMS can be effectively implemented and integrated into existing operations. It examines factors such as user acceptance, ease of use of the application interface, training requirements for users and administrators, and ongoing maintenance and support needs. ACMS demonstrates strong operational feasibility, with intuitive user interfaces, training strategies, and a structured approach to maintenance and support.
        4. Schedule Feasibility: The schedule feasibility evaluates whether ACMS can be developed and deployed within a reasonable time frame. It includes project timelines, milestones for research, design, development, testing and potential risks and mitigation strategies that could impact the project schedule. ACMS demonstrates feasible scheduling, with a structured development plan, iterative testing cycles, and contingency plans for addressing unforeseen delays or issues.

### **1.9 Significance of the Study**

The study of a web-based air cargo management system holds significant value for various stakeholders in the air cargo industry, including operators, freight forwarders, customers, and regulators. The implementation of this system addresses long-standing challenges while unlocking opportunities for efficiency, innovation, and growth. Below are the key areas of significance:

#### **1.9.1 Operational Efficiency**

One of the most immediate benefits of this study is the enhancement of operational efficiency. Traditional air cargo systems involve numerous manual processes, such as booking, documentation, and tracking, which are time-consuming and error-prone. By automating these workflows, the proposed system reduces processing time and human errors, enabling operators to handle larger volumes of shipments with the same or fewer resources.

#### **1.9.2 Enhanced Customer Experience**

Customer satisfaction is a critical factor in the highly competitive logistics industry. The system provides tools such as real-time tracking, automated notifications, and online booking, which significantly improve the customer experience. Customers can book services, track shipments, and access invoices from the comfort of their homes or offices, leading to greater trust and loyalty.

#### **1.9.3 Cost Reduction**

By streamlining operations, the system reduces the costs associated with manual tasks, paper-based documentation, and inefficient workflows. These savings are especially beneficial for small and medium-sized operators, enabling them to compete with larger players in the industry. Furthermore, the integration of billing and payment gateways reduces financial overheads and delays.

#### **1.9.4 Regulatory Compliance**

The air cargo industry is governed by stringent international and regional regulations. Non-compliance can result in delays, fines, and loss of business. The system’s automated documentation module ensures that all necessary documents, such as air waybills and customs clearance forms, are accurate and adhere to regulatory standards. This reduces the risk of penalties and enhances the operator's reputation with authorities and clients.

#### **1.9.5 Real-Time Data Accessibility**

In the modern logistics landscape, the ability to access real-time data is invaluable. The system provides real-time updates on shipment status, availability of cargo space, and financial transactions. This not only improves decision-making but also enhances coordination among stakeholders, including operators, agents, and customers.

#### **1.9.6 Environmental Sustainability**

Paper-based processes are still prevalent in many parts of the air cargo industry, contributing to waste and inefficiency. By digitalizing documentation and reducing reliance on physical records, the system promotes sustainable practices. This aligns with global efforts to reduce the environmental impact of logistics operations.

#### **1.9.7 Scalability and Flexibility**

The modular design of the system ensures it can be scaled to meet the needs of different operators, from small businesses to large multinational cargo firms. This scalability is crucial in an industry where demand can fluctuate due to seasonal peaks or global events. Additionally, the system’s flexibility allows for customization to meet the unique requirements of various operators and regions.

#### **1.9.8 Support for Decision-Making**

The inclusion of a robust reporting and analytics module provides operators with valuable insights into their operations. Managers can analyze trends, identify bottlenecks, and forecast future demand. These insights support strategic decision-making and help operators optimize their resources and services.

#### **1.9.9 Competitive Advantage**

In a market where customers are increasingly demanding transparency and speed, adopting such a system gives operators a competitive edge. Companies with advanced digital systems are perceived as more reliable and innovative, which can lead to increased market share and customer retention.

#### **1.9.10 Contribution to Research and Innovation**

This study adds to the growing body of knowledge in logistics and supply chain management. By exploring the design and implementation of a web-based system tailored to air cargo operations, it sets a foundation for further research and innovation in the sector. The study's findings can inspire future developments in related fields, such as multi-modal logistics or AI-driven optimization.

#### **1.9.11 Economic and Industry-Wide Impact**

At a macro level, the system contributes to the efficiency of the air cargo industry as a whole. By improving the speed and reliability of cargo movements, the system supports global trade and economic growth. Operators that adopt such systems contribute to a more robust and resilient logistics network, benefitting customers and industries worldwide.

### **1.10 Scope and Limitations of the Study**

#### **1.10.1 Scope**

The study focuses on the development and implementation of a web-based air cargo management system. The system is designed to provide solutions to key aspects of cargo operations, such as booking, tracking, documentation, billing, and reporting. The scope includes:

* User Roles: Targeted users include administrators, cargo agents, and customers.
* Core Features: Real-time tracking, online booking, automated documentation, and billing systems.
* Integration: Interfaces with third-party systems like customs clearance platforms and payment gateways.
* Deployment: The system will be accessible via web browsers and optimized for mobile devices.
* Geographical Focus: While initially designed for a specific operator, the system can be scaled for global use.

#### **1.10.2 Limitations:**

Despite its potential, the study and the proposed system have several limitations:

1. Dependency on Internet Connectivity:  
   The system requires stable internet access for real-time data updates and functionality. In areas with poor connectivity, users may experience delays or interruptions.
2. Initial Costs and Training:  
   While the system reduces operational costs over time, its initial implementation, including hardware, software, and training, may be costly for smaller operators.
3. Limited Coverage to Air Cargo:  
   The system is tailored to air cargo operations and does not address multi-modal logistics involving land or sea freight. This limits its applicability for operators managing diverse cargo transportation methods.
4. Security and Data Privacy Risks:  
   Being a web-based system, it is exposed to Cybersecurity threats. Although measures like encryption and role-based access control are incorporated, there is always a residual risk of data breaches.
5. Regulatory Variations:  
   Air cargo regulations vary by country, and the system may need customization to comply with specific regional requirements, which could delay deployment in certain markets.
6. User Adoption Challenges:  
   Some stakeholders, particularly those accustomed to traditional methods, may resist transitioning to a digital system. Overcoming this resistance may require significant effort in training and change management.
7. Scope of Integration:  
   While the system supports third-party integrations, not all legacy systems used by operators and partners may be compatible, leading to potential gaps in data exchange.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 GENERAL OVERVIEW

The literature review examines existing studies, systems, and frameworks related to air cargo management and web-based logistics systems. This chapter highlights the strengths and weaknesses of current solutions, identifies knowledge gaps, and establishes the foundation for the proposed system.

## **2.1 Overview of Air Cargo Management**

Air cargo management encompasses the coordination of the movement of goods via air transportation, including activities such as booking, scheduling, documentation, and tracking. According to the International Air Transport Association (IATA), air cargo accounts for over 35% of global trade by value, even though it represents less than 1% of total trade volume. The industry is pivotal for high-value goods, pharmaceuticals, and perishable items.

### **2.1.1 Challenges in Traditional Air Cargo Management**

Several studies ( Fichter & Clausen, 2020; Kumar et al., 2019) identify inefficiencies in traditional air cargo management systems:

* Manual Processes: Dependence on paper-based documentation increases processing time and introduces errors.
* Lack of Real-Time Data: Customers and operators face difficulties in tracking shipments accurately.
* Inefficient Communication: Poor integration between stakeholders, such as airlines, freight forwarders, and customs authorities, leads to delays.

These challenges underscore the need for digital solutions to improve efficiency and transparency in air cargo operations.

## **2.2 Existing Digital Solutions in Air Cargo Management**

### **2.2.1 Legacy Systems**

Legacy air cargo management systems, primarily implemented in the 1990s and early 2000s, focused on basic automation of booking and scheduling. These systems were often standalone applications, lacking integration with other systems and offering limited scalability. A study by Zhang et al. (2021) found that these systems were prone to compatibility issues with modern technologies, hindering their adoption in today’s globalized market.

### **2.2.2 Cloud-Based Systems**

Cloud computing has revolutionized logistics management by providing scalable, flexible, and cost-effective solutions. Platforms such as Cargo Wise and Descartes offer comprehensive logistics management tools. However, these systems often target large operators and require significant financial investment, making them less suitable for small and medium enterprises (SMEs) (Liu et al., 2020).

### **2.2.3 Integration with IoT and Blockchain**

Recent innovations in IoT and blockchain have been explored to enhance air cargo operations:

* IoT: Sensors enable real-time tracking of shipments, especially for temperature-sensitive goods like vaccines. However, IoT implementation requires significant infrastructure investment (Gligor et al., 2021).
* Blockchain: Blockchain enhances transparency and security in documentation processes, such as air waybills. Research by Prakash et al. (2022) shows potential benefits but highlights issues with scalability and high implementation costs.

## **2.3 Web-Based Systems in Logistics**

### **2.3.1 Advantages of Web-Based Systems**

Web-based systems offer several advantages over traditional and standalone applications:

1. Accessibility: Users can access the system from any device with internet connectivity, enhancing flexibility.
2. Cost-Effectiveness: Reduced dependency on on-premise hardware minimizes initial investment.
3. Real-Time Updates: Real-time data availability improves tracking and operational decision-making.
4. Scalability: Modular designs allow systems to grow with the business needs.

A study by Chiu et al. (2021) emphasizes that web-based systems are particularly effective in industries requiring dynamic coordination between multiple stakeholders, such as air cargo.

### **2.3.2 Limitations of Web-Based Systems**

Despite their advantages, web-based systems have certain limitations:

* Dependence on Internet Connectivity: Systems cannot function without stable internet access, which can be an issue in remote areas.
* Security Risks: Cybersecurity threats, such as data breaches and hacking, pose significant challenges to web-based systems.
* User Adoption: Resistance to change among users accustomed to traditional methods can hinder implementation (Mishra & Singh, 2020).

## **2.4 Technological Frameworks for Logistics Systems**

### **2.4.1 Role of Automation**

Automation has been a game-changer in logistics, streamlining repetitive tasks and reducing human error. Tools like Robotic Process Automation (RPA) have been applied to automate billing, tracking, and reporting processes in air cargo. Studies (e.g., Lee et al., 2019) highlight how automation reduces operational costs and improves efficiency.

### **2.4.2 Data Analytics and Reporting**

Data analytics plays a vital role in decision-making for logistics operators. Systems that incorporate business intelligence tools provide insights into shipment patterns, customer behavior, and financial performance. Research by Kim et al. (2022) shows that companies using data-driven decision-making achieve 20-30% higher operational efficiency.

### **2.4.3 Role of APIs and Integration**

Application Programming Interfaces (APIs) enable integration between logistics systems and third-party platforms, such as customs clearance systems and payment gateways. According to Gupta et al. (2021), API-driven systems enhance coordination and reduce delays by enabling seamless communication among stakeholders.

## **2.5 Knowledge Gaps**

While existing systems address several pain points in air cargo management, they leave critical gaps:

1. Limited Accessibility for SMEs: Many solutions are financially out of reach for small and medium-sized enterprises, limiting their adoption.
2. Integration Challenges: Lack of standardization in APIs creates compatibility issues between different systems.
3. Customization Needs: Generic solutions fail to cater to the specific needs of individual operators or regions.
4. User-Friendly Interfaces: Many systems prioritize functionality over usability, creating a steep learning curve for non-technical users.

## **2.6 Theoretical Framework**

This study is guided by the principles of systems theory, which emphasizes the interconnectedness of components in achieving overall efficiency. The web-based air cargo management system is conceptualized as a modular structure, where each module ( booking, tracking, documentation) interacts seamlessly to achieve operational objectives.

Additionally, the Technology Acceptance Model (TAM) is considered to ensure the system is designed with user adoption in mind. According to Davis (1989), perceived ease of use and usefulness are critical factors in the acceptance of new technologies.

# **CHA****PTER THREE**

## **RESEARCH, DESIGN AND METHODOLOGY**

## **3.1 RESEARCH DESIGN METHODS**

The research adopts a mixed-methods approach, leveraging both qualitative and quantitative methodologies. This dual approach ensures the project captures the breadth and depth of air cargo management challenges while providing measurable insights for actionable solutions.

* Qualitative Research: Involves detailed exploration of stakeholder experiences, inefficiencies in current systems, and expectations from a web-based platform. This research is conducted through interviews, focus group discussions, and open-ended surveys. The aim is to gather subjective data that highlights user pain points and desires.
* Quantitative Research: Provides a statistical foundation for understanding industry trends and validating hypotheses about system efficiency. Quantitative methods involve analyzing data from existing cargo operations, including booking volumes, error rates, and average time taken for manual tasks such as documentation and tracking. This data is essential for defining measurable objectives, such as reducing booking time by a specified percentage.

This blend of qualitative and quantitative methods creates a holistic understanding of the problem space and ensures the proposed system effectively addresses the needs of its target users.

**3.2 LOCATION OF THE STUDY**

The study's geographical focus is the air cargo industry in regions with a significant volume of international trade, as this provides a robust testing ground for the system. The research specifically targets operational hubs such as airports, freight forwarding offices, and customs offices.

These locations represent the full spectrum of stakeholders who interact with air cargo systems, including:

* Large and Small Operators: To assess the scalability of the system across diverse business sizes.
* Customs and Regulatory Bodies: To understand compliance requirements.
* Customers: Both corporate clients and individual users who rely on air cargo for their shipping needs.

The study's findings are designed to be applicable to a global context, with potential customization to suit regional variations in operations and regulations.

**3.3 POPULATION OF THE STUDY**

The population of the study encompasses a wide range of stakeholders involved in air cargo operations. These stakeholders provide insights into the current challenges and potential improvements in cargo management.

* Air Cargo Operators: These include airlines with dedicated cargo fleets, third-party logistics providers, and freight forwarders. Their feedback is critical in understanding operational inefficiencies and system design preferences.
* Regulatory Bodies and Customs Officials: They provide guidance on compliance with international and regional air cargo regulations, including documentation standards and data security protocols.
* End-Users: Customers, both businesses and individuals, represent the system's primary users. Their input is invaluable for designing user-friendly features such as booking interfaces and tracking systems.

The population is diverse to ensure the system meets the varied needs of its users while addressing industry-wide challenges.

## **3.4 SAMPLING PROCEDURE AND SAMPLE SIZE**

A purposive sampling method is employed to target key individuals and organizations that directly interact with air cargo systems. This method ensures the inclusion of knowledgeable stakeholders who can provide relevant and actionable feedback.

#### Sample Categories:

1. Air Cargo Operators: Representatives from airlines, logistics companies, and freight forwarders.
2. Regulatory Bodies: Officials from customs agencies and aviation authorities.
3. Customers: Individuals and organizations that frequently use air cargo services.

#### Sample Size:

* Operators: A minimum of 10 organizations, selected to include both SMEs and large multinational firms.
* Regulators: At least 5 officials from different regulatory bodies.
* Customers: A minimum of 50 respondents, ensuring a mix of business and individual users.

This sample size balances diversity with manageability, ensuring data collection remains feasible within the project’s timeline.

**3.5 DATA COLLECTION PROCEDURE**

The data collection process is an integral component of the research methodology, designed to ensure that all relevant information about the current air cargo management landscape is captured. This section elaborates on how data is gathered, verified, and analyzed to inform the development of the system.

**3.5.1 Defining Objectives and Data Requirements**

The first step in data collection involves a precise definition of the objectives and the type of data required. For ACMS, the objectives are categorized into three broad areas:

* Operational Efficiency: Data on booking times, shipment errors, and average delays in cargo processing.
* User Experience: Feedback on existing booking, tracking, and payment processes, particularly their usability and pain points.
* Technological Readiness: Assessment of user familiarity with web-based systems and willingness to adopt digital solutions.

Data requirements are then broken down into specific metrics, such as:

* The percentage of manual errors in documentation.
* Average response times for customer inquiries.
* Current costs of operations due to redundant processes

## **3.5.2 Designing Data Collection Instruments**

The tools for data collection are meticulously crafted to address the objectives:

* Questionnaires: Designed for scalability, these are distributed digitally and in paper form to gather quantitative data. Questions include Likert-scale items for user satisfaction and binary options for process-specific inquiries.
* Interview Guides: Semi-structured formats are employed to facilitate in-depth discussions with stakeholders, including open-ended questions for exploratory insights.
* Observation Checklists: Used during site visits to document inefficiencies in manual processes and identify workflow bottlenecks. Observations focus on both qualitative nuances and quantitative measures like processing times.

## **3.5.3 Recruiting and Informing Participants**

Participants are carefully selected to ensure a diverse representation of the air cargo ecosystem. Recruitment involves:

* Direct outreach to logistics firms and regulatory bodies via formal letters and invitations.
* Engaging customers through online platforms and physical visits to air cargo terminals.
* Informing participants about the study's goals, ensuring transparency about how their data will be used, and addressing any privacy concerns.

## **3.5.4 Collecting Data**

Data collection occurs through multiple methods to ensure comprehensiveness:

1. Field Observations: Detailed on-site observations of cargo handling processes, focusing on areas prone to errors or delays.
2. Surveys: Distributed to a wide range of stakeholders, these surveys yield numerical data on system usage and satisfaction.
3. Interviews: Conducted with key personnel such as cargo agents, customs officials, and end-users. Interviews uncover insights into challenges like regulatory compliance, real-time tracking, and usability barriers.

## **3.5.5 Ensuring Data Quality**

To ensure the reliability and validity of collected data:

* Triangulation: Cross-referencing information from interviews, surveys, and observations to eliminate inconsistencies.
* Pilot Testing: Testing survey questions and interview protocols on a small sample to refine their clarity and relevance.
* Data Cleaning: Removing incomplete or ambiguous responses from the dataset before analysis.

## **3.5.6 Analyzing Data**

The data analysis process employs robust techniques:

* Descriptive Statistics: Summarizing survey responses to identify trends and averages, such as customer satisfaction levels.
* Thematic Analysis: Identifying recurring themes in qualitative data from interviews and observations, such as common pain points in booking processes.
* Comparative Analysis: Contrasting data from different stakeholders (e.g., operators vs. customers) to identify gaps or mismatches in expectations.

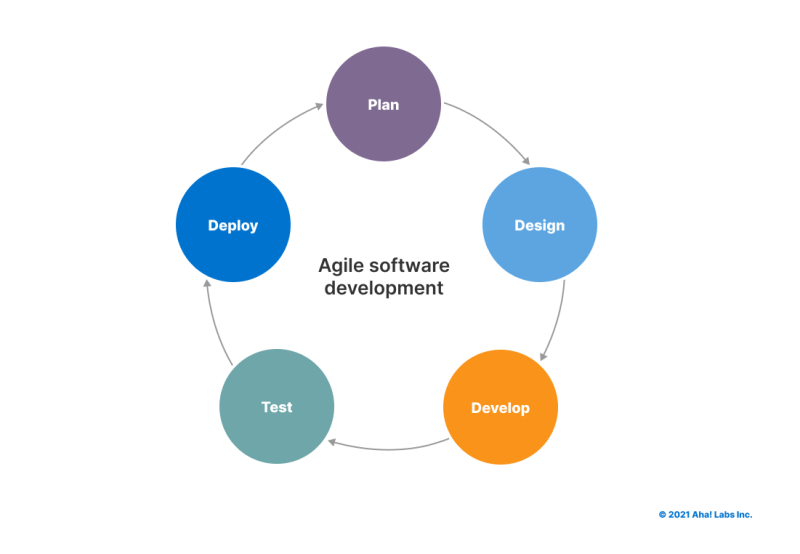
## **3.5.7 Report Findings**

Findings are structured to provide actionable insights:

* Visual Representation: Charts, graphs, and heatmaps illustrate quantitative data trends.
* Narrative Summaries: Detailed descriptions of qualitative findings, highlighting stakeholder feedback and their implications for the system design.
* Recommendations: A synthesis of insights, guiding the development of system modules and features.

## **3.6 SYSTEM DEVELOPMENT METHODOLOGY**

The development of the Air-Cargo Management System (ACMS) employs a structured and iterative methodology, commonly referred to as the **Agile** System Development Life Cycle (SDLC). This methodology is chosen to ensure that the project progresses systematically from planning to deployment, with consistent user feedback at each stage. The SDLC phases are tailored to the web-based nature of the system and the technologies used PHP and JavaScript, HTML, CSS ensuring a balance between back-end functionality and front-end usability.



#### **3.6.1 Planning Phase**

The planning phase lays the foundation for the entire project. Key activities in this phase include:

* Requirement Gathering: Information collected during stakeholder meetings and surveys is compiled into a detailed requirements document. These requirements include both functional needs (e.g online booking) and non-functional expectations (e.g scalability).
* Technology Selection: PHP is chosen for back-end development due to its robustness in handling server-side logic, database interactions, and dynamic content generation. JavaScript, HTML, and CSS are selected for the front-end to create an interactive and visually appealing user interface.
* Risk Assessment: Potential risks, such as delays in project completion, cybersecurity threats, and resistance to adoption, are identified. Mitigation strategies, such as employing secure coding practices and regular user feedback, are developed.

#### **3.6.2 Design Phase**

This phase focuses on translating the gathered requirements into a blueprint for the system. Both the back-end and front-end components are carefully designed to ensure compatibility and efficiency.

* System Architecture: A three-tier architecture is used, consisting of:
  + Presentation Layer: Built using HTML, CSS, and JavaScript, this layer ensures a user-friendly experience.
  + Application Layer: PHP handles business logic, data processing, and API integration.
  + Database Layer: A MySQL database is used to store and manage data, including user credentials, cargo details, and transaction records.
* Database Design: Normalized relational tables are created to reduce redundancy and improve query performance. Key tables include:
  + Users (with roles such as admin, agent, and customer).
  + Bookings (storing shipment details).
  + Tracking (real-time status updates).
  + Invoices and Payments.
* Wireframes and Prototyping:
  + Initial wireframes are created for the core modules (booking, tracking, and payments).
  + Prototypes are developed using HTML and CSS to visualize the user interface and gather feedback before moving into full development.

#### **3.6.3 Development Phase**

The development phase involves writing and integrating code for all system components, with an emphasis on adhering to coding standards and best practices.

* Back-end Development:
  + Core logic is developed in PHP to handle functions like user authentication, cargo booking, and document generation.
  + Frameworks such as Laravel or CodeIgniter may be employed to streamline development and enhance code maintainability.
* Front-end Development:
  + JavaScript enhances interactivity, such as real-time form validation and dynamic content updates.
  + CSS frameworks like Bootstrap are used for responsive design, ensuring compatibility across devices.
  + HTML provides the structure for pages, including forms, dashboards, and reports.
* Integration:
  + APIs are integrated for external functionalities that aid in tracking payment processes.
  + Front-end and back-end components are connected seamlessly to provide a smooth user experience.

#### **3.6.4 Testing Phase**

Testing ensures the system meets the defined requirements and functions as intended. Various types of testing are performed:

* Unit Testing: Each module, such as booking and payment, is tested independently in PHP.
* Integration Testing: The interaction between the front-end and back-end is validated, ensuring data flows correctly.
* Performance Testing: Stress tests are conducted to measure the system's ability to handle high traffic volumes.
* User Acceptance Testing (UAT): A small group of users tests the system in real-world scenarios to provide feedback on usability and functionality.

#### **3.6.5 Deployment Phase**

The deployment phase involves releasing the system for use:

* Pilot Deployment: The system is launched with limited functionality for a small group of users.
* Full Deployment: After addressing feedback from the pilot phase, the system is deployed for broader use, with ongoing monitoring and support.

**3.7 SYSTEM ANALYSIS AND DESIGN**

The analysis and design phase transforms stakeholder needs into a functional system design. This phase focuses on defining how the system will operate and interact with its users and external components.

**3.7.1 Requirements Gathering**

The requirements for ACMS are categorized into:

* Functional Requirements:
  + User authentication with role-based access control.
  + Cargo booking, including automatic air waybill (AWB) generation.
  + Automated invoice generation.
  + Reporting and analytics dashboards.
* Non-Functional Requirements:
  + High availability (99.9% uptime).
  + Scalability to handle an increasing number of users and data.
  + Security measures, including HTTPS, encryption, and input validation.

**3.7.2 System Architecture Design**

The system will employ the following modular architecture to ensure flexibility and scalability

**Use Case Diagram**



USER

CARGO AGENTS





REGULATORY AUTHORITIES

ADMIN

**Context Diagram**

USER

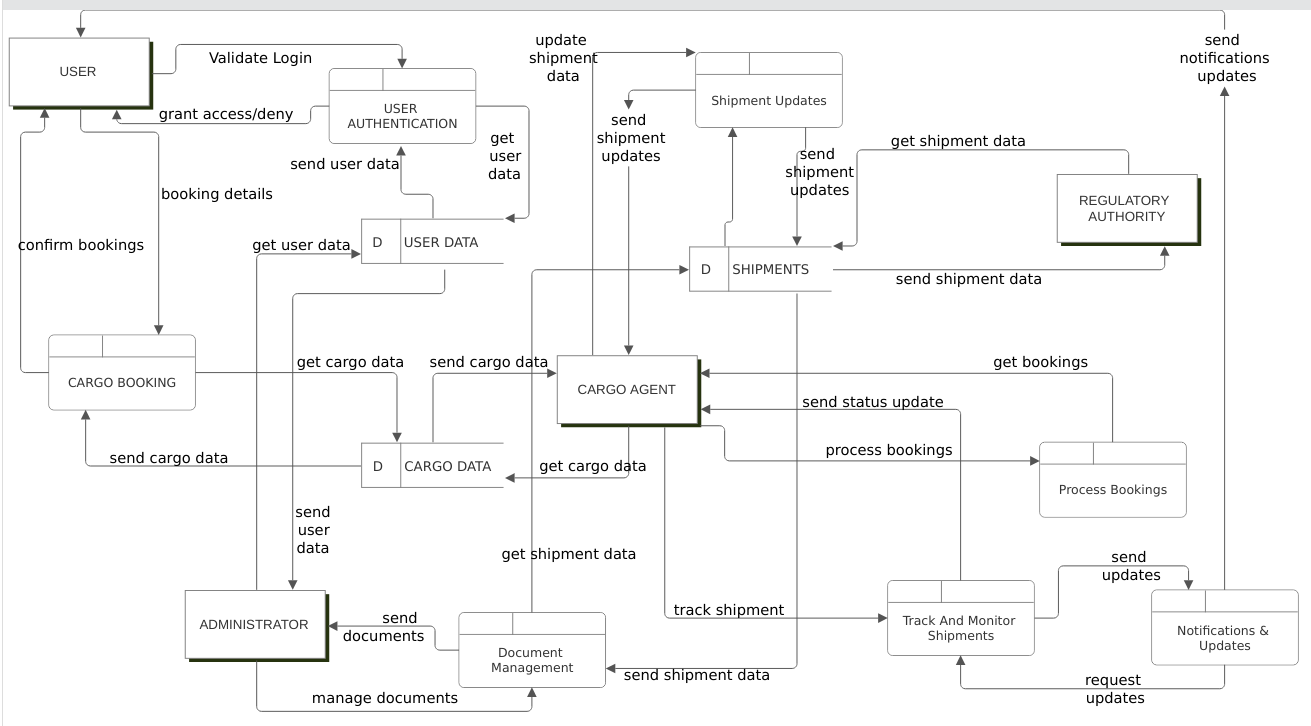
CARGO AGENTS

ADMINISTRATOR

REGULATORY AUTHORITY

uskii sasa hapa itabidi ume insert lines curved zenye zikona arrow mbele. User to acms, acms to user. Admin to acms, acms to admin ivo ivo. Sina windows OS natumia linux na haina hizi options mob za kurembesha.

**Data Flow Diagram**



**Architectural Design**

|  |
| --- |
| **Database Layer** |
| |  | | --- | | CLIENT INTERFACE | | COMMUNICATION PROTOCOLS | | DATA ACCESS LAYER | |

|  |
| --- |
| **Application Layer** |
| |  | | --- | | WEB SERVER | | BUSINESS LOGIC | | API GATEWAY | |

|  |
| --- |
| **Database Layer** |
| |  | | --- | | DBMS | | DATA MODELS | | DATA ACCESS LAYER | |

**Database Design**

**Cargo Items**

|  |  |
| --- | --- |
| **cargo\_items** | |
| cargo\_id | INT |
| cargo\_type\_id | INT |
| price | DOUBLE |
| weight | DOUBLE |
| total | DOUBLE |

**Cargo List**

|  |  |
| --- | --- |
| **cargo\_list** | |
| id | INT |
| ref\_code | VARCHAR |
| shipping\_type | INT |
| total\_amount | DOUBLE |
| status | TINY INT |
| date\_created | DATETIME |
| date\_updated | DATETIME |

**Cargo Meta**

|  |  |
| --- | --- |
| **cargo\_meta** | |
| cargo\_id | INT |
| meta\_field | TEXT |
| meta\_value | TEXT |

**Cargo Type List**

|  |  |
| --- | --- |
| **cargo\_type\_list** | |
| id | INT |
| name | TEXT |
| description | TEXT |
| city\_price | DOUBLE |
| state\_price | DOUBLE |
| country\_price | DOUBLE |
| status | TINYINT |
| delete\_flag | TINYTEXT |
| date\_created | DATETIME |
| date\_updated | DATETIME |

**Tracking List**

|  |  |
| --- | --- |
| **tracking\_list** | |
| id | INT |
| cargo\_id | INT |
| title | TEXT |
| description | TEXT |
| date\_added | DATETIME |

**Users**

|  |  |
| --- | --- |
|  | |
| id | INT |
| firstname | VARCHAR |
| lastname | VARCHAR |
| username | TEXT |
| password | TEXT |
| avatar | TEXT |
| last\_login | DATETIME |
| type | TINYINT |
| date\_added | DATETIME |
| date\_updated | DATETIME |

**3.7.3 Prototyping**

Prototypes will provide a visual representation of the system's functionality and user interface, offering a preliminary version of the system for evaluation. This approach is particularly beneficial in ensuring that this system aligns with the expectations of end-users while allowing the developer to address any anomalies in the development life-cycle early.

**3.7.4 Iterative Development**

ACMS adopts an iterative development methodology, an approach characterized by cyclical development cycles, known as iterations. This ensures that the system is continuously improved based on stakeholder feedback and ongoing testing. Iterative development is suited to ACMS, where user needs and expectations are dynamic and evolving.

**3.8 FUNCTIONAL AND NON-FUNCTIONAL REQUIREMENTS**

**3.8.1 Functional Requirements**

1.User Management:

* + Role-based access control to ensure users only access functionalities relevant to their roles (admin, cargo agent, customer).
  + Secure user authentication with features like password hashing and session management.

1. Cargo Booking Module:
   * An interactive interface for users to input shipment details, such as cargo type, weight, and destination.
   * Real-time validation of booking details, ensuring accurate data entry.
   * Automatic generation of air waybills (AWBs) and confirmation emails upon successful booking.
2. Cargo Tracking Module:
   * Keep track of shipment status while in transit.
   * Notifications sent to users if cargo dispatched, in transit, delivered.
3. Documentation Management:
   * A centralized repository for storing and accessing documents related to air cargo, with options for secure downloading.
4. Billing and Payment Module:
   * Dynamic invoice generation based on shipment details and applicable taxes or discounts.
5. Reporting and Analytics Module:
   * Customizable dashboards displaying key performance indicators (KPIs) such as total bookings, revenue, and shipment status.
   * Exportable reports in multiple formats (PDF, Excel) for operational and financial analysis.

**3.8.2 Non-Functional Requirements**

1. Performance:
   * Handle up to 1000 concurrent users without noticeable latency.
   * Key operations such as cargo tracking updates are processed within 3 seconds.
2. Scalability:
   * Accommodates growth in user base and data volume.
3. Usability:
   * The user interface is intuitive, with clearly labeled buttons, menus, and forms.
   * Accessibility standards (WCAG 2.1) are adhered to.
4. Security:
   * Data encryption protocols are implemented to protect sensitive user and cargo information.
   * Role-based access control should prevent unauthorized access to sensitive.
5. Reliability:
   * The system can maintain a 99.9% up-time provided No disruptions from users or environment.
   * Fault-tolerant mechanisms ensure data integrity and system availability in the event server fails.

1. Maintainability:
   * The system’s codebase follows standardized practices for PHP and JavaScript use.

# **CHA****PTER FOUR**

## CHAPTER FOUR SYSTEM DEVELOPMENT AND DEPLOYMENT

**REFERENCES, APPENDICES**