The Chartered Institute of Logistics and Transport

4TH RESEARCH SYMPOSIUM ON SUPPLY CHAIN MANAGEMENT & LOGISTICS

Book of

ABSTRACTS

AI and Digital Transformation: Redefining the Future of Logistics and Transport

12th February 2026

Colombo, Sri Lanka

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MESSAGE OF THE PRESIDENT

The Chartered Institute of Logistics and Transport, Sri Lanka

It gives me immense pleasure to welcome you to the 4th Research Symposium of the Chartered Institute of Logistics and Transport (CILT) Sri Lanka, convened under the timely and forward-looking theme "AI and Digital Transformation: Redefining the Future of Logistics and Transport".

The logistics and transport sector stands at a pivotal moment in its evolution. Rapid advancements in artificial intelligence, data analytics, automation, and digital platforms are fundamentally reshaping how supply chains are designed, managed, and optimized. These technologies are no longer optional enhancements; they are becoming essential enablers of efficiency, resilience, sustainability, and global competitiveness. Against this backdrop, this Research Symposium serves as a vital platform to explore, debate, and disseminate knowledge that will guide the sector through this transformation.

CILT Sri Lanka has always been committed to advancing professional excellence, thought leadership, and evidence-based practice in logistics and transport. Our Research Symposiums play a crucial role in this mission by bringing together academics, researchers, industry professionals, policymakers, and students to share insights, challenge conventional thinking, and foster collaboration between theory and practice. The growing quality, diversity, and relevance of research presented at this fourth edition is a testament to the increasing maturity of research culture within our sector.

The abstracts featured in this book reflect a wide range of perspectives on how AI and digital transformation are influencing logistics and transport, from smart ports and intelligent transport systems to predictive analytics, digital supply chains, sustainability, and policy implications. I commend all authors for their rigorous research efforts and for contributing valuable knowledge that can inform industry decision-making and national development.

I extend my sincere appreciation to the Research Committee, reviewers, organizing team, partners, and sponsors for their dedication, professionalism, and tireless efforts in delivering yet another successful Research Symposium. Your collective contributions ensure that CILT Sri Lanka continues to remain a credible and respected platform for research dissemination and professional dialogue. I also wish to place on record my sincere thanks to the CILT Sri Lanka Secretariat for their commitment, coordination, and invaluable support in ensuring the smooth planning and successful execution of this symposium.

As you engage with the presentations and discussions, I encourage you to think boldly, collaborate openly, and translate research insights into meaningful action. Together, let us harness the power of AI and digital transformation to redefine the future of logistics and transport in Sri Lanka and beyond.

I wish the Research Symposium every success.

Chandima Hulangamuwa, FCILT
President of CILT Sri Lanka

MESSAGE OF THE SYMPOSIUM CHAIR / VICE PRESIDENT - EDUCATION

The Chartered Institute of Logistics and Transport, Sri Lanka

Distinguished Guests, Industry Colleagues, and Fellow Scholars, as the Vice President of Education for the Chartered Institute of Logistics and Transport (CILT) Sri Lanka, it is a privilege to welcome you to the technical program of our 4th Research Symposium on Supply Chain and Logistics Management.

When we inaugurated this symposium in 2023, our vision was clear: to bridge the gap between academic rigor and industrial pragmatism. We sought to build a vibrant ecosystem where research findings aren't just filed away, but are instead debated, refined, and transformed into actionable solutions for the pressing challenges of our sector.

Our objective has always been to move beyond the traditional "publish-only" culture. We believe the true value of research lies in interactive knowledge-sharing. This year, I am particularly impressed by the diversity of topics brought forward by our speakers. This breadth of insight will undoubtedly spark the kind of cross-disciplinary dialogue that leads to genuine innovation.

It is a testament to the resilience and curiosity of our community that we are not only gathered here today but are already looking forward to the continuation of this symposium into 2026. I would also like to extend our profound gratitude to our Chief Guest, Prof. Nalin Ratnayake. CILT deeply values our enduring partnership with Ocean University, a collaboration that remains vital to nurturing the next generation of logistics professionals

I encourage each of you to engage deeply, question boldly, and network widely. I look forward to the collaborative breakthroughs that will emerge from today's sessions, pushing the boundaries of what is possible in supply chain and logistics management.

Prof. H. R. Pasindu, CMILT
Symposium Chair / Vice President - Education
CILT Sri Lanka

MESSAGE OF THE PRPGRAMME CHAIR

4th Research Symposium on Supply Chain Management & Logistics

It is with great pleasure that I welcome you to the 4th Research Symposium on Supply Chain Management & Logistics, organized by CILT Sri Lanka and held on 12th February. Serving as the Programme Chair of this established and growing symposium series is truly an honor, and I am delighted to be part of its continued success as a platform for academic and industry engagement.

The theme of this year's symposium, "AI and Digital Transformation: Redefining the Future of Logistics and Transport," is highly timely and relevant. Rapid developments in artificial intelligence, data analytics, automation, and digital platforms are transforming the way supply chains and transport systems operate. In an era marked by global disruptions, climate challenges, and evolving customer expectations, digital transformation has become essential for building resilient, efficient, and sustainable logistics and transport networks.

I am particularly pleased with the quality and diversity of the research presented at this symposium. The abstracts selected for presentation demonstrate strong alignment with the symposium theme and cover a broad spectrum of contemporary issues across logistics, supply chain management, and transport. I extend my sincere congratulations to all authors on the successful acceptance and presentation of their research contributions.

This symposium is the result of the collective efforts of many dedicated individuals. I extend my heartfelt appreciation to our Chief Guest and Keynote Speaker for sharing their valuable insights, and to the Session Chairs for ensuring the smooth conduct of the technical sessions. My sincere thanks also go to the authors who submitted their work and to the reviewers for their timely and constructive evaluations, which ensured the academic quality of the symposium.

I am deeply grateful to the Organizing Committee, the CILT office, and the General Chair for their guidance and unwavering support throughout the planning and execution of this event.

I look forward to an engaging symposium marked by meaningful discussions, knowledge exchange, and networking opportunities that bring together academia and industry. I extend my best wishes to CILT Sri Lanka for the continued success of this symposium series in the years ahead.

Dr. Ishani Dias, CMILT

Program Chair - 4th Research Symposium on Supply Chain Management & Logistics

CILT Sri Lanka

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Vice Chancellor

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ABSTRACTS

Terminal Handling Charges as Strategic Cost Driver: Impact on Shipping Line Operations in Sri Lanka

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This paper aims to examine the role of Terminal Handling Charges (THC) as a strategic cost factor that affects shipping line strategies, including operating costs, route strategies, and competitiveness of shipping lines in Sri Lanka. It also aims to examine the impact of rising THC levels and inefficiencies, thereby undermining the competitiveness of the Port of Colombo, an important port in the East-West route. Methodology: This paper employed a qualitative exploratory approach, consisting of semi-structured interviews of ten purposively chosen maritime industry experts, including directors and port officials. This paper employed Institutional Theory to examine the coercive, normative, and mimetic pressures that influence the industry. Findings: The findings of this paper revealed that the high THC levels impose coercive pressures, as shipping lines pass the costs to customers. The inefficiencies, including manual documentation processes and vessel delays of 36-48 hours, impose normative pressures. Additionally, the findings revealed that shipping lines experience mimetic pressures, as they seek to imitate competitors' decisions to divert cargo to automated regional hubs, such as Vizhinjam and Chennai. Conclusion and Implications: THC is one of the strategic determinants of port attractiveness. The policy implications underscore the need for structural changes in the THC of the country, benchmarking in the regions, and the national digital single window system. In terms of the practical application of the above recommendations, the establishment of the Maritime Cost Advisory Council with the provision of tariff incentive schemes is crucial for securing the transhipment volume of Sri Lanka.

Key words: *Terminal Handling Charges, Shipping Lines, Institutional Theory, Port Competitiveness, Sri Lanka*

Employee Acceptance of Artificial Intelligence in Logistics Operations: Evidence from a State-Owned Energy Distributor in Sri Lanka

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The rapid advancement of the development of artificial intelligence (AI) has generated a great opportunity to revolutionize logistics management and operations practice with better demand forecasting, inventory optimization, transportation planning, and data-driven decision-making. Regardless of such opportunities, several institutions within the developing economies still stick to extremely manual logistics procedures, which means that there is always a gap between what AI technologies can offer and how they can be effectively utilized in the business environment. The research evaluates how employees in a large state-owned energy distribution company in Sri Lanka accept AI in logistics activities and the factors that affect their intentions to adopt AI. The study follows the Unified Theory of Acceptance and Use of Technology (UTAUT) and adopts a quantitative and cross-sectional research design. A structured questionnaire was used to collect primary data from employees who were involved in logistics and operations functions, using the simple random sampling method. A total of 63 valid responses received were analysed using statistical methods such as reliability analysis, descriptive statistics, Pearson correlation analysis, and multiple regression analysis. The findings highlight that the suggested model accounts for a significant percentage (67%) of the variance in the behavioural intention of the employees to utilize AI-based logistics solutions. Facilitating conditions emerges as the most impactful determinant, signifying the criticality of the presence of organizational readiness, availability of infrastructure, and technical support in the adoption of AI. There are also statistically significant positive correlations between performance expectancy and effort expectancy with behavioural intention, which indicate that employees are more willing to embrace AI as it is perceived to be beneficial and convenient to use in the logistics process. Contrastingly, the effect of social influence is not statistically significant, thus showing that individual assessment and structural enablers are the primary factors in the decision to adopt but not peer pressure or management influence. These conclusions demonstrate that proper matching of technological investments and organizational capabilities as well as staff readiness is crucial to achieve all the benefits of AI in logistics operations. The study highlights the importance of strengthening organizational readiness, targeted training, and supportive environments to enhance digital transformation, improve AI adoption outcomes, and increase operational efficiency. The research adds to the literature on supply chain and logistics by introducing empirical evidence from a developing economic context with practical implications for the managers and policymakers to expedite digital transformation at tactical, operational, and strategic levels. In conclusion, successful AI implementation in logistics necessitates the soundness of facilitating conditions and a favourable organizational environment in addition to the technology availability to close the digital potential-operational practice gap.

Keywords: *artificial intelligence, digital transformation, logistics management, technology adoption, unified theory of acceptance and use of technology*

Key Attributes Defining Green Airport Concept

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Even though air travel is a crucial mode of transport to build up connectivity among countries, globalization, trade, and tourism, it affects the environment by carbon emissions, noise generation, waste generation, and water and air pollution. Therefore, these environmental impacts create discomfort, health problems, and poor air quality in the surrounding environment and community. The green airport concept focuses on converting airport operations and the environment into more sustainable and environmentally friendly practices. With the growth of air passenger demand, airport operations are getting more complex and congested. Therefore, transforming the airport into a green airport fully or partially is important to secure the airport's reputation and continue the operations effectively. The objective of this study is to identify the key attributes that define a green airport concept based on global standards and practices using a literature survey. This study was conducted through a qualitative research approach, and research studies, case studies, and annual reports were used to collect data. 24 airports were selected for this study, such as Kunming Changshui International Airport (KMG), Stockholm Arlanda Airport (ARN), Changi Airport (SIN), and Indira Gandhi International Airport (DEL), according to their international recognition of green practices through a purposive sampling technique. Content and thematic analyses were conducted, and the results indicate that the selected airports consistently implement renewable energy, smart lighting, wastewater recycling, and electric ground operations. Initially, more than 15 attributes were identified using the content analysis method. Then, the thematic analysis method was used to identify the 10 key attributes that define the green airport concept, considering their prevalence and impact. The analysis identified 10 key attributes: 1) Renewable Energy Integration; 2) Efficient Energy Management; 3) Sustainable Building Design; 4) Water Conservation; 5) Solid Waste Management; 6) Sustainable Ground Operations; 7) Noise Generation Control; 8) Green Landscaping; 9) Airfield Route Optimization; and 10) Sustainable Airport Access Modes. The findings demonstrate that more than 60% of the selected airports consistently implement renewable energy integration, waste management, water conservation, efficient energy management, and sustainable ground operations to contribute to sustainability. These attributes contribute to the reduction of carbon emissions and improved energy efficiency. To obtain the maximum advantage of implementing these green practices, the findings recommend integrating these practices with digitalized systems to track and manage emissions and energy consumption. Therefore, this study develops a structured framework of ten key attributes that can guide airport planners and managers in prioritizing sustainability interventions and systematically transforming conventional airports into green airports.

Keywords: *Airport Sustainability, Emission Reduction, Energy Efficiency, Green Airport*

A Time Series Forecasting Approach for Demand Optimization in Sri Lankan Automotive Spare Parts Industry: A Case Study on DIMO PLC

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Spare parts inventory management plays a critical role in Sri Lanka's automotive industry, driven by factors such as rising vehicle ownership, an aging fleet, and increased demand for vehicle aftersales support. Inaccurate demand forecasting models used for DIMO Batta vehicles spare parts demand forecasting has continuously led to overstocking, stockouts and troubled customer relationships. This research addresses these challenges by developing an evidence based ARIMA time series model to optimize DIMO Batta spare parts inventory operations by analyzing daily movement data for 10 fast moving spare parts collected from DIMO service centers situated around the island within the time period of 30th of November 2023 to 31st of August 2025.This study identifies critical demand patterns, including a noticeable seasonal patterns and a consistent upward trends for these 10 types of spare parts within this time period. The significance of this research lies in its ability to bridge the gap between theoretical forecasting and practical operational excellence. For DIMO, the model provides a data driven framework to optimize inventory by minimizing over investment in spare parts inventory and lowering holding costs while ensuring the timely availability of genuine DIMO Batta spare parts. Furthermore, it supports the financial stability of Small and Medium Enterprises (SMEs) that depend on DIMO Batta vehicles for daily operations, thereby strengthening the overall resilience of the Sri Lankan commercial transport sector. The findings demonstrate that integrating ARIMA based predictions into ERP systems allows for proactive, automated inventory adjustments, moving the organization from reactive replenishment to an optimized, analytically driven management approach.

Keywords: *ARIMA, Time series analysis, Inventory optimization, Seasonality, Forecast accuracy, Supply chain resilience*

Limitations in Data Driven Digital Service Design: Case Study of Black Market for Train Ticket Reservations in Sri Lanka Railways

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Data-driven digital service design plays a central role in modern logistics by supporting efficient resource allocation, operational transparency, and service optimization through analytics, real time monitoring, and AI enabled decision making. However, when such systems are partially integrated or lack effective monitoring, unintended operational inefficiencies and informal market outcomes can arise. Despite being a backbone of passenger logistics, railway transport has received limited empirical attention in this context. In SLR, the online seat reservation system serves as the primary and often sole digital mechanism for managing passenger demand and capacity. This study therefore examines how limitations in data-driven digital service design within the reservation system contribute to informal market behaviour and operational inefficiencies, while assessing demand capture and capacity allocation under high demand conditions, with black-market ticket pricing serving as an empirical indicator of system level digital service gaps. An explanatory sequential mixed method research design was adopted to both quantify and explain these gaps. Quantitative data were collected through a structured survey of nearly 1,000 passengers with reserved seats, including those purchasing via third party intermediaries. A one sample t-test and a hedonic pricing based statistical model were applied to identify systematic price differentials between official fares and informal channels and to assess how journey characteristics and demand conditions influence these variations. This was followed by qualitative thematic analysis of stakeholder interviews to examine institutional and digital service design limitations such as monitoring failures and reservation control weaknesses that enable unauthorized resale. Findings suggest that black market pricing is structured according to journey characteristics such as origin to destination popularity, travel timing, and distance, confirming the operation of informal intermediaries alongside official platforms. Thematic analysis highlights specific gaps in the online system, including limited digital monitoring, insufficient real time demand management, and inadequate seat allocation controls. These findings demonstrate that incomplete or improperly upgraded digitalisation can unintentionally generate operational inefficiencies and economic loss within transport logistics. Policy recommendations focused on AI based dynamic pricing, demand prediction using passenger data, intelligent seat allocation with real time availability, and digital value-added services such as priority booking and verified resale platforms. Implementing these measures can optimize platform performance, enhance operational transparency, minimize reliance on informal markets, and improve the resilience and efficiency of railway services. This study provides actionable insights for AI enabled and digitally optimized service design, highlighting the critical role of data driven platforms in modern transport logistics. It addresses macro level supply chain challenges, identifies tactical and strategic performance gaps, and uses raw data to inform feasible solutions, opening avenues for future research.

Keywords: *AI enabled forecasting, Black market, Digital service design, Online reservation systems, Railway logistics*

Evaluating the Impact of Inventory Management on Store Performance: A Study of EDB Registered Rubber and Rubber Based Manufacturing Companies in Sri Lanka's Western Province

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Effective inventory management has become a critical determinant of operational efficiency and store performance in manufacturing industries, particularly within the Export Development Board (EDB) registered rubber and rubber-based manufacturing companies located in Sri Lanka's Western Province. Specifically, the study investigates the influence of lean inventory systems, inventory models, and information technology on store performance. This study addresses a gap in research on inventory management in Sri Lanka's rubber and rubber-based manufacturing industry, particularly in the Western Province. It examines how inventory management practices affect store performance and provides a basis for future research on inventory and supply chain performance in manufacturing sectors. A quantitative research approach was adopted, guided by a positivist philosophy and a deductive research strategy. The population for this study comprises Export Development Board (EDB)–registered rubber and rubber-based manufacturing companies located in the Western Province of Sri Lanka. Out of the 65 such companies operating in the province, a sample of approximately 56 organizations was selected at the organizational level for the study. Primary data were collected through a self-administered structured questionnaire distributed to above-executive-level employees of selected companies. Using a convenience sampling technique. The collected data were analyzed using the Statistical Package for Social Sciences (SPSS), employing descriptive statistics, reliability and validity tests, correlation analysis, and regression analysis to test the proposed hypotheses. The findings show that effective inventory management significantly improves store performance. Lean inventory systems, appropriate inventory models, and the use of information technology all help reduce costs, minimize waste, improve accuracy, and ensure timely production and delivery, with integrated inventory management having the greatest impact.

Keywords: *Inventory Management, Lean Inventory Systems, Inventory Models, Information Technology, Store Performance*

Weighting The Factors Influencing Customer Satisfaction in Last Mile Delivery Courier Services: Evidence From Pickme Flash Users

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The rapid growth of e-commerce and application-based courier delivery services has positioned last-mile delivery as a critical determinant of customer satisfaction in modern-day logistics. In an urban context like Colombo, Sri Lanka, on-demand last-mile delivery services like PickMe flash play a vital role in meeting consumers' expectations for delivery speed, reliability, affordability, application usability, and convenience. Despite the increasing reliance on such delivery services, limited empirical evidence exists on how customers prioritize different service factors and how these factors vary across socioeconomic segments. Addressing the research gaps, the present research study investigates the importance of last-mile delivery factors influencing customer satisfaction among Colombo district pickMe flash users. Adopting a quantitative research approach, this research study employs conjoint analysis to examine customer trade-offs among six service attributes. Those attributes are pickup time, delivery time, delivery cost, parcel condition, app usability, and courier behaviour. Each attribute was operationalized through three performance levels to construct scenarios. 18 profiles (scenarios) were developed using the orthogonal design. Customers were asked to rate these profiles on a scale of 0 to 10 (0=least preferred, 10=most preferred). Primary data were collected by a structured online questionnaire administered to 100 active PickMe flash users in the Colombo district. The collected data were analyzed by SPSS to estimate part worth utilities, importance values relevantly and model fit indicators. This research finding reveals that app usability is the most influential factor of overall customer satisfaction, highlighting the critical role of intuitive navigation, real-time tracking, and seamless digital interaction in application-based last-mile delivery services. The second-highest customer satisfaction influence attribute is delivery time. Delivery cost, parcel condition, and courier behavior demonstrated moderate but meaningful impacts, while pickup time had the least influence on customer satisfaction. Most importantly, the research study identifies significant variations in preference structures across age, gender, income level, and frequency of using the service, indicating that customer satisfaction in the last-mile delivery is not homogeneous. By integrating SERVQUAL dimensions and expectation confirmation theory with advanced preference modeling, this research offers both theoretical and practical contributions. These research findings provide actionable insights for PickMe Flash and similar platforms to streamline processes like booking, tracking, and proof-of-delivery, introducing active notifications for delays, location changes, or unsuccessful attempts with a one-tap solution, and providing accessibility options like voice prompts. Overall, this research study shows the necessity of customer-centric, data-driven decision-making to strengthen competitiveness and service excellence in Colombo district Sri Lanka's rapidly evolving last-mile delivery sector.

Keywords: *App Usability, Conjoint Analysis, Customer Satisfaction, Last-Mile Delivery, PickMe Flash*

A Framework for Transitioning between International to Local Supply Chains during Disaster Relief in Sri Lanka

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This study addresses the logistical Efficiency versus Empowerment Paradox observed during flood relief operations in Sri Lanka, where prolonged international in-kind aid often stifles local market recovery. The primary objective is to evaluate the transition between centralized international supply chains to localized, market-based programming after the initial 72-hour emergency phase. Utilizing a mixed-methods approach, the research analyzes data from the 2024 and 2025 flood cycles to identify an "Optimal Switch Point" for aid modality. Methodologies included the deployment of structured surveys to logistics practitioners and local small-and-medium enterprises (SMEs) to populate a newly developed Social Value Added (SVA) equation. Results indicate that while international logistics are essential for immediate life-saving needs, local supply chains achieve a significantly higher SVA score by Day 4, characterized by increased beneficiary dignity and a 40% reduction in transport-related carbon emissions. The study concludes that adopting a localized "pivot" protocol at the 72-hour mark is critical for long-term community resilience and environmental sustainability in Sri Lankan disaster management.

Keywords: *Humanitarian Logistics, Local Procurement, Market-Based Programming, Social Value Added, Sri Lanka Floods, Disaster Management*

A Comparative Study of Google Map's Predicted and Actual Bus Travel Times to Evaluate the Reliability of Travel Time Estimates in Colombo, Sri Lanka

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In Sri Lanka public transport users often face discrepancies in estimated bus arrival times with the actual bus arrival times which affects daily travel planning and passenger trust in digital navigation tools. With growing reliance on platforms like Google Maps evaluating their performance and reliability for public transportation is essential. This study evaluates the reliability of Google Maps predicted bus arrival times through a quantitative comparative analysis of predicted and actual arrivals across buses of four major public bus routes in Colombo, Sri Lanka (Routes 100, 101, 154, and 176). A quantitative observational research design was adopted to assess the reliability of Google Maps bus arrival predictions. A total of 8,205 valid bus arrival observations were manually collected over a four-week period in August 2025 across peak and off-peak periods, weekdays and weekends, inbound and the outbound travel directions and segment level route locations. Actual bus arrival time was examined through direct field observation. To assess reliability, a modified delay classification model was used which categorized arrivals as On Time, Early, Late, Predicted Only and Actual Only bus arrivals. Statistical analysis was conducted using IBM SPSS applying descriptive statistics cross-tabulation and chi-square tests to evaluate the statistical significance of prediction deviations across the routes, time periods and travel directions. The findings indicated that the accuracy of Google Maps bus arrival predictions was route-specific and influenced by multiple interacting factors. Peak periods recorded higher late arrivals on Routes 176 and 101, while off peak morning periods showed the higher late arrivals on Route 154, indicating operational inefficiencies beyond congestion effects. Weekdays generally demonstrated stronger on time performance, whereas weekends exhibited higher variability and predictable mismatches mainly on Route 154. In terms of travel direction, inbound journeys toward Colombo city consistently experienced higher late arrivals and reduced prediction accuracy than outbound trips, especially on Route 100. Route-level analysis identified Route 100 as the most reliable and Route 176 as the least reliable while segment level analysis revealed stronger prediction alignment in urban segments such as Wellawatta and higher late arrivals in peripheral segments such as Kiribathgoda. In conclusion, bus arrival predictions in Colombo demonstrated uneven reliability shaped by temporal conditions, travel direction, route characteristics and operational consistency rather than traffic congestion alone. Based on these findings, two key recommendations are proposed. Firstly, app developers should enhance AI based prediction algorithms by integrating real-time traffic conditions, passenger boarding dynamics, traffic signal behavior and route specific historical performance including confidence intervals or alerts when predictions are less accurate. Secondly, public transport authorities should implement targeted, route specific scheduling and operational improvements particularly for high traffic corridors and inbound peak hour services while addressing weekend service variability and segment level operational differences.

Keywords: *Colombo, Google Maps accuracy, public bus transport, Sri Lanka, travel time reliability*

Weight of Factors That Influence Passenger Expectations of Using Park and Ride Facilities In Colombo District

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The purpose of this study was to obtain a more accurate picture of the estimated weights of the factors that influenced passenger expectations for using Park and Ride facilities in Colombo District, Sri Lanka. Possible variables were identified from the existing literature, and a preliminary qualitative study was conducted at the Makumbura Multimodal Transport Center to identify the variables further. Based on the results of the reviewed literature and the preliminary study, six variables and three levels for each variable were identified. The identified variables were payment for parking, safety and security at the parking area, public transport integration, walking distance from the parking area to public transport, public transport fares, and basic amenities at the terminal, and the three levels were poor, moderate, and high for all the variables. The researchers used structured questionnaires to collect the primary data. As per the identified 6 variables, the researchers developed 18 profiles by using the orthogonal method to use the survey, and each profile had the three identified levels of each variable. In addition, an additional control profile was also added to ensure that this study was understood by the respondents. The questionnaire contained two sections. Section one consisted of a set of queries on demographic information of the respondents, and section two was developed to identify the weight of the factors that influence passenger expectations of using park and ride facilities in the Colombo District for those 19 profiles. The questionnaire was distributed among the Park and Ride facility users and private vehicle users, and respondents were asked to rate the scale of 1-10 for 19 profiles. Conjoint Analysis was used to estimate the relative importance of each variable. The population of the study was Park and Ride facility users and private vehicle users, and the sample size was 152. The main data collection process was done through both physical and online methods. Makumbura Multimodal Transport Center was the main data collection location for the research, and the collected responses were 102; the remaining 50 responses were collected through sending an e questionnaire to respondents. According to the study, security of the parking area was the most influential factor in using park and ride facilities in Colombo District, Sri Lanka, as expected by the users. In addition, public transport integration, payment for parking areas, walking distance from parking area to public transport, amenities at the terminal, and public transport fares were also considered for the use of Park and Ride facilities in the Colombo District. To enhance the attractiveness of using the Park and Ride facilities in the Colombo District, enhancing the security of the parking area by implementing proper CCTV, regular patrolling, and a lightning system at night leads to enhancing the passenger sense of safety and security, and encourages greater usage of the service. Through these research findings, researchers intend to offer valuable insights for policymakers and transport planners to design the Park and Ride facility system to encourage greater public transportation in the Colombo District, Sri Lanka.

Keywords: *Passenger expectations, Park and Ride facilities, user satisfaction, Mode choice, travel behavior.*

An Analysis of the Artificial Intelligence-Driven Fulfilment Center in Third-Party Logistics in Sri Lanka

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A fulfilment centre is a specialized facility in the supply chain. Materials are received, stored, picked, packed, and expedited to customers, often managed by third-party logistics providers. The fulfilment centre represents a significant technological improvement in logistics operations and is part of the supply chain. Included inbound and outbound logistics to improve efficiency in these operations. An inventory-counting, AI-driven QR code system scans the pallet barcode and links it to the product barcode. Selected customers' red sticker identification and weight checking are happening through machine learning aligned with the AI. The objective of the research is to examine artificial intelligence and enhance operational efficiency in fulfilment center. The research problem reveals significant constraints to the adoption of AI in fulfilment centres, including cost concerns in third-party logistics and training requirements for employees. The authors chose to utilize both primary and secondary data sources. Conducting interviews with internal stakeholders' operations managers, system implementation managers, and operation supervisors. As secondary data sources, company database reports, such as the warehouse management system report and implementation report, are used. Functional areas: inbound and outbound logistics operations, inventory management, and improved AI-driven applications. Methods followed to analyses data in Excel, and confirm operational improvements in logistics for both inbound and outbound. Furthermore, to identify the research problem, the author conducted a cause-and-effect diagram. Root causes were identified through discussions with internal stakeholders, including supervisors, managers, and team leaders. The study's significant contribution to higher operational efficiency through AI-driven operations in inbound and outbound logistics within fulfilment centres. Research implications fill gaps in the literature, addressing superficial or under-researched areas. Plausible result of the research: AI improves the operational efficiency in the fulfilment centre operations, such as inbound and outbound operations, inventory counting, and material expediting. The results conclude that AI application support improves operational efficiency and reduces costs. And support for improving performance and profitability. Practical applications are encouraged to adopt AI-driven operations in logistics facilities and fulfilment centres. Fill the gap and make a theoretical contribution in academia. Industry practitioners can adopt AI-driven applications in inbound and outbound logistics operations. Future directions for AI research should focus on developing adaptive, real-time optimization algorithms that integrate predictive maintenance, demand forecasting, and production scheduling to enhance overall operational efficiency in the manufacturing sector.

Keywords: *AI, Machine Learning, Fulfilment Center, Inventory, Third Party Logistics*

Development of an Overlapping Index for Transfer-Based Bus Transport Network Evaluation

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Bus transport networks in developing countries frequently experience excessive and poorly coordinated route overlapping, leading to inefficient fleet utilization, unreliable schedules, congestion, and uneven service coverage. Although transfer-based bus networks have been proposed to reduce redundancy, the absence of systematic criteria for identifying routes suitable for restructuring risks increasing passenger inconvenience. This study aims to develop a quantitative and replicable framework to evaluate route overlapping while balancing operational efficiency and passenger convenience. The study adopts a methodological research design using a multi-criteria evaluation (MCE) approach. Four key variables—route density, centralized coordination, passenger demand density, and travel behavior—are operationalized through measurable indicators derived from route data, stop-level operations, and passenger surveys. Route density is measured using overlapping route length within spatial units to distinguish redundancy from complementary coverage. Centralized coordination is assessed through a stop-level coordination index based on temporal spacing of bus arrivals. Passenger demand density integrates boarding–alighting counts with population, employment, and socio-economic indicators normalized by area. Travel behavior is quantified through a composite survey-based index, which combines multiple passenger-related factors—such as transfer frequency, waiting time, walking distance, and perceived convenience—into a single standardized measure. All indicators are converted to a common scale to ensure comparability. Equal importance is then assigned to each variable and the standardized indicators are then aggregated to produce an Overlapping Index ranging from 0, representing minimal overlap impact, to 1, representing severe and functionally significant overlap. The index can be used to classify routes into high, moderate, and low overlap categories, supporting prioritization of consolidation, frequency optimization, or retention of direct services. The study concludes that combining spatial, operational, and passenger-centered indicators provides a more reliable basis for restructuring decisions than single-metric approaches. The framework offers a practical decision-support tool for planners in data-constrained environments and supports more equitable, efficient, and sustainable transfer-based bus network planning.

Keywords: *transfer-based bus networks, route overlapping, operational efficiency, passenger convenience, bus network optimization*

Manual Constraints in an Automated World: Assessing the Vulnerabilities of Subcontracted Embellishment in Sri Lanka's Luxury Fashion Supply Chain

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The luxury fashion industry now and always will survive on the virtue of quality finishing. But in Sri Lanka, apparel manufacturers are experiencing a silent crisis in their own supply chain. The worldwide trend in industry has moved to Industry 4.0, where automated embroidery and laser-cutting instruments guarantee the perfect quality. However, the local industry is still anchored on a subcontracting system that is stuck in the past. Although Sri Lankan major mother plants are technologically advanced, despite that, the outsourced external companies are used in the embellishments for beading, embroidery and sequins. These subcontractors use generalized tools and heavy handwork, creating a technological divide that deviates from the international premium brand standards. This results in a threatening technological divide between the high-end needs of international premium brands and the low, laborious realities of local workshops. This gap is another important research field that has received little attention compared to overall manufacturing efficiency. The significance of this study is that it will safeguard the image of Sri Lanka as a premier fashion destination. However, manufacturers are now faced with a threefold menace shipping time frames are lost in waiting in long, slow manual handling; fluctuation of production costs; and expensive garments are often physically damaged throughout transportation or manual handling at third-party locations. The importance of the study is evident because global requirements to speed to market are growing, and the traditional outsourced model is nearing its limit. Thus, the main objective of the research will be to apply the strategic misalignment that exists across the supply chain in the luxury fashion industry in Sri Lanka, especially the mismatch between the advanced technological expectations of mother plants and the manual operation facts of their subcontractors. As well as this aims to assess the direct effect of these technological constraints within the subcontracting level in undermining the competitiveness of the leading exporters in Sri Lanka. To reach this goal, the current research study is based on qualitative research design, which assumes that the technological bottleneck and its following impact on the luxury standards are complex phenomena, which are rooted in the professional experience and operational culture, which cannot be quantified by using only numerical data. Basic design elements include purposive sampling of 15-20 production managers and quality heads from leading exporters for broad industrial expertise: semi-structured interviews exploring outsourcing challenges, production failure strains, and manual vs. automated process comparisons, and thematic analysis to identify patterns of failure and success. The interview questions are based on challenges of outsourcing, the strain of production failure and the comparison of manual processes with modern automated processes.

The data is processed thematically to identify common patterns of failure and success in the stories. There is strong ethical conduct in all the activities, and written permission and complete confidentiality for each participant are ensured. The aim of the research is to evaluate the evolutionary strategies of garment production with a special focus on the prevailing use of such highly manual external suppliers. The study aims to explore how industry can overcome these issues, such as the potential introduction of new high-tech technologies, as well as the changes in production. Furthermore, this research investigates strategies that could enhance control over lead times and quality standards. Ultimately, the study intends to contribute to developing a model of supply chain resilience that reinforces "Made in Sri Lanka" as a mark of both craftsmanship and efficient production.

Keywords: *Embellishment, Industry 4.0, Subcontractor Challenges, Supply Chain Resiliency, Vertical Integration*

Application of Supply Chain Automation for Identifying, Analyzing and Managing Supply Chain Risks in Export-Oriented Apparel Manufacturers, Colombo Metropolitan Region, Sri Lanka

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This paper discusses the application of supply chain automation technology in identifying, analyzing and controlling operational risk in the Colombo Metropolitan Region of Sri Lanka in export-oriented manufacturers of apparel. Since the apparel industry is a significant contributor to the national export revenue (around 42 percent), the enhancement of the supply chain resilience via automation is a strategic move, especially in the context of developing countries. Data was gathered with the help of semi-structured interviews with ten supply chain professionals working in five large apparel companies in the framework of an interpretivist philosophy and exploratory qualitative design. The six-step thematic analysis that was supported by NVivo was used to find central themes by Braun and Clarke. The results reveal that Automation technologies used in organizations help increase the visibility of risks, facilitate real-time monitoring, and make data-driven decisions include Enterprise Resource Planning (ERP) systems, Internet of Things (IoT) products, sensors, Power BI dashboard and industry-specific platforms. Such tools enable the identification of risks earlier, faster reaction to disruption, and better operational performance such as cost reduction, minimize lead-times, better forecasting accuracy and better interaction with suppliers. The adoption is however limited due to high cost of investments, organizational resistance to change, integration difficulties on the system, and limitation of infrastructure. The paper is crucial in mentioning the significance of hybrid operations models that integrate automation with human skills, where it is not possible to manage risks effectively without technology. Technically, supply chain automation is a strategic resiliency and competitiveness enabler for Sri Lankan apparel manufacturers. In practice, the findings can inform managers to automate and manage change, and policymakers are motivated to facilitate digital transformation by funding and skills training. Automation is therefore not only to be seen as a competitive advantage, but also a long-term strategic investment in overcoming uncertainty in global supply chains.

Keywords: *Supply chain automation, risk management, the production of apparel, Sri Lanka, the adoption of automation, ERP systems, qualitative research.*

The Impact of Cargo Handling Delays on the Transshipment Time of Full Container Load Containers: Case Study of the Port of Colombo

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The Port of Colombo plays a critical role as a regional transshipment hub, handling a significant share of containerized cargo in South Asia. However, increasing cargo volumes and operational complexities have intensified cargo handling delays, directly affecting vessel-to- vessel transshipment time of Full Container Load (FCL) containers. This study examines the impact of key cargo handling delay factors on transshipment time at the Port of Colombo, grounded in Queuing Theory, the Theory of Constraints, and Supply Chain Flexibility Theory. A quantitative research design based on a positivist philosophy and deductive approach was applied. Secondary data from HR and Maritime logistics reports were used to identify the study population based on the selected independent variables: labour shortage delay, crane breakdown delay, equipment availability delay, and inter-terminal trucking delay. Primary data were collected through a structured questionnaire using a five-point Likert scale from 158 operational personnel, including crane operators, terminal operators, and inter-terminal trucking employees, selected through stratified random sampling from three major terminals: Jaya Container Terminal (JCT), Colombo International Container Terminal (CICT), and South Asia Gateway Terminal (SAGT). Data were analyzed using SPSS through descriptive statistics, reliability and validity tests, and correlation and coefficient analyses. Due to Cronbach's Alpha value below the acceptable threshold, the Inter-Terminal Trucking (ITT) variable was excluded from analysis because of low reliability. Therefore, subsequent analyses focused on labor shortage, crane breakdown, and equipment availability only. The findings reveal that crane breakdown delay and equipment availability delay have a significant positive relationship with increased vessel-to-vessel transshipment time, identifying them as major operational bottlenecks within terminal operations. Labor shortages were also found to influence operational efficiency, though to a comparatively moderate extent. The study highlights the importance of addressing critical constraints through preventive maintenance and improved equipment availability. The mention of inter-terminal trucking was removed since ITT was excluded from analysis. These findings offer practical insights for port authorities, terminal operators, to improve operational efficiency, strengthen port competitiveness, and support supply chain performance in the digital logistics era.

Keywords: *Cargo handling delays, equipment availability delay, Full Container Load (FCL), Inter-terminal trucking, vessel-to-vessel transshipment time.*

The Impact of Warehouse Management Systems on Operational Efficiency of Third-Party Logistics Warehouses in Sri Lanka

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This concept paper looks at the impact of implementing and optimization of Warehouse Management Systems on operational efficiency at third party logistics warehouses within Sri Lanka. Due to the growth of electronic commerce, the development of omnichannel distribution, and the increased customer service expectations, the logistics business has been moving its operations towards better efficiency and quality in warehousing, making it a glass ceiling of competitive advantage. Nevertheless, lots of Third-Party logistics providers in Sri Lanka still have fragmented information systems and labor-intensive routines, which may help to create poor inventory accuracy, slow order fulfilment, and increased cost of operation. The limited local empirical evidence to be achieved is countered by the quantitative, cross sectional survey design employed in the study, which utilizes the structured questionnaire to gather the data about around 120 operational and supervisory employees in eight purposively sampled third party logistics warehouses. The paper also measures four levels of explanatory variables, i.e. function capabilities of Warehouse Management System, degree of system integration, user training capabilities and competency, data quality and real time visibility and evaluates their impacts on operational efficiency in terms of inventory accuracy, order fulfilment speed and operating cost efficiency. The reliability and validity tests such as Cronbach alpha and factor analysis will be used to test four hypotheses and then multiple regression and, in case of necessity, structural equation modelling will be applied. It is hoped that the expected result will be Evidence based recommendations to help in the integration and optimization of the Warehouse Management System that can be used in increasing productivity, service performance and competitiveness of logistics sector in Sri Lanka.

Keywords: *Warehouse Management System (WFMC), Operational Efficiency, Third-Party Logistics (3PL), IoT, RFID, Supply chain Optimization*

Transitioning to Electric Freight Vehicles: A Case Study of Sri Lanka's Dairy Supply Chain

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Addressing climate change has become an urgent global priority as greenhouse gas emissions continue to rise, posing significant threats to planetary health and socio-economic well-being. The transportation sector is a major contributor to these emissions, accounting for roughly one-quarter of all energy-related CO_2 emissions. Road transportation accounts for three-quarters of transport emissions, with freight trucks contributing 29.4% of total transport emissions. Transitioning from conventional diesel-powered trucks to electric vehicles (EVs) is crucial for decarbonizing freight systems, particularly when combined with clean electricity generation. However, electric freight adoption is governed by complex factors including vehicle range limitations, payload constraints, charging infrastructure availability, and diverse terrain characteristics. This research determines the optimal strategy to integrate electric mobility into freight transportation systems, using Sri Lanka's dairy industry as a case study. Sri Lanka's dairy industry is rooted in rural smallholder farming, collecting approximately 500,000 liters daily from cattle and buffalo across geographically dispersed locations. The raw milk collection process involves gathering milk from numerous collection points and transporting it to processing centres. The existing fleet comprises three-wheelers, mini-lorries, pick-ups, and small trucks operating fixed daily routes over mixed flat and hilly terrain, making it an ideal testbed for evaluating EV integration challenges in diverse operational conditions. The methodology consists of five phases. First, key factors influencing EV operational parameters in freight applications are identified through comprehensive literature review. Second, suitable EV technologies for dairy freight are assessed by evaluating operating costs and performance parameters, developing a comparative cost model against internal combustion engine vehicles. Third, routes suitable for EV deployment are analysed based on range limitations, charging infrastructure requirements, and payload constraints. Fourth, multiple EV integration scenarios are tested with varying fleet compositions, considering route lengths, terrain challenges, and charging limitations. Finally, minimum criteria for successful EV integration are derived from scenario analysis. The outcomes include an optimization model which select vehicles and assign routes for them such that the total transportation cost is minimized. The model provides a guidance for EV adoption, accounting for technical, economic, and operational constraints specific to freight transportation. This research supports achieving national e-mobility targets while contributing to substantial reductions in transport-related air pollution in rural communities. Beyond the dairy sector, the methodology and findings are transferable to other freight-dependent industries facing similar electrification challenges, offering a replicable approach for sustainable freight transformation in developing economies with diverse geographical conditions.

Keywords: *dairy supply chain, electric vehicle integration, freight transportation, route optimization, sustainable logistics*

Resilient Freight Corridors in Developing Countries: Infrastructure Prioritization as Supply Chain Risk Mitigation Under Climate Change

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Climate-induced flooding has been recognized as a key source of disruption to road-based freight movement in Sri Lanka, where most freight has been transported by road and recurrent losses have been observed due to flooded corridors. Infrastructure managers have lacked simple, quantitative methods for identifying which road links should be protected first to support supply chain continuity. In this study, a streamlined hazard-based approach has been developed to prioritize road segments for flood resilience interventions in the Attanagalu Oya basin. Thirty years of rainfall data and two-dimensional hydraulic modelling have been used to estimate flood depths and velocities for a set of design events over the basin. A depth–velocity hazard index has been defined and classified into six categories, and this index has been extracted for selected road segments intersecting the floodplain. On this basis, each segment has been assigned a hazard class and has been placed into a priority group for resilience investment. The resulting ranking has highlighted a small subset of corridors, including the A003 route to Colombo International Airport, that have been exposed to high or extreme flood hazard under current and projected conditions. By relying on readily available hydrological data and standard modelling tools, the method has been designed to remain applicable in data- and capacity-constrained settings. The approach has been intended to provide transport agencies and supply chain stakeholders with a transparent, hazard-focused basis for selecting road segments for further detailed design and investment planning in similar tropical monsoon environments.

Keywords: *Flood hazard assessment, freight corridors, supply chain disruption, climate-induced flooding, Attanagalu Oya basin, depth–velocity hazard index, road segment prioritization, infrastructure resilience, hydraulic modelling*

A Discrete Event Simulation Model for Departure Passenger Flow: A Case Study of Bandaranaike International Airport, Sri Lanka

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Increasing passenger demand and heightened security protocols have made airport terminal operations a critical component of the modern air transport supply chain, with congestion having a direct impact on service reliability, subsequent flight operations, and the overall passenger experience. This research introduces a discrete-event simulation (DES) model developed to analyse the departure passenger flow, using Bandaranaike International Airport (BIA) in Sri Lanka as a case study. The model illustrates essential departure procedures, including security screening, check-in, and emigration, and was created utilizing detailed operational data such as daily flight schedules, passenger arrival patterns, and processing times derived from real-world observations. Multiple independent simulation replications were performed for each schedule to account for the inherent randomness of passenger arrivals and service procedures. Model validation was conducted by comparing simulated queue lengths with observed real-world queue data collected during specific operational periods, utilizing time-dependent confidence intervals and standard performance metrics. The validation results show that, for all modelled processes, the DES model can accurately replicate observed queue evolution, peak congestion levels, and temporal queue patterns. This study illustrates the feasibility and significance of simulation models for accurately modelling complex passenger flows within airport terminals. By providing a validated digital representation of departure operations, the model establishes a reliable foundation for future decision-support applications, scenario testing, and integration with advanced data-driven methods. This research contributes to the supply chain and logistics domain by demonstrating how simulation can improve operational visibility and facilitate data-informed planning within airport environments that are operating in the digital age.

Keywords: *discrete event simulation, passenger flow modelling, airport terminal operations, aviation logistics, stochastic modelling*

Application of Microsimulation Modelling for Capacity Enhancement and Congestion Mitigation in Multi-Terminal Port Road Infrastructure

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The escalating containerization of global trade necessitates robust internal transportation infrastructure capable of accommodating increasing traffic volumes while maintaining operational efficiency. Internal port road networks constitute critical arteries for cargo movement between terminal facilities, yet inadequate capacity and suboptimal design frequently generate bottlenecks that cascade throughout port operations. This research presents a practical traffic engineering approach employing microsimulation techniques to evaluate network performance and develop evidence-based infrastructure enhancement strategies for the Port of Colombo, Sri Lanka, specifically analyzing the multi-terminal complex serving CICT, CWCT, SAGT, and ECT facilities. The study addresses a fundamental challenge in contemporary port management where landside infrastructure constraints impose significant limitations on terminal throughput, vessel turnaround efficiency, and supply chain integration. Network performance was assessed using VISSIM microsimulation software with traffic data collected from comprehensive field surveys conducted within the Port of Colombo. Simulation runs incorporated appropriate warm-up periods and validation procedures confirmed strong agreement between simulated and observed traffic patterns, establishing model reliability for practical applications. Practical mitigation strategies were developed based on simulation results, including widening strategic corridors to accommodate projected traffic demand, upgrading roundabouts to dual-lane configurations with appropriate dimensions for container vehicle maneuverability, implementing dedicated turning lanes at high-volume intersections, establishing segregated queuing areas at processing facilities, and comprehensive road marking programs. This approach demonstrates how microsimulation modeling serves as a valuable decision-support tool for port infrastructure planning, enabling planners to test alternative designs virtually before implementation, optimize investment priorities, and predict performance outcomes. The methodology is readily transferable to other port facilities facing similar congestion challenges, offering a systematic framework for diagnosing problems, evaluating solutions, and justifying infrastructure investments. Results support data-driven decision-making for port expansion projects, helping authorities allocate resources efficiently while minimizing operational disruptions during implementation. This research contributes to advancing port operational excellence through scientific traffic management practices applicable across diverse port environments.

Keywords: *infrastructure planning, microsimulation modeling, port operations, traffic optimization, VISSIM,*

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