Sri Lanka Society of Transport and Logistics

Journal of South Asian Logistics and Transport
Volume 5 Issue 2 September 2025
JSALT 5.2.4: pp. 97-116
DOI: https://doi.org/10.4038/jsalt.v5i2.112

OPTIMISING MULTIMODAL INTEGRATION: GLOBAL BEST PRACTICES FOR SEAMLESS CONNECTIVITY AND THEIR APPLICABILITY IN SRI LANKA

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ABSTRACT

Multimodal integration enhances public transport usage, thereby reducing traffic congestion, which is particularly suitable in Sri Lanka. However, the fragmented ownership of public transport and the lack of coordination between different transport service providers make it difficult to implement this concept. This study aims to identify the best global practices and prioritise them for the Sri Lankan context, focusing on the Kandy Multimodal Transit Terminal (KMTT) as a case study for implementing multimodal integration. A qualitative and quantitative mixed-methods approach is used, including a literature review, case study analysis, and structured expert interviews, to identify the best global practices that other countries have used to implement multimodal integration and rank them according to importance and urgency based on their suitability to Sri Lanka's unique transport system. The mixed-method approach increases the accuracy of the provided practices. The analysis provided a model of the integration ladder based on the Important–Urgent matrix to implement multimodal integration step-by-step to achieve seamless transport and ensure better connectivity, accessibility, and efficiency.

Keywords: *Multimodal integration, seamless transport, public transport, physical integration, information integration, monetary integration, global best practices*

1. INTRODUCTION

Over the past decades, the demand for global mobility has increased significantly and is expected to increase even more rapidly in the coming years [1]. To meet the increasing demand, public transport, which incorporates all modes of transport where people travel as passengers rather than in their private vehicles [2], has been developed in many cities as an alternative to private transport modes. Its proportion in the modal split is quite low because of limited capacity and low service quality, particularly in developing countries [3]. Building wider roads to accommodate this extra traffic will no longer be a solution, as not only does the extra capacity induce further traffic, but land is a limited resource in congested urban areas [4]. Therefore, the focus should be on the public transport sector. A case study conducted in Singapore indicated that increasing the use of public transport is a way to solve future transport problems [5]. The integration of public transport modes has been cited by many as one of the primary factors that enhances public transport ridership and makes public transport investments more viable [4]. Integration refers to the process of moving from one place to another via rider-friendly intermodal facilities and their connections. Improved integration allows people to move more easily and reduces travel time [6]. The integration between these transportation modes is not satisfactory, especially in Sri Lanka [7]. Thus, serious issues and challenges still exist, such as a low level of service, lack of adherence to fixed timetables, and a deficit or surplus of transportation units, mainly resulting from poor planning in this vital sector [8]. This lack of coordination and connectivity between public transport services results in longer waiting times for passengers transferring between different modes of transportation.

"Multimodal Transport" can be defined as the integration of two or more different modes to complete a trip between the respective origin and destination, where the traveller makes a transfer [9]. Weak coordination between different transport regulators and the fragmented ownership of the provided transport services are critical barriers to multimodal integration in Sri Lanka. The governance structure is divided into national and provincial levels, which leads to overlapping responsibilities and a lack of unified planning [10].

The foundation of this research lies in identifying the best global practices that other cities have used to implement the multimodal concept and prioritising those practices according to the unique transport system in Sri Lanka. The Kandy Multimodal Transport Terminal (KMTT) development project in Sri Lanka is emphasised as a primary case study. Even though the bus and railway terminals will be connected somewhat physically, there is a lack of coordination and integration of information and financial integration.

2. LITERATURE REVIEW

Deregulation and privatisation have led to public transportation moving away from integration [6]. In countries such as Sri Lanka, different transport modes have been operated in isolation from one another [9]. The concept of multimodal transport was introduced to address these challenges in Sri Lanka. While developed countries have successfully implemented this concept, establishing effective multimodal systems in developing countries remains a challenge.

A study conducted to design an Integrated Strategic Public Transport Plan (ISPT) for Kandy city states that a lack of connectivity and the absence of integration between different transport modes are some of the key factors that lead to traffic congestion and a lesser attraction for rail ridership; thus, it is suggested that public transport should be integrated to provide seamless connectivity between different transport modes [11] The above-mentioned study includes a redesigned plan for the public transport system; however, it does not distinctly mention the functional practices essential for implementing the multimodal transport concept and developing a fully integrated multimodal hub. A multimodal hub mainly refers to a train/tram station that offers multiple modes to switch seamlessly for different users and travel purposes, and provides an integrated and sustainable mobility network [12]. This study is important for gaining insights into multimodal transport integration practices and which practices should be prioritised to implement a local multimodal system.

Theoretical analysis suggests that transport integration will not occur autonomously, as free-market provision is likely to be affected by service instabilities and schedule matching, and with multiple operators across several jurisdictions, integration of fares, services, and information is unlikely to occur [6]. The results revealed that a framework with three levels of integration, physical, informational, and monetary, is necessary to achieve successful public transport integration at railway stations[4]. Physical integration ensures that people can easily switch between different transport modes and conveniently access terminals [4]. In information integration, a well-coordinated transport service is provided using consistent data and technologies [4]. The harmonisation of fares and financial systems across modes and different transport service providers is considered monetary integration [4].

Barriers to integrating transport systems include difficulties in defining the integration concept, operationalising the concept of integration, a lack of evidence on the success of integrated policies, and behavioural changes that require both individual and institutional changes [4]. To overcome these barriers, the concept of the “integration ladder” includes different interchange performances to establish a conceptual framework for multimodal integration in each country. Each level has different integrations because the results reveal that a framework with three levels of integration, physical, informational, and monetary, is required to achieve successful public transport integration at railway stations. These levels of integration also need to be supported by additional interventions, such as those that enhance user perception of transit service quality, provide contextual information of the surroundings, and garner active participation of the stakeholders, which will, in turn, enhance the sense of belonging and aid in augmenting users' quality of life [4].

3. METHODOLOGY

This research adopts a qualitative and quantitative mixed methods approach to identify the best global practices and prioritise them according to Sri Lanka's unique transport system. Three main data collection methods were used: case studies, literature reviews, and structured expert interviews. This mixed-method approach was used to increase the accuracy and applicability of the results. Content analysis, summative content analysis, multi-criteria decision analysis (MCDA), Important–Urgent matrix, and sensitivity analysis are the data analysis techniques that are utilised in this research. Four main steps were followed to conduct this research. First, the current transport system in Sri Lanka was identified in relation to the ongoing development of multimodal hubs. Second, the practices used to implement multimodal integration in various countries were identified. In the third step, the best global practices among those practices were identified and categorised. As the last step, the pre-identified best global practices were selected and prioritised according to the local transport expert's perspective.

3.1. Data Collection Methods

3.1.1. Case Studies

To articulate the current transport system in Sri Lanka, the KMTT was selected as the primary case study. Since KMTT is one of the most significant ongoing transport development projects, it aims to establish a connection between different transport modes to increase public transport ridership. Semi-structured interviews, the current Bus Management System (BMS), other digital platforms, and documents such as reports and internal records were used to gather firsthand data directly. With the advancement of the ongoing development project, the current transport system and the expected changes in the existing transport system were identified. The participants in the semi-structured interviews were direct stakeholders of the projects, including those at the executive and operational levels. Eight executive-level experts currently working and consulting on the KMTT development project were interviewed. The 11 operational-level interviewees were bus drivers and conductors with more than ten years of experience, who were currently working on buses that originated from Kandy.

A secondary case study analysis was conducted to identify the best practices used by other cities to implement the multimodal concept. In practice, there are many cases of transport integration between trains and urban transport, especially in Europe and North America [13]. Twelve different multimodal transportation case studies were selected from each country. The economic level was the main criterion for selecting these case studies. A well-developed country, countries in Europe, Asian countries, developing countries, and countries with a similar economic level to Sri Lanka are represented by the United States of America, the United Kingdom, France, Germany, India, Japan, China, Singapore, South Korea, Malaysia, Brazil, and Bangladesh. Using these case studies, the practices used to establish the multimodal concept were identified. Since the multimodal concept has not been fully defined in Sri Lanka, it is better to consider countries that have already successfully implemented multimodal integration. Therefore, case study analyses have been conducted to obtain an in-depth investigation of contemporary phenomena within their real-life contexts [14].

3.1.2. Literature Review

A literature review was used as the data collection method to identify and categorise the global best practices. Literature review: Summarises and evaluates the state of knowledge or practice on a particular subject [15]. This was done to identify the best practices among the selected practices from the case studies. In addition, justify the reason for selecting them as best practices. Themes and patterns were identified in current global practices used to establish multimodal integration. The selected practices were then categorised into physical, information, and monetary integration levels based on the foundational understanding provided by the literature review. Peer-reviewed journal articles, reports from well-reputed organisations, and books were used as sources of information.

3.1.3. Local Transport Experts Interviews

The third and final data collection method was structured expert interviews. Forty-three transport experts were selected in various aspects of public transport planning and management, including academic experts, engineers, operational experts, consultants, and direct stakeholders of the KMTT development project. All the interviewees had experience in the public transport sector.

Before obtaining the responses, all the interviewees were informed about the purpose of the study, confidentiality, and how their input would be used. As for the practices that have been mentioned, as an example, if we consider a multimodal hub at the physical integration level, what is meant by a multimodal transit hub, and what is the purpose of the multimodal transit hub? 39 interviews were conducted in person, while the others were conducted virtually.

The experts were asked to respond to a structured questionnaire. The questionnaire consisted of a personal information section, pre-identified and categorised best global practices, and whether they were important or not important for implementing multimodal integration in Sri Lanka. Then, these practices were ranked based on their importance and urgency at each integration level–physical, information, and monetary–from most important to least important and most urgent to least urgent. The same rank could be given to any number of practices. In the last stage, the interviewees were asked to provide percentage weights out of 100% for each integration level to obtain a generalised value for each practice in the three integration levels and other practices that were not mentioned but should be considered for implementing multimodal integration in Sri Lanka.

3.2. Data Analysis Methods

3.2.1. Content Analysis

The data collected in the primary and secondary case studies were analysed using content analysis. Given the nature of the data collected, it was appropriate to use this initiative to classify large volumes of textual data, and different textual sources can be dealt with and used to corroborate the evidence [14] As a method of analysing written, verbal, or visual communication messages, content analysis is the most suitable data analysis method to obtain a comprehensive picture of the current transport system and then identify global multimodal practices according to the current transport system to implement the multimodal concept in Sri Lanka.

Using summative content analysis, the number of times each multimodal practice identified in secondary case studies was mentioned in the literature was identified and quantified [16]. The occurrence of the identified words was manually counted. It is an unobtrusive and non-reactive way to study the phenomenon of interest [16]. To select the best practices among the selected best practices globally, summative analysis is the most appropriate approach.

3.2.2. Multi-Criteria Decision Analysis (MCDA)

After collecting all the responses, the data were analysed using Microsoft Excel, following the Multi-Criteria Decision Analysis (MCDA). MCDA is a weighted scoring approach that is particularly effective in evaluating alternative strategies when decisions involve multiple qualitative and quantitative criteria, as is often the case in transportation planning [17]. Because the most important/urgent practices were ranked as number one, the data were rearranged to obtain the highest value for the most important/urgent practices. The values were then generalised by dividing the rank number by the number of practices in each integration level and multiplying by the weights provided in each response for each integration level. Then, the average value for each practice was calculated in terms of importance and urgency.

3.2.3. Important-Urgent Matrix

Using each practice, the importance value for the X axis, and urgency for the Y axis, the important-urgent matrix was created using the scatter plot in MS Excel. The importance and urgency thresholds were calculated by adding the highest and lowest values on each axis and dividing them by two. The important–urgent matrix enables the strategic filtering of actions, helping identify which initiatives require immediate attention and which can be deferred [18]. Using this approach, all practices were categorised into four quadrants.

1. High importance – High urgency: Do it immediately
2. High importance – Low urgency: Schedule (strategic planning)
3. Low importance – High urgency: Delegate
4. Low importance – Low urgency: Deprioritise or Eliminate

3.2.4. Sensitivity Analysis

After creating the important-urgent matrix, a sensitivity analysis was conducted to validate the results of the study. The final average value for each practice in terms of importance and urgency increased by 5% at one time and then decreased by 5%. The important-urgent matrix was created according to the newly calculated values and used to determine whether major changes occurred in the output.

4. RESULTS

First, a primary case study was conducted to identify the current transport system and the expected changes with the ongoing multimodal development project. Global practices used to implement multimodal integration were determined using secondary case studies. Among these practices, the best global practices were selected, and as the final step, these practices were prioritised for the Sri Lankan context.

4.1. Current Transport System in Sri Lanka

After analysing data gathered from semi-structured interviews and documents using content analysis, the fragmented ownership of the transport service providers was found to be the main barrier to multimodal integration in the local context. It is stated in [6] that fragmented ownership of public transport is a further barrier to integration. Transport service providers operate independently without much integration with each other. Even the public-private bus service providers are not integrated. There are three main regulators of bus services: the Sri Lanka Transport Board (SLTB), the

National Transport Commission (NTC), and the Central Province Transport Service Authority (CPTSA), which will originate from the KMTT in the near future. However, when it comes to ownership, there are more than 4000 owners. Only SLTB buses are publicly owned. Therefore, the privatisation of public transport leads to further integration [6].

There is no synchronised timetable for the bus service. Different regulatory bodies have different timetables for the buses they operate. This will ultimately create competition among different transport service providers, and this competition is increased by per-passenger income. There is no accurate, real-time data access for passengers.

The Sri Lanka Railway (SLR) is solely responsible for providing train services. However, the lack of connectivity with other modes of transport, limited train frequency, unreliable service, and lack of real-time data decrease the demand for rail ridership. Although the KMTT is being developed, connectivity will be implemented to some extent. However, to achieve successful multimodal integration and seamless connectivity, more services should be provided along with the infrastructure.

4.2. Best Global Practices

To implement multimodal integration in the current system, more suitable practices had to be identified using content analysis. Global multimodal practices were identified. A case study of Dhaka, Bangladesh, a multimodal hub, was proposed but has not yet been implemented. However, all other cities have implemented the multimodal concept. Table 1 shows the identified practices.

Table 1: Global practices for multimodal integration

City and Country	Physical Integration	Information Integration	Monetary Integration
New York City USA [19] [20]	• Multimodal hubs link subway, buses, and rail • Seamless transfer access (underground walks) • Pedestrian-friendly access • Feeder service • Infrastructure sharing • Drop off and pick up • Citi Bike docks	• Trip planner apps like MTA • Digital display Information screens • Real-time arrival alerts • Demand-based service • Synchronised tables • Passenger alerts • Common signage	• OMNY contactless payment • Weekly fare capping • Unified tickets • Mobile payment system • Common fare structure among different transport modes
London UK [21], [22]	• Multimodal transit hub • Seamless transfer access	• TfL Go app for real-time data	• Oyster and contactless cards for all modes

City and Country	Physical Integration	Information Integration	Monetary Integration
	• Dedicated lanes and priority lanes • Bike share docks • Pedestrian-friendly design • Universal accessibility • Uber and Black cabs	• Synchronised timetables • Live bus arrival signs at shelters • Demand-based service • AI-powered crowd management	• Daily/weekly fare capping • Subsidies
Paris France [23]	• Multimodal hub • Seamless transfer access • Drop off and pick up	• Connected digital platforms • Real-time trip info and alerts	• Navigo pass for all modes
Berlin Germany [24]	• Integrated hubs • Park and Ride at S-Bahn	• VBB app for trip planning • Real-time data for all public transport	• One VBB ticket for all modes of transportation • App-based contactless tickets
Delhi India [25], [4]	• Metro and city bus terminals co-located • Taxi service • TOD zones at stations	• Delhi Metro route planning app	• Smart card for express and local trains
Tokyo Japan [4], [26]	• Multimodal transit hub • Universal accessibility • Drop off and pick up • Commercial development • Taxi service	• Apps like NAVITIME, for routes • Real-time station info • Digital display screens	• Common fare cards • Contactless payment • Subsidies
Shanghai China [13]	• Multimodal transit hub • Pick up and drop off points • Taxi service • Universal accessibility • 3D pedestrian networks • TOD • Low walking distances • Luggage delivery facilities	• Real-time data • Digital display screens • Time coordination • Interchange signage and Information	• Smart cards • E-tickets • Interchange discounts
Singapore [5], [27]	• Seamless transfer access • Multimodal transit hub • Dedicated lanes and priority lanes • Universal accessibility • Taxi service	• IBOS real-time tracking • Synchronised timetables • Demand-based service	• EZ-Link • Contactless smart cards and phone payment

City and Country	Physical Integration	Information Integration	Monetary Integration
Seoul South Korea [28], [29], [4]	• Multimodal transit hub • Seamless transfer access • Dedicated lanes and priority lanes • Universal Accessibility • Park and Ride at the outskirts	• Real-time data phone Apps • Synchronised timetables • Live arrival displays at stops	• T-money card for all transit • Cashless payment and e-ticketing • Free transfers and retail payments
Kuala Lumpur Malaysia [4], [30]	• KL Sentral hub links all modes • Dedicated lanes and priority lanes • Universal accessibility • Taxi service • Intermodal stations (e.g. Pasar Seni) • Park and Ride at outer stations	• Real-time data sharing App • Digital display screens • Synchronised timetables	• Touch ‘n Go smartcard • Subsidies • Smart reloadable card
São Paulo Brazil [31]	• Metro, CPTM rail and bus interchanges • Mototaxis	• SPTrans planner for metro and bus • Real-time train/bus display screens • Journey planning apps • Social media update	• Common fare cards • Free transfer window • Fare integration
Dhaka Bangladesh [32]	• Multimodal transit hub • BRT lines under construction • Bus routes are planned to feed the metro	• Limited journey planning apps • Real data update through the Facebook page	

Using summative content analysis of the data collected in the literature review, these practices were ranked according to the number of times they were represented. Higher-ranking practices were selected as the best global practices. The papers below have been referred to gather the literature data: [3], [6], [33], [34], [35], [36], [37], [38], [39], [40], [41], [42], [43], [44], [45]

A manual procedure was followed in this step to increase the accuracy of the study. This is because different words may have the same meaning. Therefore, 17 key practices, shown in Table 2, were identified as they were mentioned more frequently to implement the multimodal concept.

Table 2: Selected best global practices

Physical Integration	Information Integration	Monetary Integration
Multimodal transit hub	Real-time data	Common fare cards
Seamless transfer access	Synchronised timetables	Contactless payment and e-ticketing
Luggage moving	Digital display screens	Public-private revenue sharing
Dedicated and priority lanes	Journey planning Apps	Subsidies
Universal accessibility	Demand-based service	
Park and ride		
Drop off and pick up.		
Taxi service		

4.3. Selected Practices and their Priority

From the personal data collected from transport experts, more than 70% of the experts had more than ten years of experience in the transportation sector. In addition, among the transport experts, 83% have gained experience in multimodal transport integration, either through consulting or working on multimodal projects.

The average values calculated for each practice using the MCDA in terms of importance and urgency are mentioned in Tables 3, 4, and 5. The Important–Urgent matrix (Figure 1) was drafted using the values from Tables 3, 4, and 5.

Table 3: Average values for physical integration practices

Practices	Importance	Urgency
Multimodal transit hub (Infrastructure)	39.00%	39.00%
Seamless transfer access	35.12%	23.47%
Luggage moving	25.51%	24.94%
Dedicated lanes and priority lanes	20.71%	21.32%
Universal accessibility	34.35%	36.56%
Park and ride facilities	32.59%	32.82%
Drop off and pick up	31.51%	29.10%
Taxi service	23.40%	23.42%

Table 4: Average values for monetary integration practices

Practice	Importance	Urgency
Common fare cards	22.09%	22.97%
Contactless payment and e-ticketing	16.83%	11.57%

Practice	Importance	Urgency
Public-private revenue sharing	19.07%	15.58%
Subsidies	15.20%	17.47%

Table 5: Average values for informational integration practices

Practices	Importance	Urgency
Real-time data	34.14%	34.28%
Synchronised timetables	29.98%	29.40%
Digital display screens	24.95%	28.26%
Journey planning Apps	20.81%	19.77%
Demand-based service	27.93%	24.56%

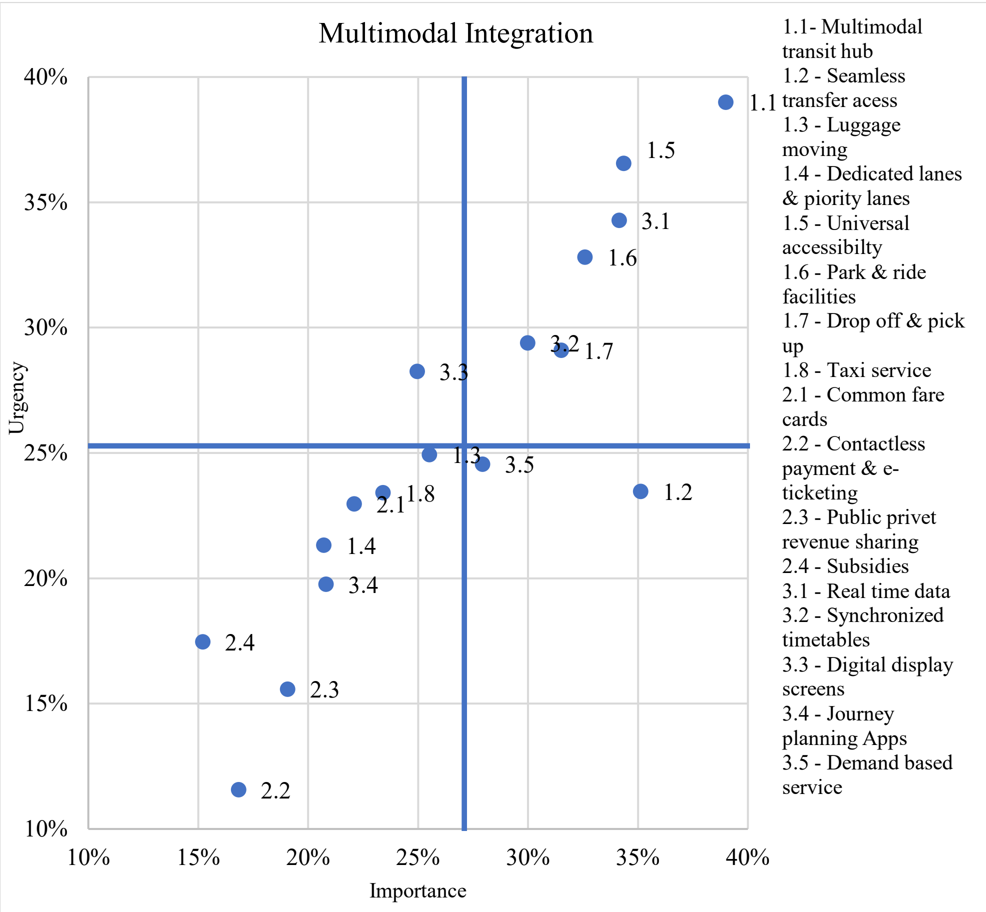

Figure 1: Important-urgent matrix

Selected Best Practices for Sri Lanka

Quadrant 1 DO	Quadrant 2 SCHEDULE	Quadrant 3 DELEGATE	Quadrant 4 Depriortize
Multimodal transit hub Universal accessibility Real-time data Park and ride facilities Drop off and pick up Synchronized timetable	Demand based services Seamless transfer access	Digital display screens	Luggage moving Taxi service Common fare cards Dedicated lanes and priority lanes Journey planning apps Contactless payment and e-ticketing Subsidies Public-private revenue sharing

Figure 2: Prioritisation of practices based on local context

Based on these results, quadrant 1 practices should be initially implemented for successful multimodal integration. Quadrant 2 can be considered later, and practices can be implemented at the right time. Practices listed under quadrant 3 can be delegated to another party for implementation as soon as possible, since they are not more important. Rather than monetary integration practices in the 4th quadrant, other practices should be eliminated or reconsidered after successful multimodal integration. These practices are not required to implement the multimodal concept in Sri Lanka, at least at the moment. Rather than making a dramatic change to the current transport system, a model of the integration ladder should be followed according to the important-urgent matrix to achieve successful multimodal integration. The sensitivity analysis provided the same results as the original dataset. Therefore, the accuracy of the results was high.

The limitation of this research is that the best global practices were selected through summative content analysis; some practices were frequently mentioned in other papers. Hence, all cases and papers were selected unbiasedly. However, the foundation of these integration levels is institutional integration. Different transport service providers must collaborate to implement these practices [13].

5. CONCLUSION

In conclusion, this study selected the best global practices to implement the multimodal concept and prioritised the key practices according to Sri Lanka’s unique transport system. Therefore, primary and secondary case studies were used to identify global practices considering this unique situation. A literature review was conducted to identify the best global practices. Structured expert interviews, multi-criteria decision analysis, and an important-urgent matrix were used to prioritise these practices for the local context. However, for successful multimodal integration, a phased implementation strategy should be followed based on the results of the important-urgent matrix. Implementing all the practices used by other countries to implement multimodal integration in Sri Lanka and abrupt large-scale changes in the current transport sector will make the current transport system more complex.

The analysis highlights that, along with infrastructure development, the focus should move to providing more service-oriented solutions, such as real-time data sharing and synchronised timetables. In addition, monetary integration is no longer more important or urgent for multimodal integration as a level of integration in the integration ladder, since all the practices of monetary integration are under the deprioritised category of the important–urgent matrix. To prove this, monetary integration is the highest level of integration that multimodal integration can achieve [13]. Therefore, these practices can be implemented at some point after reconsideration.

Using this study and implementing the practices according to the priority list, multimodal integration and seamless transport can be achieved for all upcoming and ongoing multimodal projects in Sri Lanka. Identifying the challenges in implementing this concept could be a future research direction.

REFERENCES

[1] H. Jing, Y. Chen, M. Ma, W. Feng, and X. Xiang, "Global carbon transition in the passenger transportation sector over 2000–2021," *Sustain Prod Consum*, vol. 51, pp. 556–571, Nov. 2024, doi: 10.1016/j.spc.2024.10.006.

[2] L. Glover, "Public transport as a common pool resource," in Proc. 34th Australas. Transp. Res. Forum (ATRF), Adelaide, Australia, Sep. 2011. [Online]. Available: https://australasiantransportresearchforum.org.au/public-transport-as-a-common-pool-resource/

[3] T. C. Van Nguyen and T. M. T. Truong, "Integrated transport and urban development in Asian developing cities," *Transportation Research Procedia*, vol. 82, pp. 1562–1577, 2025, doi: 10.1016/j.trpro.2024.12.141.

[4] D. Nag, M. B. S, A. K. Goswami, and S. Bharule, "Framework for public transport integration at railway stations and its implications for quality of life," *SSRN Electronic Journal*, Art. no. 1054, Dec. 2019, doi: 10.2139/ssrn.3551888.

[5] M. F. Ibrahim, "Improvements and integration of a public transport system: The case of Singapore," *Cities*, vol. 20, no. 3, pp. 205–216, 2003, doi: 10.1016/S0264-2751(03)00014-3.

[6] J. Preston, "Integration for seamless transport," Int. Transp. Forum Discussion Papers, no. 2012/01, OECD Publishing, Paris, France, Apr. 2012. doi: 10.1787/5k8zvv8lmswl-en

[7] A. S. Kumarage, *Sri Lanka transport sector policy note: Final report*, World Bank, Sri Lanka, May 2012. [Online]. Available: https://www.researchgate.net/publication/358213402_SRI_LANKA_TRANSPORT_SECTOR_POLICY_NOTE

[8] A. Abuaisha and S. Abu-Eisheh, "Optimization of urban public transportation considering the modal fleet size: a case study from Palestine," *Sustainability*, vol. 15, no. 8, Apr. 2023, doi: 10.3390/su15086924.

[9] N. Indika and A. S. Kumarage, "Formulating an investment, management and operation model for developing multimodal transport terminals in Sri Lanka," in Proc. East Asian Soc. Transp. Stud. (EASTS), Colombo, Sri Lanka, Sep. 2019. [Online]. Available: https://www.academia.edu/84219239/Formulating_an_Investment_Management_and_Operation_Model_for_Developing_Multimodal_Transport_Terminals_in_Sri_Lanka

[10] A. S. Kumarage and G. Bandara, "Sustainable transport plan for Kandy," in Proc. Civil Eng. Soc. (CES) Annu. Seminar, Univ. of Peradeniya, Peradeniya, Sri Lanka, Oct. 2017. [Online]. Available: https://www.researchgate.net/publication/328051839_Sustainable_Transport_Plan_for_Kandy

[11] DIMTS and Uni Consultancy Services, *Public transport design and operations management plan and strategic traffic demand management and design plan for the city of Kandy, Sri Lanka: Strategic traffic management and traffic circulation plan report for Kandy CBD, Vol. I of II*, Ministry of Megapolis and Western Development, Sri Lanka, Jun. 2016. [Online]. Available: https://www.scribd.com/document/772406959/1-Strategic-Traffic-Management-Traffic-Circulation-Plan-for-Kandy-CBD-Vol-I-R1-VF

[12] F. T. Kachousangi, S. Mokhtarzadeh, A. van Nes, N. van Oort, and S. Hoogendoorn, "Using space syntax to assess accessibility of multimodal urban hubs and seamless mobility within the hubs: Case study Delft-Campus train station," in Proc. 13th Int. Space Syntax Symp. (SSS 2022), A. van Nes and R. E. de Koning, Eds., Bergen, Norway: Western Norway Univ. of Appl. Sci. (HVL), Jun. 2022. [Online]. Available: https://www.scopus.com/pages/publications/85145578563

[13] L. Li and B. P. Y. Loo, "Towards people-centered integrated transport: a case study of Shanghai Hongqiao comprehensive transport hub," *Cities*, vol. 58, pp. 50–58, Oct. 2016, doi: 10.1016/j.cities.2016.05.003.

[14] S. Elo and H. Kyngäs, "The qualitative content analysis process," *J Adv Nurs*, vol. 62, no. 1, pp. 107–115, Apr. 2008, doi: 10.1111/j.1365-2648.2007.04569.x.

[15] J. W. Knopf, "Doing a literature review," *Political Science & Politics*, vol. 39, no. 1, pp. 127–132, Jan. 2006, doi: 10.1017/S1049096506060264.

[16] H.-F. Hsieh and S. E. Shannon, "Three approaches to qualitative content analysis," *Qual Health Res*, vol. 15, no. 9, pp. 1277–1288, Nov. 2005, doi: 10.1177/1049732305276687.

[17] M. N. Hassan, Y. E. Hawas, and K. Ahmed, "A multi-dimensional framework for evaluating the transit service performance," *Transp Res Part A Policy Pract*, vol. 50, pp. 47–61, 2013, doi: 10.1016/j.tra.2013.01.041.

[18] M. Choi, M. Kim, J. A. Kim, and H. Chang, "Building consensus on the priority-setting for national policies in health information technology: a delphi survey," *Healthc Inform Res*, vol. 26, no. 3, pp. 229–237, Jul. 2020, doi: 10.4258/hir.2020.26.3.229.

[19] Office of the New York City Comptroller, *Shifting gears: Steering federal infrastructure funds to support NYC's transportation future,* Bureau of Policy and Research, New York, NY, USA, Aug. 2023. [Online]. Available: https://comptroller.nyc.gov/wp-content/uploads/documents/Shifting-Gears.pdf

[20] National Academies of Sciences, Engineering, and Medicine, *Improving transit integration among multiple providers, vol. I: Transit integration manual*. Washington, DC, USA: The National Academies Press, 2014. doi: 10.17226/22226

[21] N. Dawda, G. Joshi, S. Arkatkar, and N. Vasudevan, "Multimodal of lateral transport system: A case study of successful cities worldwide," in Innovative Research in Transportation Infrastructure, D. Deb, V. Balas, R. Dey, and J. Shah, Eds. Singapore: Springer, 2019, pp. 101–110. doi: 10.1007/978-981-13-2032-3_10.

[22] C. Seaborn, J. Attanucci, and N. H. M. Wilson, "Analysing multimodal public transport journeys in London with smart card fare payment data," *Transportation Research Record: Journal of the Transportation Research Board*, vol. 2121, no. 1, pp. 55–62, Jan. 2009, doi: 10.3141/2121-06.

[23] M. Kilani, N. Diop, and D. De Wolf, "A multimodal transport model to evaluate transport policies in the North of France," *Sustainability*, vol. 14, no. 3, Feb. 2022, doi: 10.3390/su14031535.

[24] Z. He and H. D. Haasis, "Integration of urban freight innovations: sustainable inner-urban intermodal transportation in the retail/postal industry," *Sustainability (Switzerland)*, vol. 11, no. 6, 2019, doi: 10.3390/su11061749.

[25] P. P. Kumar, M. Parida, and M. Swami, "Performance evaluation of multimodal transportation systems," *Procedia Soc Behav Sci*, vol. 104, pp. 795–804, Dec. 2013, doi: 10.1016/j.sbspro.2013.11.174.

[26] A. Bramson, M. Hori, B. Zha, and H. Inamoto, "Social and economic flows across multimodal transportation networks in the Greater Tokyo area," *Appl Netw Sci*, vol. 5, no. 1, p. 7, Dec. 2020, doi: 10.1007/s41109-019-0244-y.

[27] S. Li, M. Meng, S. H. Lam, and Y. D. Wong, “Optimal coordination strategy for an integrated multimodal and multioperator transit system: case of Singapore,” *J Urban Plan Dev*, vol. 142, no. 2, Jun. 2016, doi: 10.1061/(ASCE)UP.1943-5444.0000308.

[28] J. Y. Song, J. K. Eom, K. S. Lee, J. H. Min, and K. Y. Yang, “Public transportation service evaluations utilizing Seoul transportation card data,” *Procedia Comput. Sci.*, vol. 52, pp. 178–185, 2015. doi: 10.1016/j.procs.2015.05.053

[29] Y. Kim, E.-J. Kim, S. Jang, and D.-K. Kim, “A comparative analysis of the users of private cars and public transportation for intermodal options under Mobility-as-a-Service in Seoul,” *Travel Behav Soc*, vol. 24, pp. 68–80, Jul. 2021, doi: 10.1016/j.tbs.2021.03.001.

[30] M. A. Ismail and M. N. Said, “Integration of geospatial multi-mode transportation systems in Kuala Lumpur,” *IOP Conf Ser Earth Environ Sci*, vol. 20, p. 012027, Jun. 2014, doi: 10.1088/1755-1315/20/1/012027.

[31] C. M. Senne, J. P. Lima, and F. Favaretto, “An Index for the sustainability of integrated urban transport and logistics: the case study of São Paulo,” *Sustainability*, vol. 13, no. 21, p. 12116, Nov. 2021, doi: 10.3390/su132112116.

[32] N. Sultana, *Efficiency analysis of public transit systems in Bangladesh: A case study of Dhaka city*, M.S. thesis, School of Planning, Univ. of Waterloo, Waterloo, ON, Canada, 2013. [Online]. Available: http://hdl.handle.net/10012/7600

[33] Q. Luo, S. Samaranayake, and S. Banerjee, “Multimodal mobility systems: joint optimization of transit network design and pricing,” Feb. 2021, doi: 10.1145/3450267.3450540.

[34] Z. Cheng, M. Trépanier, and L. Sun, “Real-time forecasting of metro origin-destination matrices with high-order weighted dynamic mode decomposition,” *Transportation Science*, vol. 56, no. 4, pp. 904–918, Jul. 2022, doi: 10.1287/trsc.2022.1128.

[35] J. Cai, Z. Li, and S. Long, “Integrated optimization of route and frequency for rail transit feeder buses under the Influence of shared motorcycles,” *Systems*, vol. 12, no. 7, p. 263, Jul. 2024, doi: 10.3390/systems12070263.

[36] N. O. Widiastuti and M. Z. Irawan, “Ride-hailing preferences for first- and last-mile connectivity at intercity transit hubs,” *Sustainability*, vol. 16, no. 7, p. 2927, Apr. 2024, doi: 10.3390/su16072927.

[37] M. Dixit, T. Brands, N. van Oort, O. Cats, and S. Hoogendoorn, “Passenger travel time reliability for multimodal public transport journeys,” *Transportation Research Record: Journal of the Transportation Research Board*, vol. 2673, no. 2, pp. 149–160, Feb. 2019, doi: 10.1177/0361198118825459.

[38] E. and M. National Academies of Sciences, *Statewide approaches to the development of comprehensive transit information systems*. Washington, DC.: The National Academies Press, 2023. doi: 10.17226/27438.

[39] International Transport Forum (ITF), “Transit-oriented development and accessibility,” Paris, France, Oct. 2023. doi: 10.1787/41b95623-en.

[40] National Academies of Sciences, Engineering, and Medicine, *Improving transit integration among multiple providers, volume II: research report*. Washington, D.C.: Transportation Research Board, 2015. doi: 10.17226/22224.

[41] S. Li, “Optimal coordination for an integrated multimodal and multi-operator transit system,” Nanyang Technological University, 2008. doi: 10.32657/10356/12198.

[42] L. Zhang, J. Li, K. Zhou, S. Gupta, M. Li, W. Zhang, M. Miller, and J. Misener, “Traveler information tool with integrated real-time transit information and multimodal trip planning: design and implementation,” *Transp Res Rec*, no. 2215, pp. 1–10, Dec. 2011, doi: 10.3141/2215-01.

[43] Y. Wang, D. Li, and Z. Cao, “Integrated timetable synchronization optimization with capacity constraint under time-dependent demand for a rail transit network,” *Comput Ind Eng*, vol. 142, Apr. 2020, doi: 10.1016/j.cie.2020.106374.

[44] K. Kadem, M. Ameli, M. Zargayouna, and L. Oukhellou, “Multimodal urban transportation network equilibrium including intermodality and shared mobility services,” Aug. 2025, doi: 10.48550/arXiv.2402.00735.

[45] M. Farooq, N. Afraz, and F. Golpayegani, “An adaptive system architecture for multimodal intelligent transportation systems,” Feb. 2024, doi: 10.48550/arXiv.2402.08817.