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Intermodal And Multimodal Passenger Transport Systems Integration: A Contribution Towards Better Understanding.

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Abstract
Most urban transportation systems rely solely on road transportation, causing congestion and limiting passenger options. While intermodal and multimodal transport systems are in use worldwide in freight transportation, there is the need to be clearer in the definition and explanation of these two systems and relate them to passenger transportation. This paper aims to explain the definitions and benefits of intermodal and multimodal transport systems and suggest ways to improve their benefits through integration. The advantages of transport integration for passengers, operators, and stakeholders are highlighted. Additionally, this paper investigates the factors that impact the selection of urban transport modes by examining different mobility theories and approaches. A mixed-method approach was used to gather information, including interviews with transport operators, policymakers, and industry experts in road and air transport. The researchers gathered data from a survey of passengers at Accra-Takoradi air and vehicle terminals. They found issues with the current transportation integration framework and suggested a new approach for better policy direction. Collaboration between public and private operators and stakeholders is important for successful integration efforts.

Keywords: *Intermodal, Multimodal, Uni-modal, Integration, Collaboration and Competition*

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I. INTRODUCTION

Transport modes share the common goal of fulfilling a derived demand, supporting the mobility of people or goods (Rodrigue, Comtois, & Slack, 2016). Various mobility theories and approaches explain the need to move people and cargo. They form the prime theoretical foundation and basis for introducing transport systems. Understanding the essence of transport integration is vital in building a sustainable and robust transport system. Transport integration refers to coordinating different modes of transportation to provide customers with a seamless and sustainable flow of services. According to Strategies for Public Transport in Cities (SPUTNIC), this involves using public and private transportation systems across a local or regional area, regardless of the mode of transport, fare, ticket system, or schedule. This creates a more efficient and convenient experience for passengers.

Transport integration is a complex concept that involves various factors and definitions (Train, Givoni, & Banister, 2011). Some have dismissed it as confusing, while others see it as an issue with variables that cannot be broken down (Glaister, 2002). Many researchers use the integration ladder or the seven steps to integration to explain transport integration (Potter & Skinner, 2000; Hall, 2010). However, to achieve successful transport integration, it is necessary to conduct integrated planning, have integrated transport infrastructure, and ensure efficient transport operation.

There appear to be many definitions and thoughts on intermodal and multimodal transport systems (Crainic & Kim, 2007). Some literature erroneously suggests that these two systems are synonyms and could be interchanged. In contrast, others explain the difference only in terms of the number of transport modes, which needs to be improved as these definitions, omit other relevant issues such as the flow of transport activities, services offered, contractual issues, operation and the smooth linkages to other modes of transportation.

Interestingly, in terms of passenger transport integration, Denmark and Switzerland have established national integrated ticketing systems, that allow seamless travel across various modes of transportation and destinations. The UK, Australia and Sweden also use an integrated ticketing system on public transportation in major cities and metropolitan areas in their country. In Africa, the South African government plans to move the

country forward to forming an integrated transport system (Shankaran & Chaithra, 2018). There is also a white paper and transport framework with a vision for PIDA[1] and AUC to support African countries in integrating their transport network by 2063 (EU, European Development FUND and Group, (Union, Fund and Group, 2016).

Like many other nations, Ghana's government had a national transport vision that aimed to implement an integrated transport system by 2020. The main policy objective for the transport sector was to establish an efficient and complementary network for the movement of both people and goods (Kwakye and Fouracre, 1998). In Ghana, the unfulfilled objectives of the National Transport policy (2008), coupled with the lack of clarity on the concepts of multimodal and intermodal transportation, underscores the relevance of this paper. The paper explores the various transport systems, along with their benefits and distinctions in relation to operations, connections, and agreements. Using a qualitative approach, the paper generated and analysed relevant data and, proposed the implementation of an integrated transport system.

The paper comprises eight sections, beginning with an introduction and then a review of mobility theories and approaches in section two, which aims to clarify the intricacies of intermodal and multimodal transport systems. The section delves deeper into the topic of integrated transport systems. The third section covers intermodal and multimodal systems, including the necessary components and requirements for success. Section four reviews transport integration frameworks. Section five explains the materials and methods used in the research. The findings are enumerated in section six, and section seven discusses the results. Finally, section eight presents the conclusions and recommendations based on the study.

II. MOBILITY THEORIES AND APPROACHES: A SURVEY OF THE LITERATURE

For as long as we can remember, humans have been using non-motorized or semi-motorized modes of transportation to move people and goods over distances. Sheller and Urry (2006) outlined the six theories underpinning the mobility paradigm in the social sciences. These include the work done originally by providing a framework for mobility studies. In 1959, George Simmel examined how people make connections and socialize with each other. He particularly observed the impact of the fast-paced urban lifestyle on the social, economic, and psychological aspects of city dwellers. Simmel's study sheds light on the various ways people interacts and form relationships in urban environments.

Studies in science and technology have created a second theory on mobility. This theory focuses on mobile socio-technical systems that integrate both human and non-human elements. Examples of such systems include automobiles, railroads, and air transport networks that contribute to an efficient transportation system that benefits society. Furthermore, it is also suggested that non-transport information networks may have unforeseeable impacts on promoting or hindering people's physical mobility (Rossi, Gastaldi, Carturan, Pellegrino, & Modena, 2012).

The third mobility theory comes "*from the post-modern conception of spatiality, with the substance of places constantly in motion and subject to constant reassembling and reconfiguration"* (Urry,2006 p. 215). The fourth mobility theory is a "*re-centring of the corporeal*[2] *body as an effective vehicle through which we sense, place, move, and construct emotional geographies". For example, the car is "experienced through a combination of senses and sensed through multiple registers of motion and emotion"* (Sheller & Urry, 2006, p. 216).

The fifth mobility theory explains how the structure of social networks influences the formation and evolution of complex patterns and sequences. Modern communication technology and ways of living have resulted in many weak social connections that span time and distance, limiting opportunities for face-to-face interactions and increasing reliance on networked connections (Sheller & Urry, 2006).

The final mobility theory involves analyzing complex transportation systems ranging from chaotic to well-organized systems. For example, rail systems are often rigid and bound by historical factors, while environmental conditions and politics can create unpredictability. These theories highlight the importance of examining three key factors in mobility: spatial, social, and perceptual approaches. The spatial approach examines how land is used and how human activities are distributed in different areas. This means people must move around depending on where they are and where to go to carry out their daily activities. On the other hand, the social approach looks at how individual movements are connected to their socioeconomic characteristics (Muro-Rodríguez, Perez-Jiménez and Gutiérrez-Broncano, 2017).

Then, the perceptual approach refers to the image formed or accepted by individuals that vary from person to person or group but lead in many different ways to assessing the same information that influences decision-making (Muro-Rodríguez, Perez-Jiménez and Gutiérrez-Broncano, 2017). These theories and approaches are practically demonstrated in the operation of transport systems. Therefore, a transport system can

[1] Program Infrastructure Development for Africa (African Union)

[2] It is something related to the body or something physical or tangible

be conceptualised as the set of relationships between nodes[3] of networks and the service demand. What, then, is the difference between intermodal and multimodal transport systems?

III. INTERMODAL AND MULTIMODAL TRANSPORT SYSTEMS

Intermodal transport system

Although intermodal transportation has experienced growth, there is still no widely accepted definition for it. Several people and organisations have defined or explained it in different ways. For instance, the European Conference of Ministers of Transport (1993) explained intermodal transportation as the *"movement of goods in the same loading unit or vehicle, which uses successively, various modes of transportation (road, rail, and water) without any handling of the goods themselves during transfers between modes"* (European Conference of Ministers of Transport, 1993). This explanation leaves out the movement of people or passengers. Similarly, the United Nations Economic Commission for Europe, explain intermodal transportation as *"the movement of goods using two or more modes of transport but in the same unit or the same road vehicle, and without stuffing or unloading*" (United Nations, 2019).

The United States Department of Transportation (USDOT) also explains intermodal transportation as: *"the use of more than one type of transportation, e.g., transporting a commodity by barge to an intermediate point and by truck to a destination"* (Oudani, El, Alaoui, Boukachour, & Havre, 2014). Macharis and Bontekoning (2004) and Shen and Bergqvist (2014) also explain intermodal transport as *"the combination of at least two modes of transport in a single transport chain, without a change of container for the goods, with most of the route travelled by rail, inland waterway or ocean-going vessel and with the shortest possible initial and final journeys by road."*. This explanation was later revised by Loo and Comtois, to include passenger movements as well. They explained intermodal transport as, "*the transportation of people or load from its origin to its destination by a sequence of at least two transportation modes, the transfer from one mode to the next being performed at an intermodal terminal"* (Loo & Comtois, 2016).

The explanation by the European Conference of Ministers of Transport (1993) appears to suggest only the movement of goods in the same unit or vehicle, which needs to be revised to include the movement of people. Also, Macharis and Bontekoning (2004) defined intermodal transport as the movement of cargo with various types of transport modes, moving seamlessly on routes from origin to destination. Just like many others, this explanation again restricts intermodal to the carriage of only cargo and excludes passenger travel. The above explanations of intermodal transportation suggest that intermodal transport is a system that relates only to cargo transportation. However, in this paper, we agree with Loo and Comtois (2016) and argue that intermodal transportation may relate to freight haulage or passenger movement for short or long distances, covering rural and urban areas and national and international zones.

From all the above, it is clear that the intermodal transport system has no universally agreed definition. Against this backdrop, this paper defines an intermodal transport system as the use of two or more similar transport services or modes for the carriage of either cargo or passengers that has its operations directly linked together in sequential order from one leg or a trip to the other. The distinguishing features of these are illustrated in Table 1.

The intermodal transport system has a lot of advantages however, a few of its disadvantages include the slow link between one transport mode and the transfer of passengers or cargo to the other. Other disadvantages include the need to ensure more reliability of intermodal transport operations, improvement in the erratic frequency of the transport services, the high unitary infrastructure and operating cost, and the flow restriction the intermodal transportation operations may suffer compared to a multimodal operation. The benefits or advantages of the intermodal transport system have been outlined below.

Advantages of intermodal transport systems:

- There is the possibility of enjoying lower fare or tariff from the choice of transport services or modes along a route. Just as shippers of cargo may choose carriers to take advantage of lower rates for each transport leg or trip, similarly in intermodal passenger transportation, passengers select from available services and pay the fares for each trip or leg.
- There is flexibility for passengers to select from the similar modes of travel and cargo transporters may gain flexibility and specialised handling of loading and unloading goods at different terminals or destinations.
- Regarding cargo transportation, intermodal transportation may benefit from increased product security.

[3] Where movement originates, ends and the transiting points of entry or exit in a transport system. They vary according to the location or geographical scale being considered, ranging from local nodes such as a rail station or bus terminals to global nodes such as harbours or airport terminals.

- Passengers may also have better access to transit schedules, terminal facilities or equipment and operators may have better control of seat occupancy or space capacity on vehicles.

Multimodal transport system

Multimodal transport was originally created to ensure the smooth transportation of goods via both land and sea. It is therefore not surprising that the United Nations Economic Commission for Europe (UNECE, 2009) defines multimodal transport as "*the transport of goods by at least two different modes of transport."* Nonetheless, this definition is too vague and does not differentiate the meaning of the two transport systems. Other studies have viewed and explained multimodal transportation as the same as co-modal transportation. Multimodal transportation is also defined by the Commission of the European Communities (CEC, 2006) as *"the use of two or more modes of transportation."*. This appears not to fully explain the transport system.

Therefore, in this paper, a multimodal transportation system is defined as, the use of two or more different transport services or modes operationally combined, with a single contract to transport people or cargo from the point of origin to the destination in a coordinated manner. By this definition, multimodal transportation may be the transport operation where a single provider and a single contract are issued despite using several modes. This operator assumes the entire responsibility of the passengers or cargo from the origin until it arrives at its destination (MacAndrews, 2019). While there are some drawbacks to utilizing a multimodal transport system, such as increased expenses resulting from transit of passengers at terminals, transshipment, or cargo handling at terminals without the ability to negotiate for better fares for individual legs of the journey, there are also numerous advantages to this type of transportation, which are outlined below.

Advantages of multimodal transport systems

Multimodal transport has several benefits, some of which are listed below (Fastcoo, 2015):

- It allows for a seamless transportation experience, smooth movement of travellers from their starting point to their destination using various modes of transportation.
- It ensures the most efficient combination of multiple modes of transport and transport services while optimising deadlines.
- Passengers pay one fare from beginning to end of journey regardless of the number of modes used. From the freight haulage perspective, it reduces inventory expenses, and the transport fare of the products are maintained at a reasonable level.
- Multimodal transportation promotes higher environmental sustainability by reducing the environmental impact of transport operation.
- It may result in the reduction of indirect costs for both passengers or freight transportation, by reducing the cost related to equipment usage and quantity and cost of human resources needed for operations.
- Multimodal transportation ultimately contributes to industrial growth and economies of scale of communities especially regarding transport negotiations and construction or use of improved transport infrastructure and terminals.

Despite the support of environmentalists and cargo transportation experts, multimodality may induce individual costs through modal interfaces such as trans-shipments. However, all these costs are relatively less expensive than depending on only uni-modal or intermodal transportation, making it a more efficient means of transport. A multimodal transport system integrates different geographical scales from the global to the local. It gives accessibility to the global market through the development of transport infrastructure and transport terminal hubs (Muro-Rodríguez, Perez-Jiménez and Gutiérrez-Broncano, 2017).

Table 1 summarises the differences between intermodal and multimodal transport systems. It explains and compares these two systems with an integrated transport system.

Table 1. Differences between intermodal, multimodal and integrated transport systems

DESCRIPTION	INTERMODAL TRANSPORT SYSTEM	MULTIMODAL TRANSPORT SYSTEM	INTEGRATED TRANSPORT SYSTEM
OPERATION OF SYSTEMS	Two or more similar transport modes operationally linked together.	Two or more different modes operationally combined as if one system.	Several transport modes operationally combined and linking one another from origin to destination
OPERATIONAL LINKAGES AMONGST SERVICES OR MODES	A direct link or connection of services of operators in a similar mode of transport. From one to another sequentially from one leg to the other.	A single service operator assumes all responsibility by coordinating between various service operators or mode operators, from the point of origin to the destination.	A direct link or connection of services where one party or operator assumes the coordinating and is responsible from origin to destination.

KEY OBJECTIVE & RELATIONSHIPS OF THE SYSTEM	The critical relationship or objective of intermodal transportation is cooperation among various modes of transport services.	The critical relationship or objective of multimodal transportation is to ensure coordination of all the transport modes and services.	Essential relationship or objective is to ensure both cooperation and coordination of all the transport modes and services.
TRANSPORT AGREEMENTS, CONTRACTS, DOCUMENTATION& POLICY	May have various transport agreements/documents/fares or freight tariffs for each modal trip or sometimes transport service leg.	A single transport document is used for the whole trip from beginning to the end regardless of the number of services, trips or transport modes system engaged.	A single transport document or ticket purchased in advance may be used for any available service along the route.
FLOW OF TRANSPORT SERVICES / ACTIVITIES	May lack a seamless flow. (To enhance the flow of the service, there is the need to ensure reliability, direct movement, inter-connection of transport services and adequate information flow).	Operate a seamless flow. (Transport service flow, does not arise out of limitation in structure, but there is a voluntary and natural process to work together as teams.)	A smooth flow of services to benefit passengers regardless of the ownership, structure, type of service, terminal connectivity, or infrastructure.

Source: Field Research 2018 and extraction from literature (Containership.eu /Searates.com/ Mobisoftinfotech.com)

To benefit from the strengths of each transport system, it is suggested that these transport systems need to be integrated.

Components and requirements for a successful integrated transport system

There are several prerequisites for the achievement of successful integrated transport. Ferreira, Charles and Tether (2007) listed three main prerequisites; however, this paper adds a fourth which is the drafting of integrated transport policy. The prerequisites include:

- **Drafting an integrated transport policy**: This is the main legal framework or document needed to implement an integrated system. A clearly expressed and drafted policy should explain the plan, scope, processes, requirements, timelines, resources needed, responsibilities and roles of all stakeholders and various activities concerning transport integration.
- **Integrated Planning:** A significant challenge of the task is getting all those responsible for planning and delivering transport networks to coordinate their efforts and adhere to the new transport policy. Coordinating the plans for the various modes will ensure that connection at interchanges, both spatially and temporally, results in minimum trip disruption, discomfort, and higher safety and security concerns (Charles, 2019). Passengers expect a comfortable, reliable, and quick journey, with seamless connections from start to end (Charles, 2019).
- **Integrated infrastructure:** Transport modes must be seamlessly connected to enable the most convenient, comfortable, and highest-quality travel experience. Interchanges must ensure seamless physical connections between modes, facilities, and terminals (Charles, 2019). Therefore, this effort requires good, functional, and detailed infrastructure designs to support the implementation. Proximity and ease of connection will significantly improve user satisfaction, increase public transport patronage and transport sustainability (Ferreira et al., 2007).
- **Integrated operations:** After providing infrastructure, transport services need to be well coordinated to ensure seamless connections between services from origin to destination. Therefore, streamlining schedules, stops or terminals, fares, and passenger information makes it easier for passengers to cut operational costs and boost operational revenue (BEIJING, April 7, 2015).

Even though passengers demand an improved form of mobility, the progressive effort towards integrating transportation is still lacking. It is therefore, not surprising that Ghana drafted an urban and national transport policy emphasising the need for an integrated multimodal transport system. Specifically, the National Transport Policy (2008) had one of its objectives being "*to foster effective modal integration and economical assignment of traffic to modes through the market mechanism to minimise overall transport cost to users"*, remains unfulfilled (Ministry of Transport, 2008, p 14).

IV. EXISTING AND PROPOSED TRANSPORT INTEGRATION FRAMEWORK

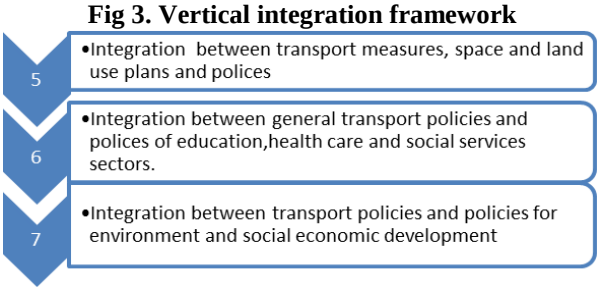
Figure 2 displays the current horizontal integration framework that combines various elements of transportation, including passenger travel information, available services, operator fees, and operational infrastructure. On the other hand, Figure 3 portrays the vertical framework that joins all the activities together,

including governance aspects like land use integration, plans, policies, and their impact on socio-economic development and the environment.

Fig 2. Horizontal Integration framework

Source: Adapted from Preston (2012)

Fig 3. Vertical integration framework



Source: Adapted from Preston (2012)

Identified challenges with the existing framework.

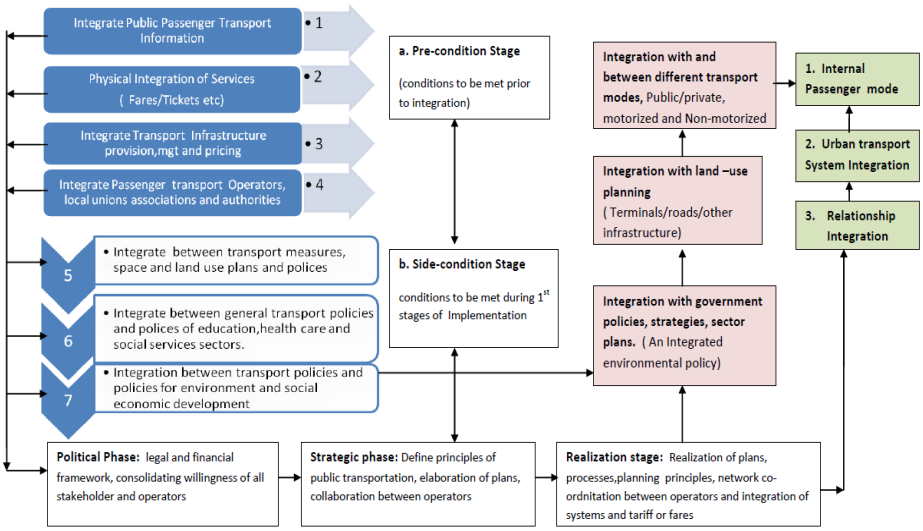
The integration ladder, consisting of 7 steps (as shown in Fig 2 and Fig 3), implies a progression from lower to higher levels as individuals move through the stages. The process involves monitoring the situation, providing relevant information, presenting alternatives, and if financial and non-financial incentives will encourage passengers to change their behaviour. The final three steps (5-7) of the ladder involve implementing restrictive policy measures. However, it is important to note that such measures may cause agitation and discomfort among passengers and other operators.

According to the seven steps from Preston's (2012), it should be possible to quickly share passenger travel information so that passengers can find out about transport availability, location, and cost. However, implementing this step could be difficult in countries or environments where only a small number of passengers have access to transportation information. Additionally, the traditional methods of passenger transport operation in many developing countries such as unscheduled services, private or individual transport ownership, and unplanned operations with little or no regulation or coordination could pose challenges to the framework. After examining various theories and frameworks, I propose a new integrated framework (Figure 4).

The proposed new integrated passenger transport framework

The new framework combines Preston's seven-step integration framework from 2012, the approach from Strategies for Public Transport in Cities (SPUTNIC) in 1998 on the one hand, and the framework from New Approach to Appraisal (NATA) as stated by Walton & Shaw (2003), which was later improved by Egis Bceom International in 2015, on the other hand. This statement aligns with the current framework that divides the integration process into two types: horizontal transport integration, which combines various aspects of the transport system, and vertical transport integration, which brings together transport activities related to governance (as shown in Fig. 1 and Fig. 2).

Fig. 4: Proposed Integrated Passenger Transport Framework



Source: A framework on integrating urban transportation. Adapted from (Preston, 2012), (SPUTNIC,2011), NATA, New Approach to Appraisal and (Egis Bceom,2015).

In terms of process, the first step represents certain conditions that must be met before integration. This step has been grouped into two stages. Firstly, the "pre-condition stage", where certain conditions must be met before integration. There are several activities that fall under the umbrella of transport integration, such as efforts to combine different modes of transportation, coordination between operators and authorities, and plans to connect public and private transport systems. These initiatives aim to establish a shared understanding and create a more seamless transportation experience. This stage creates a basis for network integration and sets a political and strategic framework for operators. This stage breaks down activities into daily operation levels. The second stage is the "side condition stage", which represents conditions that must be met during the first phase of the transport integration implementation. Then the process is tested through three phases being, the political phase, which forms the legal and financial framework that consolidates the willingness of all stakeholders and operators to work towards integration.

Next is to go through the strategic phase, which defines (a) the collaboration between operators of the integrated transport system and (b) the plans and principles of the public and private transport operation. Finally, the realisation phase is reached, during which plans, processes, and principles of operation are coordinated to establish a transportation tariff structure. This involves harmonising different modes and operators of transportation, as well as transport fares and ticketing arrangements. This stage also plans the establishment of travel time schedules where possible, as well as advertises travelling routes and connections to ensure reliability and quality of service. At this stage, there is the need to have an integrated environmental policy, create terminals and infrastructure integration or a land use integration plan. Furthermore, the integration of different modes of transportation needs to be considered. This includes integrating public and private transportation and both motorized and non-motorized transportation systems. As this integration takes place, rural and urban transportation systems will gradually link up to establish a good working relationship. This is necessary for sustainable transportation integration.

V. MATERIALS AND METHODS

The aim of this study was to explore the meaning, usage, and distinctions between multimodal and intermodal transportation systems. Additionally, the report proposed a framework for achieving transport integration to benefit passengers, operators, and all stakeholders. This research was done following an empirical, analytical method by adopting the epistemological approach, which emphasizes strong knowledge and how it can be obtained. Although the research used a mixed-method approach, involving both qualitative and quantitative methods, it primarily adopted a qualitative methodology. The qualitative methodology was conducted using NVivo version 11, the study was done thematically in an explanatory, inductive and deductive manner.

Firstly, using a rapid review methodology, a literature review was done to collate and synthesize various articles, papers, materials, and documents on the subject of intermodal and multimodal transport systems.

To implement segmentation or sampling in the transportation industry in Ghana, professionals and policymakers from various transport sectors were chosen. To gather information, a survey was conducted with a sample size of 783 passengers based on earlier studies using 400 and 600 passengers. They were conveniently selected at each terminal, while waiting to board either road or air transport. They completed a questionnaire designed for the purpose. Additionally, 31 transport professionals were purposively selected and interviewed about policy-related questions. Six of these respondents, chosen based on their expertise in specific fields, were further interviewed about intermodal, multimodal, and transport integration systems.

The interview responses were recorded and later coded into themes and sub-themes to get a holistic account. Quantitatively, a survey questionnaire was designed and administered to transport operators of both road and air modes at the main Accra-Takoradi transport terminals in Accra, Ghana, to seek their views on transport integration, intermodal and multimodal related issues, and questions. The route was selected for the study because of its potential and the planned policy decision to operate combined multimodal transport services such as road, rail, air, and sea modes.

The study followed an explanatory sequential mixed approach, which involved two distinct phases of analysis. In the first phase, quantitative analysis was conducted to examine the impact of two modes of transportation and several service attributes, such as accessibility, availability, reliability, frequency, speed of service, comfort, safety, and security. The significance of these factors was determined through multiple responses and multinominal regression analysis. In the second phase, qualitative analysis was performed to expand on the qualitative results obtained from the first phase. Finally, the findings were linked together and explained in detail.

VI. RESULTS

Quantitative Results

Fifteen different transport attributes were evaluated by passengers on both the air and road modes. From the analysis, the statistically significant physical attributes for both air and road modes were traffic congestion, environmental pollution, staff conduct, transport service availability and general terminal organisation. On the other hand, the statistically significant perceived attributes for air and road modes were overall service quality, safety, comfort, affordability, security, and general satisfaction. The analysis further showed that the differences in transport attributes, such as frequency, accessibility, convenience, overall service quality, cleanliness, and speed of service, were not statistically significant.

In summary from Table 2, respondents were asked about the actions that Government and local authorities should take to establish an integrated multimodal passenger transport system. The results showed that a large percentage (71%-100%) strongly agreed with drafting laws, policies, and regulations, as well as promoting policies to develop both private and public operators. They also strongly agreed with supervising and managing safety and security issues, strengthening cooperation among national operators, and sharing passenger information, fares, vehicle location, and capacities of both vehicles and terminals. However, there was no clear consensus on allowing competition between public and private operators and letting each group of operators determine their fares and route of operation, with half in favour and half against.

TABLE 2: Respondents' concerns on the implementation of an integrated passenger multimodal system

What must be done to implement an integrated multimodal passenger transport system? Govt. & Local Authorities need to.....		Strongly Agree %	Don't Agree %	do not know %	Not sure %
Formulate transport & terminal integration development strategies & plans	Strongly agree	**93.5**	**-**	**3.2**	**3.2**
Draft multimodal & intermodal passenger laws, regulation & policies relating to current & future development	Strongly agree	**100.0**	**-**	**-**	**-**
Promote and develop a national passenger transport policy for both private and public transport operators	Strongly agree	**80.6**	**9.7**	**-**	**9.7**
Exercise supervision and management over the urban transport market & maintain fair competition	Strongly agree	**87.1**	**6.5**	**-**	**6.5**
Be responsible for supervision, training, management & enforcement of safety & security issues	Strongly agree	**77.4**	**6.5**	**6.5**	**9.7**
Strengthen national cooperation between groups of operators	Strongly agree	**71.0**	**9.7**	**3.2**	**16.1**
Allow all operators both private and public to compete against one another & determine own fares & routes	Split	**41.9**	**41.9**	**6.5**	**9.7**
Share passenger transport information such as fares, services, location, and capacity of terminal to all operators	No clear decision	**83.9**	**6.5**	**-**	**9.7**

Formulate transport & terminal integration development strategies & plans	Strongly agree	**93.5**	**-**	**3.2**	**3.2**
Draft multimodal & intermodal passenger laws, regulation & policies relating to current & future development	Strongly agree	**100.0**	**-**	**-**	**-**

Source: Field Research 2018

Qualitative Results

1. Perceived challenges besetting multimodal and intermodal and transport integration

Transport professionals and experts were asked to share their thoughts on the question: "to what extent have the challenges besetting the multimodal and intermodal passenger transportation system affected its implementation?". Specifically, each participant was asked to state some of the challenges that exist or are likely to occur regarding the development of an effective intermodal, multimodal and integrated passenger transport system. Based on their responses, the following subthemes were generated.

2. No apex authority responsible for the system

One major challenge revealed by the respondents was the lack of an apex authority that is responsible for transport integration and multimodal systems. That is, no specific transport authority controlled how the entire national integration system should be structured. The following excerpt is illustrative:

"Currently there are so many transport ministries... one for Aviation, one for Railway development, then Roads and transport, and others. Who is responsible for the entire policy and regulation on multimodal transport?" (Participant 4, Male, Officer, Ministry of Aviation).

Additionally, it was revealed that, because of this challenge, there needs to be more coordination with perhaps an active policy direction, leading to the practical construction and implementation of a multimodal passenger transport system. It was further suggested that there should be proper coordination and collaboration between the various transport operators and unions.

3. Poor Planning of urban communities

The study found that another challenge plaguing the effective operation of intermodal and multimodal passenger transport systems is poor planning of the urban communities. According to respondents, poor planning has made it quite tricky for some of the new transport organisations to establish their presence in some areas and communities. "*How can any operator shift to a multimodal transport operation when our transport infrastructure is badly connected due to poor planning of our cities"* (Participant 5, Male, Planning Officer, Department of Urban Roads).

It was further added that this challenge had caused significant congestion in our cities and weak linkages to some areas in the urban communities. It was found that some road transport terminals need to be better planned in terms of the best location. Some terminals emerge because a few operators decide to come together and create one along the roadside or acquire land somewhere and then start operating. These terminals soon turn into a market of various vendors and then a whole business community emerges later, creating further congestion and environmental challenges.

4. Lack of funding

The lack of funds that affect governmental and non-governmental agencies, as well as these transport operators hinder the implementation of an effective intermodal and multimodal transportation system. Participants unanimously agreed that operators, non-government agencies and stakeholders, needed more funds and resources to construct infrastructure for an effective integrated transportation system. Transport operators added that they do not receive any form of funds from the government to develop and improve their services and infrastructure. Instead, the heavy operational burden is supported by private sources, and this has led to some transport operators needing more support to contribute financially to physical infrastructure and terminal development. A transport consultant had this to say about funding:

"At the end of the day, all these nice initiatives need funds to implement. Where are the funds from operators, government, and other stakeholders?" (Participant 11, Male, Road Safety & Transportation Consultant).

5. Lack of pricing scheme

Further interaction with the participants also revealed that the lack of a pricing scheme was another major challenge. Regarding intermodal and multimodal transportation, most respondents expressed their displeasure that there is no uniformity in pricing or pricing scheme which regulates how transport operators should charge their fares. As a result, some transport operators charge outrageous fares while others deliberately charge lower fares to attract more passengers.

"Who determines and ensures that the right transport tariffs are charged? It appears there is no strict regulation leading to arbitrariness in transport fare fixing by many operators…" (Participant 27, Male, Transport Manager, MASLOC).

These variations in fares sometimes need to be clarified for passengers. It was also revealed that there is often agitation between these transport operators and their passengers due to the need for a proper transparent transport fare scheme.

6. Poor Road linkages

Poor road and transport infrastructure was another challenge that hindered the effective intermodal and multimodal transport system. Poor roads within the cities and the rural areas continue to be a major headache for most transport operators, as summarised by one of them as follows: *"I recall travelling on the Accra-Takoradi road and running over numerous and dangerous self-community constructed speed ramps, and large potholes on the highway. They are all over, and I counted over 60 groups of such speed ramps along the route from Mankessim to Takoradi"* (Participant 11, Male, Road Safety & Transportation Consultant).

According to the respondent, transport accessibility is compromised due to operators' inability to reach some vital areas. They recounted instances where some roads had been damaged to the extent that it was impossible or very difficult for buses or other vehicles to transport passengers to such areas. They also recounted instances where roads had been constructed poorly without any form of drainage systems. As a result, when it rains, the roads become very flooded, making it impossible for vehicles to travel on them.

"When will we have adequate road infrastructure, and when will our road contractors and Engineers get it right? Many roads without good drainage system lead to flooding and potential accident spots when it rains." (Participant 11, Male, Road Safety & Transportation Consultant).

7. Payments of one fare from origin to destination

It was also found that multimodal transportation enabled passengers to benefit from one standard fare across the journey regardless of the number of transport service selected. This initiative calls again for cooperation among operators and establishing standard tariff or fare systems operationally based on distance travelled. For this to work, an active electronic ticketing system is needed to ensure passenger benefit from one ticket or one fare per trip along a selected route.

8. Use of different modes of transport services

It was found that one other benefit of using a multimodal urban transport system is the ability for passengers to benefit from using different modes of transport service along the journey based on distance travelled.

"I don't know why I have to wait for hours for a bus to Takoradi when the government could have introduced a railway system on the route or introduced a cruise vessel on the sea along the coast to Takoradi." (Participant 11, Male, Road Safety & Transportation Consultant)

"Congestion along the route and accidents could have been reduced or prevented if we had other alternative means of travelling to my destination" (Participant 31, Male, Transport & Logistics Consultant).

It was also found that because urban transport systems are mainly uni-modal in operations, Multimodal transport terminals still need to be developed to serve the different needs of passengers along the route. Passengers, therefore, have no choice but to use what is available.

9. Lack of scheduled urban transport services

The study found that contrary to what exists today, another benefit of a multimodal transport system is the ability for operators to schedule their transport services based on time of departure or arrival at various terminals along the route. It was found that only one bus transport operator, i.e., Inter-City STC, applied a scheduled system along the route. Secondly, the only domestic airline operating the Accra-Takoradi route at the time of the study, Africa World Airline operated a scheduled domestic flight service. Even though there were often delays in operating these schedules, it was deemed better than no schedule.

"Passengers have no choice, and they have to sit and wait in hot vehicles till each vehicle is fully loaded before it leaves the terminal" (Participant 22, Male, Ministry of Aviation).

"Due to lack of scheduled time of departure, I cannot plan my journey time because all intercity movement depends on when the last ticket is purchased". (Participant 11, Male, Road Safety and Transportation Consultant)

10. Lack of policy direction

According to the participants, the need for more policy direction was the most critical and pertinent issue that prevented the need for coordinated action and integrated passenger transportation system. From their

responses, it can be suggested that even though the National Transport Policy offers a clear policy on operating intermodal and multimodal transportation systems in the country, this policy does not give a clear direction regarding its implementation. However, this has led to a series of concerns among transport operators. Some of these issues include who will supervise the entire implementation project, who will be responsible for accountability, monitoring and evaluation, and guidelines on how this can be achieved. Eventually, the respondents said these issues have led to suspicion and lack of trust in the system and among other transport operators.

Further interaction also revealed that the lack of policy direction had caused others to have a deep fear of failure. Some operators feared that *"if this transport service integration works, someone will take over our transport business".* (Operator at VIP terminal).

11. Lack of alternative modes of transport

Another major issue from the participants' perspective is the need for more available alternative modes of transport systems in the country. According to them, there are only a few transport modes in the country, which implies that passengers do not have much choice regarding getting access to different ways of inter-urban travel. We seem too focused on the road sector, and we have not encouraged other modes of transport to develop.

"I don't know why we have to wait for hours for a bus to Takoradi when the government could have introduced a railway system on the route or a cruise vessel on the sea along the coast to Takoradi." (Participant 31, Male, Transport & Logistics Consultant)

"Apart from choosing between the bus operators along the route, there is no other affordable alternative transport mode for passengers. No railway alternative." (Participant 24, Male, CILT Governing Council Member)

However, this gives the impression that implementing an integrated passenger transportation system will take a lot of work to achieve due to these few modes of transport. Therefore, the government needs to reconsider the railway development policy along the route and perhaps find other alternative methods such as implementing a passenger cruise vessel operation on the sea along the Accra –Takoradi route.

12. The high cost of transport services

The participants also raised the high cost of transport services as a possible hinderance to the operation of a multimodal passenger transportation system. It was revealed that setting up of a transport service required a lot of funds, which, according to the participants, was challenging to raise. As a result, there needs to be more investment in the transport industry. Additionally, the lack of a pricing or fare scheme that regulates how much fares should cost has made most transport operators design their pricing schemes based on hikes in fuel prices which are not uniform. This situation makes it difficult for transport operators to generate enough profit from their operations, let alone contribute towards developing new infrastructure for the creation of a multimodal transportation system.

13. Transport operators need to gain requisite professional training and skill for the integration system.

The transport industry, according to the participants, needed more literate and professional personnel who have been well trained and have operational skills and enough competencies to champion and sustain this mode integration project. For instance, no law or regulation governs road transport service operators.

"In many developing countries, anybody can operate a taxi, trotro or bus service as long as he has funds to purchase a second-hand vehicle, convert it to commercial use by creating seats in these vehicles" (Participant 11, Male, Road Safety and Transportation Consultant).

"Unfortunately, I see that one does not need to be educated in transport management or operation to operate a transport service. ...this is affecting the quality of service" (Participant 31, Male, Transport & Logistics Consultant).

They also added that they needed more resources, including funds and infrastructure, to undertake such a project independently as operators.

VII. DISCUSSION OF RESULTS

As explained earlier, existing literature fails to clearly distinguish between Intermodal and Multimodal systems in terms of operation of the systems, linkages among services or modes, the flow of activities and transportation agreements and contracts. Against this backdrop, the objective of this paper was to elucidate the operational meaning, advantages, and differences between intermodal and multimodal transport systems and how these transport systems are improved through integration. The paper also aimed to find the significant factors or attributes influencing urban passenger transport choices. This paper further sought to suggest ways in

which transport integration can be achieved to benefit passengers, operators, and all stakeholders. The paper also aimed to propose a suitable transport integration framework.

The key findings of this research are presented below.

A. No clear explanation of intermodal, multimodal and integrated transport systems

From the numerous explanations of intermodal and multimodal transportation, this paper clarifies the definition of intermodal, multimodal and integrated transport systems as follows: Intermodal transportation is the use of two or more similar transport services or modes for the carriage of cargo or passengers. Its operations are directly linked together in sequential order from one leg or a trip to the other.

Multimodal transportation is the use of two or more different transport services or modes operationally combined, with a single contract to transport people or cargo from the point of origin to the destination in a coordinated manner.

The advantages, disadvantages and differences between intermodal and multimodal transport systems have also been explained in this paper. The need and reasons for the proposed transport integration system have also been clearly explained, adding to the efforts made by many governments to integrate transport planning and operations to benefit all stakeholders.

B. The attributes that influenced the choice of urban transport modes

Various local studies on urban transport are based on a single mode of transportation (road mode), The finding showed that socioeconomic factors influenced the choice of transport modes (Abane, 2011; Potter & Skinner, 2001; Kolawole, et al., 2022; and Agyemang, 2015). In this paper, the statistically significant physical attributes influencing the choice of air and road modes were traffic congestion, environmental pollution, staff conduct, transport service availability and general terminal organisation. On the other hand, the statistically significant perceived attributes for air and road modes were overall service quality, safety, comfort, affordability, security, and general satisfaction. The analysis further showed that the differences in transport attributes, such as frequency, accessibility, convenience, overall service quality, cleanliness, and speed of service, were not statistically significant.

C. The proposal of a new integrated transport framework

Based on the limitations identified in Hall's (2010) integration ladder, which only focused on the public transport operator and examined vertical and horizontal integration, this paper has proposed a new framework. This framework was developed by combining Preston's (2012) seven-step integration framework, the approach from Strategies for Public Transport in Cities (SPUTNIC, 1998), and the framework from New Approach to Appraisal (NATA), which was later improved by Egis Bceom International in 2015. Like the existing framework, the proposed framework divides the integration process into two categories: horizontal transport integration, which brings together various aspects of the transport system, and vertical transport integration, which brings together transport activities related to governance.

However, it adds the perspective of considering pre-condition and side condition stages while taking cognisance of the political, strategic and this discovery gave a theoretical foundation and guided the study. realization phases of transport integration. The new framework also advocates the importance of considering land use planning and integration of government policies, strategies and activities towards the success of the integrated transport system. The paper emphasises integrating transport modes in the form of public-private integration and integration of motorised and non-motorised transportation systems that enables both rural and urban transport system to be linked up gradually to have a good operational relationship for the transport integration to be sustainable.

D. Role of government and local authorities

It was overwhelmingly agreed by respondents that, Government, Municipal and Local Authorities must play a major role in multimodal transport operation and implementation of transport integration. Specifically, they must ensure the following:

- Formulation of transport and terminal integration development strategies and plans.
- Drafting multimodal and intermodal passenger laws, regulation and policies relating to current & future development.
- Promotion and development of a national passenger transport policy for both private and public transport operators.
- Strengthening national cooperation between groups of transport operators.
- Being responsible for supervision, training, management and enforcement of safety and security issues'
- Exercise supervision and management over the urban transport industry and maintain fair competition.

- Sharing of passenger transport information such as fares, services, location, and capacity of the terminal to all operators.

However, there was no clear position by respondents on the need to allow all operators both private and public, to vigorously compete against one another, determine own fares and routes.

VIII. CONCLUSION

The aim of this paper was to provide a clearer understanding of intermodal and multimodal transportation in the literature. This was achieved by thoroughly explaining the differences, advantages, and disadvantages of these transport systems, under their operational linkages and relationships with other modes, flow of transport services and documents, ticketing or fares, contracts, and agreements. Additionally, the paper highlighted the importance and benefits of transport integration and proposed a process for passenger transport integration.

The new framework for transport integration was developed to solve the deficiency of the existing horizontal and vertical integration framework. Some of the major findings on how transport integration could be achieved included the need for the government to spearhead the initiative of transport integration, supervise the successful implementation, facilitate the process by outlining some rules and regulations that will govern the implementation as well as ensure the enforcement of these laws.

It is advisable for the government to involve all parties, educate them on the benefits and significance of the proposed system, and establish a favourable environment for various transportation methods to work together efficiently for maximum productivity. The government may construct multimodal transportation systems for both motorized and non-motorized vehicles in urban regions. These transportation hubs, located in strategic areas throughout the country, can offer scheduled transportation services to facilitate the multimodal and intermodal transportation systems. These hubs should be developed in economic and geographical zones that are easily accessible to passengers.

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