Design of Multimodal Integrated Transportation Services: A Review

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Abstract: As India's transportation needs continue to increase and urbanization develops rapidly, innovative solutions and methods are being developed and borrowed from other countries. Over the past decade, many large rapid transit systems have emerged in cities such as Metro Rails, Bus Rapid Transit Systems and Monorails. From a planner's perspective, the inter linkages between these various modes of public transport and various other models are now an important issue from the perspective of users and opportunities for seamless travel across models and sustainable urban public transport networks. This article attempts to understand the comprehensive multimodal urban transport in India. With the help of the Delhi case study, efforts were made to determine the strengths, weaknesses and challenges of integrated multimodal urban transport in Indian cities.

Keywords: Multi-Modal Transport System (MMTS), Integrated Transportation, Transit Systems, Bus Rapid Transit Systems

1. Introduction

The Multi Model Transport System (MMTS) includes a combination of one-way modes: vehicle mode (bus, subway, car, tram, etc.) or service mode (private/public), between which commuters have to move. Transfer is an important part of multimodal movement, including mode changes at the transfer node. Thus, seamless movement is an important feature of the system. In fact, it offers various options that allow you to carry out the journey in the most convenient way, but an important requirement for the whole system is integration. As it is important to assess the travel needs of multimodal transport services, commuting preferences and preferences, and related relocation needs, should be assessed throughout the travel chain. However, service attributes (time, reliability, etc.) and information about the service can affect the behavior of the trip selection.

1.1 Planning for Integration

Integration is important to the need for sustainable development and public transport response. For example, the best way to solve the traffic problem in Delhi is to establish a public transport infrastructure. New public transport, i.e. subways, ports, light rails, etc., need to be properly connected. We need to improve the existing infrastructure, through the BRET corridors, low-floor e-buses, vehicle tracking systems and central parking, which can be done before checking the cleaning and reliability of each vehicle.

1.2 Planning and Design of Interchange

Exchange and smooth travel is now an important part of an integrated transport strategy. Exchange is a key element of modern transportation networks and is part of the infrastructure involved in diverse activities. Therefore, one of the starting points for public transport is the key to the first interaction between the user and the available public transport services. The following points should be considered in the exchange plan: Define the exchange location in the transport network to fulfill the transport function.

- Define interchange the layout for smooth transition.
- The current line interchange location provides efficient access to the current transport network.
- The existing route exchange location provides efficient access to the existing transportation network.
- Improve existing roads/construct new roads.
- Priority access mode-walking, bicycle, feeder service etc.
- The size of the exchange based on the expected demand.
- When implementing station changes to facilitate the exchange, develop the exchange equipment and consider the associated costs and benefits.

2. Multimodal Transport

Multimodal Transport (which is also known as joint transport) is about to transport goods under a contract, but in two different ways of transporting at least. Various transportation (railway, sea, highway etc.). Carriers does not need all the resources of transport and is generally available; Transportation is generally done by sub-actions, which are legally called sub-operations "Real Carriers". “As. Responsible career for full transportation is called multi-mode carrier or MTO.

Multi Modal Transport System

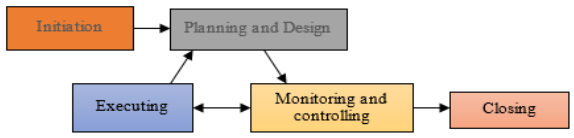

Figure 1 Various Stages in Project Development

The Multimodal transport system (MMTS) is contemplating the use of two or more ways of transportation to move quickly, secure, comfortable and comfortable travelers in urban areas. It offers convenient and economical connections in various modes to complete the journey from origin to destination. Usually, MMTS is characterized by the ability, efficient access, and better node integration and integration. Since public transport is an important part of multi-mode transport systems, local and regional transport systems must be an integral part of it.

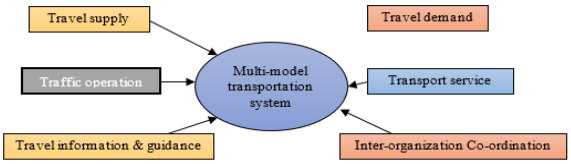

Figure 2. Various Stages in Multi-Model transport System

Nowadays, most Indian cities have high density urban areas, organic development (unfair land use regulation), lack of appropriate materials and social infrastructure, especially transportation infrastructure, lack of proper roads and parking facilities, etc. There is a feature. Public transportation is inconvenient and there is a lack of training for road users. The urban transportation system of most Indian cities is under tremendous pressure and adversely affects the quality of life of the urban population. Public transport in the city is not enough to provide a fast, comfortable and convenient trip. This has resulted in a significant increase in the travel of commuter passengers to private or private transportation, and as a result, a significant increase in personal car ownership. The result is increased traffic congestion and pollution, increased fuel consumption, and reduced levels of commuting services. However, more than one million cities are generating more travel needs, and private transportation has not been able to fully meet these needs. Transport Services the Government of India has taken a number of steps to promote sustainable urban transport. There are more than 4 million people in 7 cities. There are approximately 100 kilometers of subways operating in Delhi, and an additional 250 kilometers of subways are being built in the first five cities. The other two cities are actively planning their rail transport system. Eleven cities have introduced the BRT system, but two other cities are in the planning stage. However, the efficiency and effectiveness of large-scale transportation depends on the ease of access to the different modes of the city, the design and availability of routes, the entrance traffic of station pedestrians, and the frequency of services You Transportation infrastructure development, traffic management, intelligent traffic system, environmentally friendly use of renewable fuels, higher traffic speed, lower operating costs, maximizing the use of public transport, reducing traffic congestion and traffic accidents, pedestrians easier And safety Mobile phones are an important factor in the sustainability of public transport. As an incentive to meet the everlasting needs of urban commuters, the authorities have attempted to combine two or more public transports in order to achieve an easy and uninterrupted travel in the city. The final process is the Integrated Multimodal Transportation System (IMMTS). This includes road congestion, longer travel times and coordinated use of various modes to cope with air pollution and their integration.

Transportation models are used to support the planner's work in the planning and decision making process. These models attempt to reduce system behavior and target systems. The proposed model takes into account the transport system and its interaction between supply systems and demand systems. Transmission models include demand models, network models, and a series of impact models. The demand model contains travel demand data. Simulate activities and generate travel chains to estimate and predict the behavior of a population-specific matrix of departures and destinations that uniformly fills the population. Travel demand estimates are derived from land use data from structural models and service indicators determined from impact models. The demand model describes the traveler's choice between different traffic modes, so they can be marked as multimodal. Public transport locations, links, routes for public transport. The impact models obtain input data from demand models and network models. It integrates different impact models to analyze and evaluate the traffic system. The user's model listened to the movement of movement of public transport passengers and car drivers. Based on the routing and assignment model, calculate traffic and service metrics such as travel time, number of times service frequency was sent, and so on.

3. Applications of Multimodal Transportation

Design methods for multimodal transport systems (MMTS) can be divided into two categories: integrated design and replacement design. The integrated design of the MMTS terminal integrates buses, feeder services, bicycles, rickshaws etc. with high-speed transport systems. This design offers multiple access modes while ensuring everyone integration, security and ease of use. The degree of effectiveness or integration of design exchange can be assessed based on the availability of the exchange. There are three main elements to the utility of exchange: Exchange requirements. This depends on the amount of time spent and the associated penalty. The time it takes to transfer between modes, and the time to wait for a connection. The design of the multimodal transportation system includes planning techniques, sound and economical, aesthetically pleasing building design and construction, and engineering expertise.

There are many factors in high quality replacement, such as:

- High quality standby environment
- Provides high timeline information (highlighting, easy to access).
- Reliable phone information service
- Advanced personal safety
- Easy access to ticketing and pricing systems.
- High billboards with interchange and bus and train services. Staff can ask for help.
- It can easily access the first car and find the next service during the exchange.
- Focusing on multimodal transport may bring some improvements to the transport system. The five key improvements are:
- With improved forwarding node design and improved synchronization of public transport services, forwarding is less annoying.
- Access to Private public transmission services can be improved, especially in low density rural areas. The availability of the destination's mode of transport can be improved, for example, by leasing the service, especially for areas with poor quality public transport services.
- It may be easier to obtain information before and during travel, making it easier to plan and complete multimodal transport;
- The economics of multimodal travel can be simplified through electronic payment functions or transport service integrators.
- As these improvements are independent of multimodal transport concerns, improvements in transport services themselves are not included in this selection.

4. Background

Macharis & Bernardini (2015) in this article, they outline the application of multi-criteria decision analysis (MCDA) in transportation project evaluation. This review aims to reject the use of MCAC procedures in evaluating transportation plans. He investigated which transit decision is decided in the MCCA law. The review included identifying traffic-related topics, interrelated decision-making issues, and the types of representative MCDA methods used to evaluate transportation projects. This review provides a general framework for assessing transportation projects. One of the conclusions brought about the

importance of including stakeholders in the decision making process, which is not yet common in the transport project under consideration. A multi-disciplinary multi-standard analysis (MAMCA) method was suggested as the direction of further study. The MAMCA approach has proven its utility in many decision-making issues and enables its acquisition to be clearly part of the decision making process. Rudi et al. (2017) The assessing and selecting multimodal transport routes for key objectives (transportation time, transport emissions, cost) is a major challenge in multimodal transport network design. The purpose of this paper is to offer a multi-mode transport support system that provides the method of transportation, route and airline study and determines the reduction in emission reduction. The result is to provide the industrial practitioner. At the heart of this approach is a network flow model with multiple capacity products, taking into account the three minimization goals (ie cost, time, and carbon dioxide equivalents). In this contribution, the 3-objective mixed integer linear model equation minimizes the number of transported and transported maximum loading trucks, taking into account the capital and travel distance in transit. The decision support system is validated with an example case study application that analyzes the optimal path and target sensitivity to carrier selection. By applying the extended ε constraint method, Pareto effective frontier has decided to study the trade-off between economic purpose and ecological purpose in multimodal transport planning.

Ma et al. (2018) China's urban railway transport system is being built rapidly to address the effects of urbanization, such as severe urban congestion and excessive air pollution. The plan for durable land use around the subway station (i.e., traffic-based development, TOD) for railway transmission system is very important because there is a long-term impact on transport demand. However, limited research has focused on station-level TOD planning. In this context, the purpose of this study is to offer a multi-functional planning model, which includes transportation and land use designs are included in the level at the station level. By taking an example of the Beijing subway station, this study is considered unique features of urban development (such as high density and diversity). This model studies five goals such as railway passengers and compacts. Access, conflict level and environmental impact. At the same time, an improved immune genetic algorithm is designed to obtain the optimal solution under alternative land use planning. The results of the model shows that the algorithm is better than the traditional genetic algorithms. It is expected that this research will provide sustainable planning for decision makers of urban planning.

Sun et al. (2015) this article discusses real multi-plant assignments and scheduling issues, including internal and navigational transport regulations. Based on the last Hadith, the name of the deductible (DBB) is a new heir method which has been developed to improve the computing performance of the precision algorithm and genetic algorithm (GA). In addition to the DB applications, the proposed GA is also directed by a new Fiji Controller, which is designed to eliminate other GA deficiencies while dealing with multiple plant models. GA resolution standards and computing performance were tested. Judicial Experiments demonstrate the value of this perspective in this practical global supply chain.
In this study, they proposed new models and new solutions for multi-plant allocation and production-allocation scheduling problems. In this new model, they take into account the changes and limitations of maritime transport, and their impact on production and distribution planning. The goal is to find integrated production and inland/sea shipping schedules in a multi-plant production system to provide mutual benefit to manufacturers and customers. Existing literature does not solve this problem. Numerical experiments have shown that the newly proposed integrated model can save significant cost and improve delivery efficiency. In addition, its performance is also reliable for external shipping schedule changes and production cost variances between plants. The newly proposed deadline-based cut-off rule (DBC) improves the computational efficiency of accurate algorithms by 80%. Meanwhile, the proposed fuzzy guidance heuristic method achieves the optimal solution and better computational efficiency by comparing with the efficiency improvement algorithm. Furthermore, after applying DBC, it turned out to be suitable for practical and large-scale problems with superior solution quality compared to classical genetic algorithm.

Acheampong (2018) Housing and decision-making decisions have a strong impact on urban emergency conditions, which determine the turnover patterns, energy consumption and greenhouse gas emissions related to travel. Therefore, the ability to understand and predict these selection processes is important for sustainable urban land use and traffic strategies in the long run. About housing-The workplace selection process needs to address the interaction between the decision maker's heterogeneous attributes and the different place definition attributes at multiple spatial scales. In addition, in order to better understand the interdependencies between these location selection sets, it is necessary to conduct an empirical investigation of how family and work react with one another over time. This study responds to these experimental needs by domestic investigations and individual housing options in the context of Ghana Metropolitan area of West Africa. Survey used cross section survey data from 665 families and used 1,158 individual workers from Kumasi Metropolitan, second largest city in Ghana. As a result, households and individuals have different preferences for macro-scale positioning factors and individual spatial options designated as urban areas, housing types, and lease arrangements. Residence-A retrospective analysis of the interdependence of work options suggests that, in most cases, residence decisions will be made first, this will be sequential where work decisions are fixed at the first residence means the selection process. In addition to a detailed experimental contribution, it also shows that research results ultimately provide information for the development of planning a plan to integrate the location selection in sustainable urban development and traffic management policies.

In this paper, cross-sectional survey data is used to simulate household and individual residence and workplace preferences and their interdependencies. The selection process is conceptualized as a process by which decision makers select the attributes of a set of location definitions displayed at multiple spatial scales. According to this concept, the probability of selection associated with these location-defining attributes is quantified in metropolitan areas, urban areas (i.e., historical center, suburbs, and suburbs) and dwelling unit sizes. The cross-sectional design used in this study is limited in that it can properly capture the evolution of home and individual home and work choices. Nevertheless, changing the location of the study's home or office has made it possible to retrospectively reflect some of the dynamics in the location selection process into the

current study. Based on the insights of current research, future research can use vertical design to capture changes in the place selection process. For example, using life-course approaches in vertical design, future studies explore how residence and employment changes are represented spatially and evolve with family and individual life cycle changes help. Furthermore, location data geocoded with a spatially explicit statistical analysis method that allows realistic acquisition and representation of spatial attributes that define residence and place of work, taking into account possible interdependencies. It is useful to investigate the place selection process further using. The resulting place selects data from the corresponding location.

Dolence et al. (2015) they proposed a new two-dimensional (2D) axisymmetric neutrine neutral emission/nuclear hydraulic model of nuclear waste super nova. They use CASTRO code to multi-dimensional multi-group flow, spread the spread neutrino transport including all related O (V / C) items. The main motivation for carrying out this research was to win many wonderful blasts created by other groups to compare the 2D model, most not included the term of the Vulcan result O (V / C) in the recent 2D. They follow 12, 15, 20 and 25 solar mass evacuations, about 600 millenniums after the uprising, and these models have no explosions. Though the reason for mass differences between groups involved in CCSN modeling is not clear, but they can be influenced by the use of all other groups of "an easy way of radiation". It seems to be a number of countless neutron flow angle and time "beam to beam", and it seems to think that it can capture on the other hand, multi-dimensional procedure, about the difference between the groups. I have difficulty attracting the obvious result of the root because their two dimensional models are also estimated. They discussed some of the commonly used diagnostic methods in CCSN simulation analysis and highlighted the close relationship between the various explosion conditions being proposed.

Alizadeh et al. (2016) He presented an effective and strong digital model for hearing of electronic events in durable networks, including energy conversion, flow, and a chip system on the label. These networks are combined with the position of fluid-pulse strip equipment's between fluid flow and ion transport. These equations describe various transfer phenomena that can be intertwined in a complex, highly non-linear way in a network containing multiple wells with different characteristics. Here they propose a low-dimensional computational model that handles many pore networks through the solution of one-dimensional equations. Assuming that each hole in the network is long and thin, they yield a one-dimensional model that describes the longitudinal transmission of the pores. They take into account in homogeneities in the potential and ion concentration distribution on the cross section of the hole in the form of area average coefficients at different flux terms representing fluid flow, current and ion flux. The unique advantages of this framework include: completely conservative discretization, averaging coefficients for fully constrained tabular regions, elimination of singularities within infinite thickness double layer (EDL), and equilibrium conditions There are multiple pore intersections for accurately maintaining magnetic flux discretization and general network expansion. By considering the hierarchy of increasingly complex normative problems, they demonstrate that the development framework can capture a wide variety of phenomena. An exemplary demonstration involves predicting the osmotic pressure established within the pores affected by concentration gradients, propagation of deionization impacts, and induced recycling of cross-pores with different properties.

Bilir et al. (2017) This paper analyzes a multi-purpose supply chain (SC) network optimization model based on the combined SC network optimization and competitive feature setting model, and the impact of SC network decision on customers' demand Analyze the results of ignoring. The goals used in this model are as high as profit, maximum sales and lower risk of SC. Model only requires an unknown variable. Assume that the demands of each customer area are determined by the value and utility functions. The utility function is defined as the availability of one-day shipments from the distribution center (DC) to the customer area. The application of the proposed model is explained by real world problems and can be solved as a single objective model and a multipurpose model. Next, compare the results of the single goal model and the multipurpose model. After solving this problem, a sensitivity to examine different factors of sample, such as cost elasticity, daily supply limit, risk factor (probability of probability), and target relative target weight models. Analysis will also be done.

Gasparik et al. (2017) The link transmission represents a comprehensive periodic schedule and is a timeline for periodic monitoring and network interconnection. The Key element is to reduce when it changes the selected locations or transport centers. The goal points are to reduce the total transit time of points from A to points A. The cornerstone of transport services is to provide travel opportunities through contacts and contact establishment. In many cases, each method introduces a new schedule and is subjectively assessed after discussing whether it is good or bad. The author solved some problems in the quality of railway passenger transport services. Currently, there is no way to evaluate train schedules from a traffic point of view. They do not evaluate the quality of the connection from point A to point B, only by evaluating the specific trains and connections within the station.

The proposed procedure is fully considered to be any pair of tool stations in the selected railway network. Not only can you evaluate the contact of a particular relationship, but you can review the availability of connections between average transactions like average matrix, average waiting, average shipping speed, average applicable, and two selected charge points as well. This allows you to assess the quality of travel opportunities in your area using selected indicators. You can then use several standard analyzes to evaluate customer satisfaction with selected quality attributes based on importance. Finally, by examining the quality connections of the network, you can check the statistical dependence of the number of railway passengers transported. This proposal helps to establish a competitive transportation system that uses system resources effectively. It is a project for the same European transit zones, within a white paper capacities "Single European Transit Zone Road Map - Contest and Resource efficient transportation system". This is aimed at achieving an efficient and integrated mobile system. The importance of transport service quality, accessibility and reliability over the next few years may be even more important.

Chen et al. (2014) Since efficient transportation services are always the primary concern of operators, a significant evaluation of passenger capacity is one of the basic requirements for designing designs and ensures effective operation of large transport terminals. The center of this survey is on the Transport

Center. Big city with many transportation services linked city-to-city traffic. Because performance is due to quantifiable factors and subjective perceptions of different sizes and rating ranges, it is very difficult to assess the overall performance of passenger travel. In this paper, they developed a multi-criteria evaluation of transfer options by developing a standard system and integrating performance factors. Design global assessment results and generate alternative rankings using multi-level gray assessment (MGE) and order-first techniques similar to the ideal solution (TOPSIS). The advantages of this approach are described in the study of Beijing South Railway Station case in China. This is particularly useful for research designers and operators, transportation performance in the context of increasing demand for modern transportation and the center of large-scale movement of service. In this paper, they use MGE and TOPSIS modes to evaluate aggregate passenger performance of large transmission terminals in different ways. Weighted weighting is used to overcome the weighted set from an individual's subjective or objective point of view in the assessment. The case was conducted on Beijing South Railway Station after the gathering of data and 12 experts' decision. Several conclusions were drawn from the evaluation results of the case study.

There observes contradiction between subjective and objective views. Experts' subjective judgments pay more attention to transfer efficiency, as meeting traffic needs of millions of people in China is still the most urgent task. At the same time, it is often important to shift facility capabilities, continuous transfer, transfer levels of services, and sustainable development from an objective perspective based on actual attribute values. Integrated weighting can effectively narrow the gap between objective and subjective perspectives and provide more reasonable results for evaluation. The MGE and TOPSIS modes provide similar results for multi-standard evaluation. At Beijing South Station, the transfer of passengers between buses and trains from buses and trains to the subway is preferable to the transfer between other means of transportation, especially those related to cars and taxis. The need for sustainable development is gradually increasing accessibility and agility. This article focuses on static criteria in the transfer of multiple criteria evaluations. By extending the study and simulation of passenger transport behavior, the transport performance of large transport terminals can be fully evaluated.

Schroeder et al. (2012) it is widely believed that micro-simulation and agent-based methods can be successfully applied to traffic policy analysis. However, the complex relationship between the logistics decision and the freight forwarder makes this a difficult task, and why is the development of the freight model still behind the development of the passenger model. In this paper, they offer a multi-agent transport model in which logistics decisions can be divided into two different roles. It is a transportation service provider, operator, planning trip, and planning vehicle that creates a transportation chain. Both types of drugs can be integrated at their respective levels to achieve economies of scale. The MATSIM traffic simulation was integrated into the model of the lowest level (including individual trucks) and a comprehensive model of traffic transport. Traffic passengers, traffic system error or policy measures may be received by the cargo driver in the passenger demand, and can be processed, which can affect the vehicle scheduling and transport channel construction decision. As a proof of concept, they set up a scenario where a virtual freight forwarder serves a group of customers. They have proved that they can simulate freight transport under different traffic conditions and policy measures.

Pérez et al. (2015) big cities around the world are strongly concerned about the effects of urban traffic. Rapid population and motorization in major cities will directly affect the sustainable development. As a result, multiple private and public sector participants involved in the design and operation of urban passenger transport systems often make decisions to optimize their goals. However, a citizen passenger transmission system is a complex task, which includes many standards of economic, environmental and social political issues. Multi-standard decision-making (MCCM) technology actually supports the decision-making process. This paper offers MCC research paper on design and operation of the Civil Transfer Transmission System from 1982 to May 2014.Through over 30 years of analysis, this white paper emphasizes the importance of considering actor diversity and unique criteria and solutions. This study calculates papers on urban passenger transport system projects published between 1982 and 2014 and builds them according to different subject areas. There is evidence that since 2007, in particular, scholars are increasingly interested in the field of widely defined transportation projects. In addition to the traditional economic elements of the system, recent research has focused on environmental and social issues. . By identifying some gaps in the scholarly literature, this paper also proposes some further research methods.

Bachmann et al. (2014) a multi-region input-output model based on probabilistic availability for space economy and traffic interaction modeling is introduced. The main method development and important results of more than 12 applications from 1996 to 2013 were introduced. Next is the outlook for potential future directions. Further research is needed in five areas: (a) a comprehensive review of methods, perhaps by retrospective application of infrastructure planning, and observation of the impact of trade; (b) According to the fact, business factors (c) use multi-scale models to capture the conflicts of geographical scales and to improve the representation of exports and exports; (d) variables; Innovation and technical development to improve cost impact and performance due to technology factors. Follow more detailed algorithm surveys that include elastic selling prices.

Schroeder et al. (2012) believed that micro-simulation and agent-based methods can be successfully applied to traffic policy analysis. However, complicated relationship between logistics decisions and freight promotions makes it a difficult task. Why is the development of freight models still behind the development of passenger models? In this paper, they recommend a cargo model of multi-material dividing the various decisions in different roles. Shippers make transport frequency decisions, transport service providers, transport chain creation, operators, travel planning, and vehicle arrangements. All dealer types can integrate cargo and achieve economies of scale at each level. The MATSIM traffic simulation was integrated into the model of the lowest level (including individual trucks) and a comprehensive model of traffic transport. Changes in passenger demand, traffic system intervention, or policy measures have been received by cargo drivers and are affecting the above predate, vehicle scheduling and transport chain construction decision, and Impact of the plane. As a proof of concept, they set up a scenario where a virtual freight forwarder serves a group of

customers. They have proved that they can simulate freight transport under different traffic conditions and policy measures.

Conclusion: In India, as the number of middle classes increases, so does the number of personalized vehicles. In the past decade, this situation has increased in many ways, which further led to the deterioration of traffic flow. Environmental conditions. This has created an indispensable need to change the way travel is done. Car walking/riding short trips and long distance travel by public transportation. Integrated multimodal transport Urban transport is the forerunner to achieve this goal. It is a promising field in Research and development in the near future, and science and practice implement adequate infrastructure; as most Indian cities are pacing Improve transportation infrastructure through various transportation projects. The case of Delhi's integrated multimodal transport system is an upcoming prelude Appropriate integration of various modes of transport in high-density areas Indian urban area. The biggest challenge facing Indian cities is achieving the highest level Multiple modes of integration to transfer personalized passengers in captive transport At least partially use public transportation for mixed mode travel.

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