

Investigating Sustainable Urban Freight Policies for Indian Conditions

Marimuthu Venkadavarahan^a and Sankaran Marisamynathan^b

^aResearch Scholar, ^bAssistant Professor

TEM, Department of Civil Engineering,

National Institute of Technology Tiruchirappalli (NITT), Tamil Nadu India

Indian cities have intensive roads with narrow streets and a high concentration of people in the city centers for commercial activity and recreational activity. It results in large flows of people going to work, shopping, eating, or visiting tourist sites, with corresponding flows of goods. However, these narrow streets are not appropriately planned for urban freight operation. The commercial vehicle of large, slow, and highly polluting is forced to stop in the city centers and dense areas for making deliveries, which require enough space for loading/unloading and parking, which is often performed at the sidewalk of the road section and double parking. This will create massive traffic problems which are found visually in every city. In reality, urban freight trip activity is typically perceived as a nuisance, and the urban freight system is largely ignored by the government and local authorities. Implementing urban policies with passenger movement in mind will lead to an ineffective urban environment. Also, it is important to consider the urban freight operation for smooth movement of passengers and goods without hammering the city's livability and sustainability. Therefore, it is essential to propose sustainable freight policies based on local city conditions to improve the existing mobility system.

The study on sustainable urban freight policies is heterogeneous as it needs to note the contrasting goals and interests of the various urban mobility players. Also, the wider perspective of components such as governance (authorities), the geographic approach of the city, infrastructure facilities, vehicle operators, and economic and environmental characteristics need to be considered to improve and enhance the urban freight system. In such context, solution and policy initiatives that focus on the particular type of agent or specific set of players are not adequate in delivering suitable solutions. Thus, a different group of experts like government authorities, stakeholders, and academicians are involved with their varied preferences for proposing effective urban freight policies. A two-level hierarchy such as criteria and sub-criteria are used to propose the urban freight policies. Four criteria are formulated related to public infrastructure, land use management, commercial vehicle access conditions, and traffic management. Each criterion framed with four alternative policies and sixteen alternatives' policies are proposed for the better planning and performance of the urban freight system. Public Infrastructure policies related to constructing new infrastructure facilities, introduction of infrastructure facility in outskirts of the city, development of facilities to encourage electric freight movement, and development of dedicated freight feeder are recommended. Then, land-use management policies related to urban consolidation centers (UCC) and hubs, parking space, allocation of curbside parking spaces, and introduction of separate loading and unloading bays are presented. Access according to the weight and volume, road pricing/toll, off-hour delivery, and access time windows are suggested in the commercial vehicle access condition. Traffic management policies related to intelligent transport system

technology (ITS), enforcement, heavy fines, automatic access control, and operation management are proposed.

In order to evaluate the sustainable urban freight policies, an expert's opinion survey is conducted to understand the interconnected relationship and contradictory association of the urban freight policies from various urban mobility players. Responses are collected on a five-point Likert scale (1 = strongly disagree, 2= disagree, 3= neutral, 4 = agree, and 5 = strongly agree). Urban freight planners, academic faculties working in transportation planning, and logistics stakeholders are targeted in the expert opinion survey process. The survey was conducted in January 2021, and a total of 51 responses were obtained from experts. In which 41.18 % of respondents were academicians, 47.06% of respondents were government authorities, and 11.76% of respondents were stakeholders.

Then model framework is developed to prioritize and rank the sustainable urban freight policies from experts' opinions using Fussy Analytic Hierarchy Process (Fussy-AHP). Finally, the best suitable and sustainable policies are ranked using weight vector in Fussy- AHP method for Indian conditions. The weight vector for all the alternatives rated by experts has been obtained from model development. It was observed that the introduction of mandatory nighttime or off-hour delivery systems of heavy-duty vehicles has been preferred to be one of the effective policies among other policies for improving the performance of the sustainable urban freight system. Followed by UCC in specific locations, Freight terminal infrastructure facility, ITS integration for traffic management, Operator monitoring database system, Dedicated freight feeder service, Parking space, and strict access condition were considered to sustainable urban freight policies. These policies minimize overlapping with passenger traffic and reduce negative effects like congestion, queuing, etc., to ease cargo movement in the urban area. Few urban policies seem to achieve higher degrees of sustainability in the beginning but actually end up creating more inefficiency in the overall transport system. Thus, urban freight policies can be implemented based on the degree of suitability and anticipated outcome in the urban area. Also, it is highly suggested to monitor and collect the database for assisting better insights into the urban freight policies. Moreover, a specific policy or combination of policies can be implemented, and all the alternative policies are general and appropriate for any urban area.

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