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Analyzing Transit Network Design versus Urban Dispersion

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Abstract : This research answers which is the most suitable transit network structure to serve specific demand requirements in an increasing urban dispersion process. Two main approaches of network design are found in the literature. On the one hand, a traditional answer, widespread in our cities, that develops a high number of lines to connect most of origin-destination pairs by direct trips; an approach based on the idea that users averse to transfers. On the other hand, some authors advocate an alternative design characterized by simple networks where transfer is essential to complete most of trips. To answer which of them is the best option, we use a two-step methodology. First, by means of an analytical model, three basic network structures are compared: a radial scheme, starting point for the other two structures, a direct trip-based network, and a transfer-based one, which represent the two alternative transit network designs. The model optimizes the network configuration with regard to the total cost for each structure. For a scenario of dispersion, the best alternative is the structure with the minimum cost. This dispersion degree is defined in a simple way considering that only a central area attracts all trips. If this area is small, we have a high concentrated mobility pattern; if this area is too large, the city is highly decentralized. In this first step, we can determine the area of applicability for each structure in function to that urban dispersion degree. The analytical results show that a radial structure is suitable when the demand is so centralized, however, when this demand starts to scatter, new transit lines should be implemented to avoid transfers. If the urban dispersion advances, the introduction of more lines is no longer a good alternative, in this case, the best solution is a change of structure, from direct trips to a network based on transfers. The area of applicability of each network strategy is not constant, it depends on the characteristics of demand, city and transport technology. In the second step, we translate analytical results to a real case study by the relationship between the parameters of dispersion of the model and direct measures of dispersion in a real city. Two dimensions of the urban sprawl process are considered: concentration, defined by Gini coefficient, and centralization by area based centralization index. Once it is estimated the real dispersion degree, we are able to identify in which area of applicability the city is located. In summary, from a strategic point of view, we can obtain with this methodology which is the best network design approach for a city, comparing the theoretical results with the real dispersion degree.

Keywords : analytical network design model, network structure, public transport, urban dispersion
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