PUBLIC TRANSPORT NETWORK APPRAISAL AND IMPROVEMENTS - a case study of Porto

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Abstract

The city of Porto is currently witnessing a major restructuring of its public transport system, prompted by the construction of the 1st stage of its light rail (LRT) network and the introduction of complete fare integration. Until now, its public transport system consisted of an extensive bus network (STCP and several small-medium private companies) and three suburban railway lines. With regard to physical integration, STCP has been re-designing its network so as to: optimize integration with the new mode, eliminate redundant routes, and improve the remaining bus services. In this paper, we provide an evaluation of different public transport network scenarios, from the point of view of accessibility and efficiency. STCP management expects the completion of the 1st stage of the LRT network in September 2005 to drastically reduce bus demand along certain corridors. Therefore they wish to cut back the about 35% of the number of lines (with a reduction of 17% in total vehicle-kms).

Transport modeling software EMME2 was used to build different public transport network scenarios and then to assign a fixed demand matrix to each one. A relatively detailed zoning system (350 zones covering an area with a population of about 1 million inhabitants) was developed based on existing statistical units. A public transport demand matrix was built for the morning peak period (7h to 9h) based on a 2000 household survey and the 2001 Census, using a gravity-type model. The project includes exclusively the coding of the Public Transport Network using stops and splits of the network. Average vehicle speeds are based entirely on operational data. For this purpose was created a zoning, each zone having a specific speed. Average walking distances were calculated using GIS and field visits, and walk, wait and in-vehicle time weights were taken from the literature. It was assumed that OD travel cost (out-of-pocket cost) is constant regardless of the transport modes used. We defined the following three scenarios for appraisal purposes: Scenario 10 (Reference Case) – Current STCP Network + Suburban Railways; Scenario 20 – Reference Case + LRT Network; Scenario 30 – STCP Strategic Network + Suburban Railways + LRT Network. A number of comparisons were carried out between these scenarios, for example: Scenario 20 vs Scenario 10 – gives us the expected impact of the LRT network. Scenario 30 vs Scenario 20 – allows us to evaluate the Strategic Network. Scenario 30 vs Scenario 10 – gives us the expected impact of the new public transport system (SN and LRT). A number of aggregate indicators were used to compare scenarios, including: average travel time, average walk access time, average waiting time, average number of interchanges, average occupancy rate by mode, passenger per line, total required number of buses, operating costs. Having produced demand assignments for each of the network scenarios, we built **GIS plots of average zonal accessibility** (based on generalized travel time). These were used to compare different networks (exposed above) and identify areas where significant losses of accessibility occurred following the introduction of the new networks. Two types of accessibility analysis were made: general accessibility, aggregated by origin, and accessibility of individual zones to all the other zones. This information was then used to make iterative adjustments to the network proposals, until we obtained acceptable accessibility indexes, from the point of view of the user, and yet efficient from the point of view of the bus company.

Using Enif, we were able to plot passenger flows for each scenario, comparing the capacity and predicted demand for each line of the strategic network which we used to analyze the proposed frequencies. As expected, we identified some lines with excessive capacity offer and other almost reaching the limit (>90%). We also used Enif to study the main transfer interfaces, analyzing the conditions (localization, facilities, etc) they offer for this activity and in some cases we proposed new locations, the assignment results showing that they improve substantially the transfer times and consequently the total travel times.

In conclusion, our study clearly shows that the introduction of an LRT network brings about significant accessibility improvements to the transport system. This is due to the much higher average speed of LRT with respect to bus, especially in the city centre and along very congested corridors, but also in other parts of the metropolitan area. This shows the importance of modal integration in taking full advantage of a fast transport mode. However, increased inter-modality also implies an increase in the average number of interchanges. Thus, the design of interchanges to maximize comfort and safety and to reduce walking distances can contribute significantly to the success of the new mode. Our results show that, even though the “Strategic Network” does produce generalized travel time increases in certain zones, these are small in comparison with the gains produced by the LRT network, and certainly in comparison with the cost savings it generates. In addition, we were able to show that the SN leads to an increase in the number of LRT and train passengers, promoting a major inter-modality system, if there is an integrated fare system shared by all the operators.

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