Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 104 (2017) 530 – 538

Procedia Computer Science

ICTE 2016, November 2016, Riga, Latvia

Simulation-based Public Transport Multi-modal Hub Analysis and Planning

Anastasija Bolkovska[a,]*, Julija Petuhova[a]

[a]*Riga Technical University, Daugavgrivas street 2, Riga, LV-1048, Latvia*

Abstract

The multimodal transport system concept, transportation systems management technology and other researcher's related studies of multimodal hub planning are analysed in the paper. A methodology for multimodal transport management support systems development is proposed based on the performed theoretical analysis.

The proposed methodology includes three subsystems: transport traffic control support system, transport cruising time synchronization system, and user support system. The information of the population of the Latvian cities and other necessary data has been collected and processed using open source statistical data bases. The available transport timetables and structure details of the JSC "Riga International Coach Terminal" (further in text – Terminal) and Passenger Train Station are used as the input data for simulation model.

The developed methodology is approbated using simulation technology. The proposed public transport multimodal node development methodology is tested on the Terminal bimodal transport hub "train - international bus". The experiments are performed by analyzing capacity of waiting hall and passenger service level based on the average passenger transfer time between transport arrival and departure. Finally, recommendations on the increasing of the operation efficiency of the bimodal transport hub "train - international bus" are given.

Peer-review under responsibility of organizing committee of the scientific committee of the international conference; ICTE 2016

Keywords: Bimodal hub; Simulation techmology; Arena software

* Corresponding author. Tel.: +371-67089514; fax: +371-67089513.
E-mail address: anastasija.bolkovska@rtu.lv, julija.petuhova@rtu.lv

Peer-review under responsibility of organizing committee of the scientific committee of the international conference; ICTE 2016
doi:10.1016/j.procs.2017.01.169

1. Introduction

Urban transportation systems are complex in nature as they involve many interacting agents behaving in myriad ways that are extremely difficult to predict. The development of intermodal passenger transportation solutions to address the mobility issues facing society constitutes a major thrust area of urban transport policies[1].

For years, urban networks were designed and built to carry massive flows of passengers to and from workplaces. Their role was limited to their transport function and did not take into consideration passenger expectations and the integration of the system in its environment. A high transport capacity is no longer the sole criteria for assessing urban rail's efficiency. Mobility patterns are hence changing as cities, are generating greater and more diverse mobility demands. Citizens are demanding not only greater mobility - i.e. Mobility that is more frequent and more widespread – but also higher quality mobility. As they were built at a time when the majority of journeys were fixed and routinely made, most existing public transport systems now find that they must fundamentally change their approach. Public transport must take an increasingly flexible and competitive approach to meet the needs of today's travelling public. It must increase its quality, punctuality, frequency, attractiveness and comfort: these factors have an impact on its productivity. Indeed, urban networks have been transformed from just being a transport system into being an urban achievement around which the city and its mobility system are structured and developed. It is therefore crucial that an optimization of interchange and transfer points between modes occurs with the goal of making them functional and pleasant. As well as, there is no use in setting up an efficient transport system if passengers do not know how to use it.

Another important aspect is to provide high quality information. Under "high quality information" one must understand: a delay, departure or arrival times, and other important information connected with the passenger transportation. These two aspects, minimizing waiting times and giving real-time information to guide the customers efficiently, are two essential points for the design of an intermodal transportation system[1].

Transportation itself envisages a management system to support all processes related to the transportation. Thereby the Multi-modal transport system management support system development methodology is proposed. The methodology elaborates three subsystems: Transportation Traffic Management support System (TTMS), Transportation Cruising Time Synchronization support System (TCTSS) and User Support System (USS). TTMS uses and stores such data as in transportation involved vehicle quantity, vehicle identification numbers, vehicle type and passenger capacity. TTMS must provide a decision making support in emergency situations. TCTSS coordinate and synchronizes arrival and departure time between different transportation modes involved in multimodal transport system. USS provides access for all technical users (dispatchers, drivers, administration, etc.) to all stored data and also provides a limited access (online purchase of tickets, time tables, etc.) for end users (passengers).

2. Literature review

Harris and Wang[2] offers a definition for multimodal transport: “Transportation of goods by two or more different modes of transport (such as road, rail, air or inland waterway, and short- or deep-sea shipping) as part of the contract where often a multimodal transport operator (MTO) is responsible for the performance of the entire haulage contract from shipping to destination.” Definitely this definition can be related to transportation of passengers also.

There are several terms that can be related to multimodal transport: intermodal, co-modal and synchromodal transport. There are differences between those terms; multimodal is a type of transportation which uses two or more different modes of transport; intermodal transportation uses the same loading unit (e.g. a TEU container), co-modal adds the efficient use of different modes (resource utilization) and synchromodal accentuate the real-time aspect of the transport. The definition of multimodal transportation system that offers[3] allow identifying the key elements in this type of system: passengers, different vehicle types, different transportation operators.

During the planning of the multimodal transportation hub it is necessary to use some management methods that allow to manage transportation and delivery operations and moreover to manage critical situations on the road during delivery. One of the methods/ networks that can be used is hub-and-spoke. The method is based on the point-to-point network concept. In the thesis[4] a hub-and-spoke network is explained as follows: trains with load units for various destination terminals run from various origin terminals to a hub with an exchange facility. At this hub exchange facility either rail wagons (at a shunting yard) or load units (at a terminal) are exchanged between trains