### lntrodumion



The road based transportation system has become the most irnponant part of th

infrastructure in almost ali developed countries. It is not only important as the **physical** Smx j u re of the sociely, but also as the foundation f9r $ocial and econom‹c developmem. ThrougW\ I e yea rs, most attention has been focused impr vi/jg the traff< system on behalf of private transportation. The auto traffic is though causing Ixoblems. ‹most of all in forms of congestions and environrnemal mpacts.

1.2 Objectwes and Contributes

# In this ihesis. we focus on strategic and tactical planning of an integrat ed public

transport system. The main objective is to present a framework for evaluation and design of such a system. General guidelines of how to implement and operate an integrated pubhc transport service shall a|so be give,

# this thesis conuibu‹es \o the area of public transport planning in 1he follow ng ways. The thesis

## qives a survey of modeling of integrated public transport services. wnh special emphasizes on Ike use of optimizatlon and elmulation models.

* presents a framework for evaIuaHon and deslgn of an integrated public trans' port syslem, This frarnewo+l‹ consists of a geographical information sts\em. optimization tools an0 simulation tools.

## fanning of Public Transg<rt

### This chapter describes how planning of public tr an sport is performed both for fixed

route seances and frs demand responsive services. We also discuss how operations research is of help in the planning process. Operations research uses mathemai<aI modets. stasis ic s and **algorithms to** aid in decision- making. It is - I- of app¥ed

nJathematic s, most often used to analyze complex real worse! systems. The goal is generally to inJpro‘/e or optimize the performance of the studied system.

* 1. The Planning Process

When planning a public transport system, or any other public service, the planning must be made front several aspects such as efficiency, effectiveness anc! equity, for ex ample described in Savas (1 978). These aspects should be put together to formulate the objecti‘.'e of the planning. No matter v.’Fiat the objective is, planning of public transpon always involves a number of difficult, coinbinatorial problems, where op erations research in general and optimization in particular, is of highest importance and can be a really useful tool. To understand the role of operations research in planning of an integrated public transport system, it is necessary to first understand the different problems involved in the process of planning public transport in gen

eral. A planning process can usually be described at strategic, tactical or oper ationat level. In this thesis, we do not distinguish between str at epic and tactical planning. The planning process will in this way only be divided into strategic planning and operational planning.

The strategic and operational planning of fixed route services can be described as a systematic decision process, first presented in Ceder & Wilson (J 986)

* 1. Planning of Integrated Services

As described in Chapter 2, a lot of 'work is done on how to plan both fixed route services as well as demand responsive services separately. In this chapter, focus is on how to plan an integrated service. This service is intended to be used in urban traffic systems and the service should suit a wide range of customers from different market segments. Both the category of elderly and disabled as well as any other public transport customer shall be able to use the service

.Road Network:

The network representing the town of G"avJe consists of 4087 nodes and 9384 di rected links. The area co'.'ered is approximately 130 km2

The original net\work was

extracted from the Sn'edish national road database. The description of the network was then modified in the way needed to represent it in LITRES 2.

Conclusions and Future Research:

We have described how a framework for planning of an integrated service should be designed. The importance of a connection between a GIS, simulation tools and optimization tools has been emphasized.

The evaluated mode4ng tool LITRES 2 has pro en to be a useful tool for simulating muhi nodal public transport journeys. It offers a unique opportunity to study mar kens response to changes in the range of transpon services. What is missing is the possibility to plan an integrated public transport system fully from the operator’s

perspective. Performed simulations have given some guidelines of how.’ to operate an

integrated service. They hax'e shown that small vehicles can efficiently be used in an integr ated public transport service operated door to door.

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The evaluated modeling tool LITRES•2 has proven to be a useful tool for simulating multi modal public transport journeys. lt offers a unique opportunité to study mar- kets response to changes in the range of transport services. What is missing is the possibility to plan an integrated public transport system fully from the operator’s

perspective. Performed simulations have given some guidelines of how to operate an

integrated service. They have shown that small vehicles can efficiently be used in an

inteqrated public transport service operated door-to-door.

The exact model of how to assign passengers to vehicles in an integrated public transport system has been tested on several cases and proven to work as intended. It has also shown that it is possible to solve small instances of the integrated dial- a-ride problem to optimality. The literature review shows that more work has to

be done on effective planning of journeys in integrated services. Also research on systems for planning and design of such services are needed, as well as to study the effects of an integrated service, to passengers, operators and society.

One focus on future research within this area should be on how to develop more

efficient methods to plan integrated journeys.