Chapter 10
Sustainable Transport System:
Transport On-Demand

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ABSTRACT

Transport systems are major emitters of greenhouse gases, which makes environmental sustainability of any transport a crucial issue. Another issue is the lack of a systematic approach to the modeling and implementation of public transport systems. Finally, there are problems with the human interfaces to public transport systems, which do not encourage, and many do not allow, comfortable and simple interaction with the system. In this chapter, the authors discuss their solutions for these problems, explaining how to cover the existing gaps in a methodological and systematic way. The main contribution of this chapter is a model of an on-demand transport system that covers all the points mentioned above and focuses on spatial planning and optimizations including environmental issues in transport planning.

INTRODUCTION

One of the powerful drivers for sustainable transportation is public transport. The more people who share the one means of transport, the less the cost and damage to the environment. However, there are many specific problems and challenges, which make the use of public transport inaccessible and inconvenient for potential new passengers. Some of these issues, which we will consider in this chapter, are:

- *Time* - Long waiting times. A passenger may be required to wait indefinitely for the next bus/train/tram, and any time longer than 20 minutes is perceived as being too long;
- *Distance* - Long walking distances to the next nearest stop/station. Passengers may live a long way away from the nearest public transport route, or the connecting multimodal options may be far separated;

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- *Timetables* - Non-punctuality. If the public transport vehicle is not following the timetable, e.g., is running late due to disruption, delays, congestion, passengers may miss their connections and be late for work.

It might appear that increasing the number of services and so making the timetable denser could solve these problems, but this solution would mean

- higher costs for the transport company, and
- further emission of greenhouse gases.

Another factor which could make this solution even more questionable would be if the bus were to be empty (idle drive) which could happen for some parts of any route during some times of the day. Hence quick and obvious options are not always the best solutions, and a systematic approach is needed to deal with these problems. A crucial question here also is, how to model this idea in such a way that it

- is applicable to any kind of transport system; and
- allows extensions for the special cases of transport systems having different flexibility in their operation possibilities; and
- covers modelling of exceptions (problems with the traffic due to some disruptions).

In this book chapter we will develop and explain our model for making public transport sustainable, *transport on-demand,* through the use of various definitions, examples and scenarios. Our methodology is aimed at providing smart solutions for sustainable outcomes, so that a transport system becomes a part of a 'smart city', cf. (Ercoskun, 2011; Nam & Pardo, 2011). We conform with the desire to develop sustainable software and systems, i.e., such software and systems that "meet the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987). The sustainability of software and systems development becomes increasingly important every year for many reasons, including expanding the software usage as well as growing demand for building further applications based on it. The three pillars of sustainability, namely the economy, society, and environment need are not balanced, and to deal this problem, a "green software" solution is required, cf. also (Hilty & Aebischer, 2014; Easterbrook, 2010). We also work within the classification of green software according to the Green Software Engineering project where the aim is to apply "green" principles to "software products, software development processes and their underlying software process models", (GreenSoft, 2009). However, we mainly focus not on the green development process, but on the development of software and systems that can have a positive impact on the environment and human beings.

The main idea behind our approach is to identify whether a bus, tram, or train would normally be empty during the day/night for some parts of particular routes. It could be empty for some cases if the timetable were denser or if the route were extended to outlying districts. We aim to have these parts of the route provided as optional choices in the timetable, during these hours. This would imply both lower costs for the transport company with less emission of greenhouse gases, as well as enabling the transport system to be more attractive for actual and potential passengers due its flexibility. To make this idea realistic, a proper model of the system is essential.