# A framework for the analysis of the implementation of road user charging projects

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# Preface

This thesis report is the written result of my research conducted as the final assignment to complete my studies for receiving a degree in Systems Engineering, Policy Analysis, and Management at the Delft University of Technology.

The idea of investigating Road User Charging originates from my conviction that traffic problems will become a serious issue for our society in the near future. This was for me a motivation to apply for an internship at Berenschot. I am very grateful for the experience and support I got at Berenschot in this initial phase of my research, although the contract with the ministry was unfortunately cancelled shortly after the start of my internship. Working on this subject and writing this thesis has been a valuable experience for me, but due to the complexity of the subject it was also an intellectual and personal challenge.

I would like to take the opportunity to express my gratitude to my graduation committee for their advice and support. My special thanks go to the interviewees, especially the representatives of the Dutch Ministry of Transport, Public Works and Water Management, who were willing to cooperate on very short notice. These interviews have been of great value for the conducted research, especially for the validation of the developed framework.

And last but not least, I would like to thank my parents for their patience and continuous support in sometimes challenging periods, and especially my father for many inspiring discussions.

Andreas Furch

Amsterdam, August 2010

# Executive Summary

Mobility is one of the essential needs of human beings. The unrestricted right to move around and free access to means to move from one place to the other has always been a deep-seated desire of mankind. The growing population, the rise of the number of vehicles and increased transport and travelling activities are reasons for a steady increase of the traffic on our roads, especially in urban areas. Traffic congestion has therefore become a fact of our daily life, and traffic congestion is further growing. The concept of demand management by letting the car user pay for his actual usage of a road, which means that he has to pay a price determined by the driven distance, the day of the week and the time of the day, and the type of road, is an approach to tackle the traffic congestion problem and to improve mobility (or at least to prevent it from getting worse). The concept of a differentiated kilometric road charge is nowadays understood under the term "Road User Charging (RUC)".

The introduction of RUC based on the "user and polluter pay" principle aims to reduce traffic congestion (especially in the peak hours) and to achieve a more efficient usage of the road infrastructure by a better distribution of the traffic over time of the day and place. Guaranteed mobility and the protection of the environment have become a topical issue for our society. RUC is seen by many governments as a promising way to get these issues under control.

One of the countries, which have a long history of struggling with congestion and environmental issues, are the Netherlands. All the governments in the last decades have recognised the need to take measures against the growing traffic congestion. After a number of failed attempts to implement RUC in the Netherlands, the Dutch government decided in 2007 to introduce a nationwide RUC system, called ABvM (*Anders Betalen voor Mobiliteit*). The objectives of ABvM are:

- creating a fair system, where one has to pay for the use of a car instead of to pay for the ownership of a car,
- improving accessibility and traffic flow by applying peak rates for busy times and places,
- creating a positive effect on the environment.

These objectives shall be achieved with the introduction of the kilometre charge for all cars on all roads. As announced in 2007, the system should be operational for trucks in 2012. In a phased approach the introduction for all other road users was scheduled between 2013 and 2019. These wide-ranging objectives led to a complex set of requirements for the Dutch RUC system. To be fair, the RUC system has to be applied as a matter of principle to all road users and on all roads (national and secondary roads) in the Netherlands.

In order to succeed with the implementation of such a complex system a good knowledge of the factors which are critical for the success or failure of the implementation is essential. This need for better knowledge is sufficient motivation to investigate which lessons can be learnt from the positive and negative experiences gained in RUC projects abroad and in small-scale RUC projects in the Netherlands. Based on the analysis of the implementation processes of several relevant RUC projects abroad and drawing from the experiences gained in small-scale projects in the Netherlands, the factors playing an important role for the implementation of RUC systems and therefore mainly determining the success of their implementation have been identified. Acceptability turned out to be the most important factor for a successful implementation.

These factors have then been incorporated into a framework, which gives an overview of these crucial factors and emphasizes the important role of acceptability. It shows the factors influencing the acceptability, but also other factors that we identified to determine the success of the implementation of RUC systems. An important finding is that most of these factors are heavily interrelated. Good knowledge and correct understanding of these interrelations and the identification of areas of potential conflicts, which can lead to dilemmas in the implementation of RUC systems, are important for a solid analysis of the implementation of such complex projects.

In a following step the characteristics, history and status of the implementation of the nationwide RUC project in the Netherlands, ABvM, are described in detail. This detailed discussion of ABvM reveals the extreme complexity of the system and of its implementation and provides a comprehensive review of the implementation process of ABvM, which cannot yet be found in the literature.

The developed framework was then used for the analysis of the implementation process of the Dutch RUC project, ABvM, in order to validate the framework. Since the identified factors incorporated in the framework play indeed an essential role in the current implementation of ABvM, it can be stated - as confirmed by interviews with representatives of the Dutch Ministry of Transport, Public Works and Water Management - that the framework identifies correctly the crucial factors of the implementation process and how these factors support or hamper the (potential) successful implementation. Furthermore, the conflicting interrelations, which can lead to serious dilemmas and which partly explain the difficulties and delays actually occurring in the implementation of ABvM, are also shown. The discussions about the areas of conflicts and dilemmas in the implementation of ABvM clearly identify the conflicting relation "complexity of the scheme ⇔ fairness of the scheme ⇔ acceptability" as the core of the problems in the implementation of ABvM up to now.

As the application of the framework to the ABvM case demonstrates that most of the crucial elements of the implementation are covered by the framework, the developed framework can be considered validated and proved to be a useful tool for the analysis of the implementation of complex RUC projects. The interviews with the experts from the ministry confirmed the applicability of the framework and especially its usability for the preparatory phase of the implementation of RUC projects, which makes the framework a useful tool for e.g. foreign ministries of transport, but also for new stakeholders and organisations joining an RUC project during the implementation phase.

Despite all difficulties and delays, ABvM (or a sort of RUC) will come in the Netherlands, when the congestion problem will become so severe that it is unacceptable for the majority of the public, and other issues, now still being a major concern for acceptability, will probably play a less decisive role (e.g. costs, taxation law, privacy). The increased public support will then make a political decision for implementation easier than nowadays. RUC continues to be a hot issue: it was an issue for the recent elections and now it will become an issue for the coalition negotiations.

# A framework for the analysis of the implementation of road user charging projects

# 1. Introduction

## *1.1. Research context and background*

Mobility is one of the essential needs of human beings. The unrestricted right to move around and the free access to means to move from one place to the other has always been a deep-seated desire of mankind. Whereas in the beginning the only means for moving around were our feet, the desire to move persons as well as goods between different locations in a fast and convenient way across increasing distances inspired the human brain to invent better means: The invention of the wheel was the basis for wagons and carriages, which first were pulled by men, but soon were pulled by horses. During many centuries horses and horse-drawn coaches were the backbone of the transport over land. An important step forward for improved mobility, however, came with the invention of the steam engine for trains and the combustion engine for cars. Motorized vehicles (cars, trucks, motorbikes, scooters) are nowadays used on a broad scale to move persons from one place to the other and to transport goods. Modern society relies on mobility and transport by cars (KTA, 2008). Whereas in the early phase of motorisation the possession of a car was reserved to the "upper" class of wealthy citizens and considered as a "luxury" good, today nearly every family owns one car and, moreover, in the Netherlands a second car is becoming more and more prevalent (KiM, 2009). Motorized vehicles are now indispensable elements of our daily life and are used for the transport of food and goods, for commuting between the place of work and the place of residence, and for leisure and holidays.

It is a fact that our population is not only steadily increasing (e.g. the population of the Netherlands is expected to continue to grow from today's 16.5 million to at least 17.5 million by 2038) (Nimwegen & Heering, 2009), but is concentrating in cities and urban regions (like the "Randstad" in the Netherlands, which is one of the fastest growing urban agglomerations in Europe (Praag & Nimwegen, 2006)). Moreover, since 1985 the mobility of the Dutch population has increased by 40 percent and the use of cars has increased by 54 percent caused by following factors: population growth, an increase in the number of people employed, longer home-to-work travel distances, and more frequent pursuits of leisure activities located further away from home (KiM, 2009).

An obvious solution to cope with the increasing traffic is the construction of new roads. However, there are - especially in a densely populated country like Holland - natural limits for the expansion of our road infrastructure, since Holland cannot grow and the ground which can be made available for new roads is rather limited. Especially in cities or urban regions there is just no space anymore for new roads (If at all possible, very expensive construction techniques have to be used like tunnels or double-floor roads). Traffic congestion has therefore become a fact of our daily life (From 2000 to 2008, time loss due to traffic jams and delays on highways increased by 55 percent, whereas the traffic volume grew in the same period by 14 percent) (KiM, 2009).

Although in 2008/2009 the growth of congestion has somewhat slowed down, most likely due to the world economic crisis (KiM, 2009), it is expected that traffic congestion will further grow as soon as the world economy has recovered. If no countermeasures are being taken soon, the road traffic system will become very inefficient in the not so distant future due to the further growing traffic congestion. As it is widely accepted that there is a general

traffic problem, a number of measures are being taken or are being planned (Bendixson, 2008).

Expanding the capacity of our road network by building new roads is, as said before, not a practical and feasible solution, especially not in densely populated areas, where the traffic congestion is worst. In addition other hurdles have to be taken like the compliance with environmental regulations or the resistance of citizens' action groups, which can end up in endless lawsuits and huge project delays.

An alternative approach to tackle the traffic congestion problem and to improve mobility (or at least to prevent it getting worse) is the concept of demand management (Meyer, 1999). As many people know from their own experience, there are periods of the day or week, in which even the roads with the most severe congestion allow a fluent traffic. The basic idea behind traffic demand management is to reduce travel demand and to redistribute the traffic more equally over time and space and thus ensuring a more efficient usage of the existing road network. Steering the traffic stream can be achieved by delivering to the road users more and better (i.e. up-to-date) information. Today information about traffic jams or accidents on roads is already provided via the radio, via road displays and via traffic information systems integrated into car navigation systems. Nevertheless, there is still room for improvement. It is, however, an inherent disadvantage of this information-based approach of demand management that the only motivation for a car driver to choose an alternative (longer) route is his personally expected saving of time in comparison to a congested road. The individual interest is in the foreground, whereas the collective effect does not count much for the decision of the individual driver.

A more radical measure to reduce the level of traffic is to raise the price for the usage of cars and roads. If this is done in a global and undifferentiated way like adding another flat tax or increasing the tax on gasoline, the effect of this measure will only be of short term, considering that his car is the Dutchman's "holy cow". As we have learned from the oil crisis in the last century, our society is willing to pay nearly any price for gasoline for not loosing mobility. The concept of road pricing will only be an effective means for traffic demand management, if the actual user has to pay for his actual usage of a road (Schelin, 2008), (Bendixson, 2008), (KTA, 2008), which means that he has to pay a price determined by

- the driven distance,
- the day of the week and the time of the day,
- the type of road.

**This concept of a differentiated kilometric road charge is nowadays understood under the term "Road User Charging (RUC)".**

The basic concept of letting a road user pay for the usage of a road is not new. It existed even before cars existed, and goes back to the time of the Romans (Schelin, 2008). In the era of horse-drawn carriages it was quite common to have toll houses on certain roads, where passing people had to pay toll. Tolls can easily be collected by installing toll booths or toll gates, where road users have to pay their toll, before they are allowed to continue their trip. Even today this toll concept is still applied all over the world on tolled roads, e.g. certain highways, bridges, tunnels etc. It is obvious that the primary objective of tolling is in general to generate revenues for the government. Only in special organisational constructions the toll revenues are directly used for the maintenance or construction of highways, bridges or tunnels. Examples are

commercial or semi-commercial entities which are created to build and operate expensive parts of the road infrastructure like roads crossing the Alps. In these days this tolling concept plays an important role in countries of Eastern Europe, where a modern and well-maintained road infrastructure does not yet exist and toll revenues have to be used to modernise the road network.

Until a couple of years ago, a driver had to stop at a toll booth to pay his toll, which made the use of toll roads quite cumbersome. Nowadays, thanks to new technological developments, the process of road charging by collecting tolls has become more user-friendly and more efficient. For example, free-flow systems do not require that a driver has to stop at toll booths. Moreover, new technological progress in the domains of mobile communications and satellite navigation made in the recent years paves the way for new applications and the implementation of a real road user charging in the strict sense of a differentiated kilometric pricing. Since only modern electronics and ICT technologies render this form of road user charging possible, RUC is also known as Electronic Toll Charging (ETC) or Electronic Road Pricing (ERP).

Generally speaking one can identify following three explicit or implicit goals of road pricing, which are based on the "user and polluter pay" principle (Niskanen & Nash, 2008):

- to collect revenues for the financing of the maintenance of existing roads or the construction of new roads,
- to reduce traffic and nuisance (externalities such as congestion, pollution of the environment, noise pollution, etc.),
- to promote the traffic efficiency (i.e. the usage of the existing road capacity).

Although there are a number of other applications of RUC, the demand management aspect seems to be the most important one having triggered the rapid development of RUC projects and plans in the last years. The introduction of RUC aims to reduce traffic congestion (especially in the peak hours) and to achieve a more efficient usage of the road infrastructure

- by a better distribution of the traffic over the day and
- by motivating people to make more use of public transport.

Guaranteed mobility and the protection of the environment have apparently become a topical issue for our society, and many western countries are struggling with these issues. RUC is seen by many governments as a promising way to get these issues under control. RUC is more and more regarded as an instrument to reduce congestion, to regulate traffic volume and traffic flow, and to reduce harmful emissions and noise pollution. The implementation of measures like RUC is presumed to improve road access and mobility, but also to contribute to the protection and preservation of our environment (Niskanen & Nash, 2008).

One of the countries, which have a long history of struggling with congestion and environmental issues, are the Netherlands. The Netherlands are very densely populated, especially in the "Randstad" (Praag & Nimwegen, 2006), and suffers since decades from traffic congestion (KiM, 2009), which seriously impacts the economic growth. It has been estimated that congestion and delays in the Netherlands cost between 2.8 and 3.6 billion € per year (KiM, 2009). We have become quite used to the traffic information following the hourly news, where we are informed about the number and length of the daily traffic jams, which can sometimes go into the hundreds of kilometres. As standing still in a traffic jam is rather unproductive, the negative impact of

traffic congestion on our economy is tremendous. In the Netherlands the issue of traffic congestion is further aggravated due to the fact that the typical Dutchman is rather reluctant to change his place of residence, but prefers instead to accept long commuting distances (between work and home). All the governments in the last decades have been and are aware of this burning issue and recognised the need to do something against traffic congestion. The fight against traffic congestion has become a priority for all recent governments. Different initiatives as building new roads, stimulating public transport and making the usage of cars unattractive by increasing the price for fuel and introducing new taxes have been developed to tackle the congestion problem. Whereas these measures provide solutions on the short term, they are insufficient to solve the congestion problem on the long term, considering that the congestion problem most likely will get worse.

For more than twenty years there have been plans to introduce RUC in the Netherlands. The names of the various projects are well known (LogicaCMG, 2005), (Ministerie van Verkeer en Waterstaat, 2009f):

- Rekeningrijden I (1988-1990),
- Spitsvignet (1991-1993),
- Rekeningrijden II (1994-2001),
- Kilometerheffing (2001-2002)

The fact that up to now not much progress has been made with the implementation of an operational system in the Netherlands shows that the introduction of a nationwide RUC system is a very challenging undertaking, obviously due to the complexity of such a system. Many possible reasons for the lack of success up to now can be found, but the most important reasons seem to be

- the maturity level of the needed technology (which has not yet been enough developed or tested),
- the lack of public support and
- the weakness of politics (lack of strong and consistent decision will and power due to change of governments):
    - The principle of a pricing policy was already introduced in the Traffic and Transport Structural Plan (1977-88).
    - Further to the Second Structural Plan (SVV2), there was a new discussion in the late 1980s on introducing a pay-as-you-drive system.
    - Between 1991 and 2001, there appeared to be increasing political support to develop plans for toll plazas, peak vignettes and toll gateways, however support and political will were not strong enough to succeed.
    - The introduction of a charge per kilometre to replace fixed taxes was prepared by the second Kok government, but the project came to a halt with the collapse of the government in 2002. (Ministerie van Verkeer en Waterstaat, 2007a).

In 2006 in "Nota mobiliteit 4" the Dutch government announced new plans for a RUC project based on the recommendation of the platform "Anders Betalen voor Mobiliteit" issued in 2005: the introduction of a price per kilometre differentiated by

- time,
- place,
- environmental characteristics,
- with a proportional elimination of fixed charges.

The clear intention was not to add another extra charge for the road users, but to find another (more fair) way for paying for the actual usage of roads.

Eventually, in 2007 the new government (Balkenende IV) decided to introduce an operational nationwide RUC system and called the project "Anders Betalen voor Mobiliteit" (ABvM, "Different Payment for Mobility"). As a matter of fact, ABvM is part of a package of several measures to improve mobility:

- using in an optimum way the existing road infrastructure to cope with the existing traffic demand,
- building new road infrastructure,
- introducing a pricing scheme.

The objectives of ABvM as laid down in the government's coalition agreement are:

- creating a fairer system, where one has to pay for the use of a car instead of to pay for the ownership of a car,
- improving accessibility and traffic flow by applying peak rates for busy times and places,
- creating a positive effect on the environment.

These objectives shall be achieved with the introduction of the kilometre charge for all cars on all roads. As announced in 2007, the system should be operational for trucks in 2012. In a phased approach the introduction for all other road users was scheduled between 2013 and 2019.

These wide-ranging objectives lead to a complex set of requirements for the Dutch RUC system. To be fair, the RUC system has to be applied as a matter of principle to all road users:

- all road users have to pay for usage (with a minimum of exemptions),
- all roads (national and secondary roads) in the Netherlands have to be charged.

The primary requirement for charging the user is of course to register the travelled distance, but there are other factors which have to be registered in addition. To improve the accessibility and traffic flow some differentiation of the registered information is necessary:

- period of time at which the kilometres were driven,
- place where the kilometres were driven,
- environmental characteristics (emissions and economy) of the car.

The Netherlands are not the first country in the world which introduces a RUC system. During the past years a number of RUC projects have been realised in some cities and countries throughout the world. However, in comparison with the planned Dutch system, all the other systems abroad are less complex. In particular, the charging schemes introduced abroad are less ambitious, since they are

- applied only on a limited part of the road network (e.g. main roads or highways),
- applied only on special vehicle categories (e.g. only Heavy Goods Vehicles (HGV) in Germany and Austria),
- introduced only in a restricted area (e.g. congestion charge in London).

As the Dutch system is intended to be applicable on all roads (ca. 136.000 km) and for (almost) all road users (ca. 8 million users), the system planned for the Netherlands is unprecedented and unique just for its size, but even more for its complexity. An additional difficulty for the implementation of the RUC in the Netherlands is the need "to accommodate the interests of various stakeholders,

including national and local governments, road users, citizens and businesses" (Curacao, 2009).

Not surprisingly, these ambitious top-level requirements have far-reaching consequences for the design of the system, and the technical challenges, but even more the organisational and political challenges, are massive. Elements making RUC projects, and in particular the Dutch RUC system, so complex and difficult to implement are:

- Even if RUC projects are not pure ICT projects, they certainly have a large ICT core. This means that
  - rules for designing and implementing large and complex ICT systems apply,
  - problems known from the implementation of large ICT projects will have to be faced in RUC projects and need to be solved.
- RUC systems do have more than just a technological element. Implementation of a road user charging scheme is not a pure ICT project.
- RUC schemes are "business and societal change programmes implemented by interacting groups of people and machine" (Royal Academy of Engineering, 2006) involving a spectrum of various dimensions.

In general, for RUC systems following dimensions can be identified, which are quite complex on their own:

- Political dimension:
  - Proponents/opponents
  - (Conflicting) interests
  - Window of opportunity
  - New elections
  - Compliance with European directives (e.g. European Electronic Toll Service (EETS))
- Organisational dimension:
  - Public, private or a combination of both
  - Lifecycle (Development, exploitation)
- Technical dimension:
  - Technology:
    - Cameras (ANPR) (Gates)
    - DSRC tags (Gates)
    - GPS (Satellite)
    - Innovative solution
  - Process model (actors):

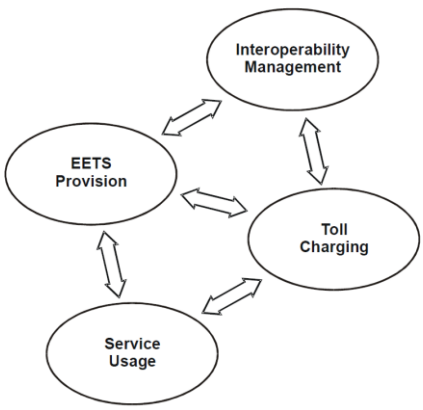


Figure 1.1: CESARE EETS Process model – actors (CESARE III Project, 2006)

- System architecture:

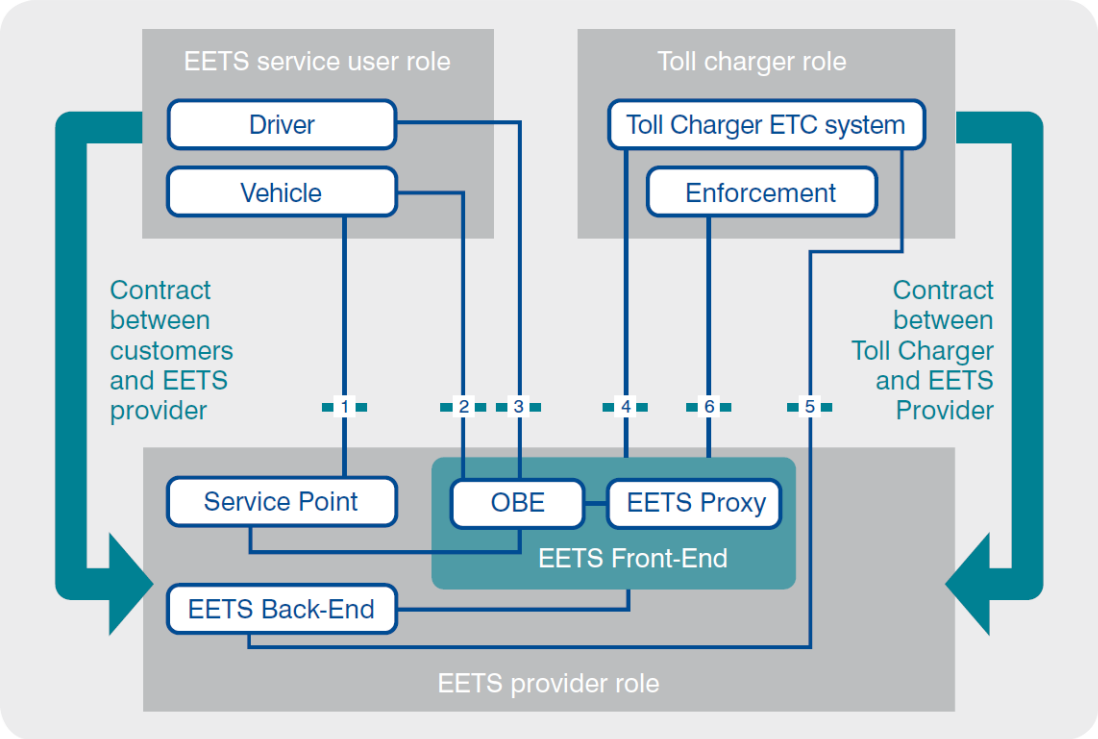


Figure 1.2: High-level EETS architecture for interoperable road charging (RCI, 2008)

- Social dimension:
  - Impact on society
  - Public opinion
  - Public, societal support
- Economic dimension/arena:
  - Cost-benefit
    - User (Public)
    - Toll Charger (Government, Private company)
    - Provider (Government, Private company)
  - Value-added services (VAS)

These dimensions and aspects have been the subject of extensive research. International research projects (already completed or currently running) investigated these aspects, often focussing on one (or a few) of these dimensions and therefore being somewhat unbalanced in their research approach. The real problem is that these dimensions are heavily interrelated, and their interrelationship is not yet completely understood. The dimensions are not independent from each other and are linked, sometimes in a complex way. Further research is needed to get full insight into the complexity of these interrelations. Without a good understanding of the complex relations between the different dimensions it is quite risky to start with the implementation of a large-scale pilot test or of an operational RUC. Although there are some experiences and results from research and tests done in other countries, one can say that in the Netherlands the knowledge of the impact of the RUC system on all dimensions together is rather unexplored and quite some uncertainties exist.

In order to prepare for the implementation of the nationwide RUC system in the Netherlands, first pilot projects (so-called mobility projects) have already been started and will soon deliver first real experiences. These pilot projects, however, are difficult to compare and are not representative for the ABvM, since they are projects on a small scale, at different locations, are differently organised and lack coordination. As these pilot projects will show for the first time in the Netherlands the real effects on the different dimensions and the actual design process, it is expected and hoped that important lessons can be learnt for future road user charging undertakings like the introduction of a nationwide RUC system in the Netherlands.

Due to the enormous time pressure the different planning and development processes of the nationwide Road User Charging system in the Netherlands run mostly in parallel making a strict top-down planning not an easy task (Mr. Heijboer, personal communication, August 3, 2010). With several processes running in parallel, it becomes a difficult management task to keep track of all developments and to maintain a correct up-to-date planning. Running decision, planning and development processes in such a complex project like RUC in parallel leads unavoidably to the inherent danger of delays, cost overruns and non-compliances with the user requirements.

It is therefore important and desirable for a successful introduction of the Dutch nationwide RUC system, but also for the start-up phase of the implementation of nationwide RUC projects in other countries, to understand the many aspects of the implementation process, to identify the various factors determining the success or failure of the implementation of a complex RUC project, and to describe their complex interrelations and dependencies.

The Dutch nationwide RUC system "ABvM" is the first and only large-scale (= nationwide) RUC project in the world, which has already entered the phase of implementation, but it is struggling with difficulties, delays, dilemmas and conflicts. Other countries having plans for the introduction of RUC projects, like Belgium and Denmark, look with high interest on the progress, but also on the difficulties of the Dutch ABvM project (Mr. Arnoldussen, personal communication, August 3, 2010). Above considerations and in particular the recurrent discussions in the various governments as well as in the public causing further delays in the implementation of ABvM are sufficient motivation for further study of this topic and an in-depth discussion and description of the status and features of the ABvM, which is worldwide considered as a reference project for a nationwide RUC project.

In the domain of "system engineering and project management" a commonly used approach for the structured analysis and the description/modelling of complex systems is the development of a theoretical "framework". Such frameworks have already been developed and applied to various scenarios and case studies, e.g. in the ICT domain (Bondavalli, Brancati, Ceccarelli, & Falai, 2009), (Silva, 2009), in the political domain (Miller, 2009) and in the engineering domain (Chiaradonna, Lollini, & Di Giandomenico 2007).

From the experiences gained in relevant RUC projects abroad and in the small-scale RUC projects in the Netherlands the involved factors will be derived, described and then combined in a framework, which can be used to analyse and support the implementation of complex RUC projects in general. The targeted users of this framework are the authorities responsible for the planning and implementation of large-scale RUC projects of the size and complexity of ABvM, and new stakeholders and organisations joining an RUC

project during the implementation phase. With this thesis an attempt is made to contribute to a better understanding of the factors and their complex interdependencies influencing and determining the success of the implementation of large-scale (nationwide) RUC systems.

## *1.2. Research objective*

The objective of this research project is to establish a framework for the analysis of the implementation process of RUC projects, which can be used to visualise in a structured way the factors determining success and failure of the implementation of RUC projects and their complex interrelations.

This framework has been derived from the experiences gained and lessons learnt during the introduction and implementation of RUC systems in countries abroad. Local systems have been successfully implemented in cities like London, Hong Kong, Stockholm and Cambridge (Edinburgh is an example for a system, which was aborted in an early phase of implementation). Nationwide RUC systems, however limited to heavy trucks on highways, have been successfully implemented in Austria, Germany and Switzerland (In the UK the plans were not realised).

In addition, projects in the Netherlands like small-scale projects (e.g. Spitsmijden 1 and Spitsmijden 2 (*Avoiding car usage in the peak hours*)) and mobility projects have been studied in order to learn from the experiences gained and the lessons learnt.

The developed framework can serve as a tool to be used for the analysis of the implementation of RUC projects. In the course of this thesis the implementation process and the status of the Dutch nationwide RUC system ABvM have been studied and as a test of the framework it has been applied to identify and analyse the factors which influence the implementation process of ABvM. This analysis and the related reflections will possibly help to avoid mistakes and errors in the preparation and implementation of a nationwide RUC system in the Netherlands, but also abroad, since the developed framework is based on lessons learnt and practical experiences.

## *1.3. Research questions*

**Main question**

Which factors influencing the implementation of RUC projects can be derived from the positive and negative experiences gained in RUC projects abroad and in small-scale projects in the Netherlands and how can they be translated into a theoretical framework to be used as a tool for the analysis of the implementation of large RUC projects like the Dutch nationwide ABvM project to support an efficient and successful implementation?

**Sub questions**

1. Which are relevant RUC projects abroad (operational, in implementation, aborted) and in the Netherlands?
   - What is the status of RUC projects abroad (past/running/planned)?
   - Which are the characteristics of these systems?
   - What is the status of small-scale RUC projects in the Netherlands (past/running/planned)?
   - Which are the characteristics of these systems?
   - What is the status of the planning and implementation of the nationwide RUC project in the Netherlands?
   - Which are the characteristics of this Dutch nationwide system?

2. Which are the factors identified and experiences learnt regarding the implementation of RUC projects and what are the differences between the projects abroad and in the Netherlands?
- Which are the factors identified and experiences learnt abroad regarding the implementation of RUC?
- Which are the factors identified and experiences learnt from small-scale projects in the Netherlands?
- Which commonalities and differences in the implementation processes of these projects can be identified?
- Are there features, which are specific for projects in the Netherlands requiring special attention?

3. Is it possible to integrate these lessons into a theoretical framework for the analysis of the implementation of RUC projects?
- Are there models and frameworks, which have been used up to now for the analysis of the implementation of RUC systems?
- How can the identified factors and gained experiences be translated (integrated) into a theoretical framework, which can be used for the analysis of the implementation processes of RUC projects and can be used to support its implementation?

4. Is the developed framework suited and fully applicable for the implementation of the nationwide ABvM project in the Netherlands and what is the added value of using this framework?
- What are the benefits, shortcomings and limitations of this framework?
- Considering that this framework has been derived from small-scale projects and projects with limited complexity abroad, can it also be used with benefit for the analysis and implementation of the large-scale nationwide RUC system in the Netherlands?
- Is further research recommended to modify the framework in order to make it better suited for the analysis of the implementation of large-scale nationwide RUC projects, which are rather complex projects?

5. Is it possible to derive relevant observations and recommendations concerning the actual implementation process of the ABvM by applying this framework?

## *1.4. Scope of research*

The focus of this research project is on the *implementation* of RUC, not on the *system* itself (i.e. not on the technical aspects and the organisational design of the system). However, system design and technology elements, which have an influence on the system *implementation*, will be identified and discussed. The focus lies on the framework to be used as tool for the analysis of the implementation process (derived from experiences and lessons learnt from various RUC projects).

## *1.5. Methodology and approach*

By analysing and comparing the implementation approaches of existing RUC projects abroad and in the Netherlands the lessons learnt have been elaborated and a (theoretical) framework for the analysis of the implementation of RUC projects has been developed.

The analysis of the various RUC projects has provided a summary description and comparison of the different projects, already implemented or currently in

the implementation phase. These project cases have been used to identify the key factors determining success and failure of RUC projects.

Based on the theory and examples of frameworks described in the literature, these key factors have been structured in a new framework to visualise the complex interrelations between the various factors.

By studying the recent literature and, even more important, the latest project documentation, the implementation process and the actual status of the Dutch ABvM project have been investigated in depth and detail.

Furthermore, it has been studied and analysed whether and to which extent this generic framework is suitable and applicable to the Dutch nationwide RUC project and whether this framework can be directly applied to derive observations and recommendations for the implementation of the nationwide RUC system in the Netherlands. By doing so, the project case of the ABvM has been used for the evaluation and validation of the developed framework. In order to get also an external validation of the framework by experts in the field, interviews with representatives of the Dutch Ministry of Transport, Public Works and Water Management have been held and their opinion about the applicability of the framework has been reported.

## *1.6. Outline/structure of the thesis*

This thesis consists of eight chapters.

In **Chapter 1** the research context and the background, history and status of RUC projects have been presented. In addition, the motivation for this research project dealing with the implementation of RUC projects in general and with the Dutch ABvM in particular has been elaborated and the research objectives and research questions have been formulated.

**Chapter 2** deals with the description of RUC projects abroad (London, Stockholm, Edinburgh, Austria, Germany) and with the identification and analysis of the key factors determining success or failure of these projects.

The running (small-scale) RUC projects in the Netherlands are dealt with in **Chapter 3**, which provides a description of the characteristics of these projects and gives an overview of their current status. In the second part of this chapter the characteristics of the Dutch (small-scale) RUC projects are compared with those of the RUC projects abroad.

**Chapter 4** is devoted to the central research question of this thesis, namely the detailed discussion of the success/failure factors in RUC projects and the design and description of a framework representing these factors and their interrelations and dependencies.

Another major element of this thesis is **Chapter 5**, which contains in its first part the detailed description of the ABvM and its characteristics, followed in the second part by a detailed presentation and discussion of the implementation process and its actual status including the unclear situation after the fall of the Balkenende-IV government in February 2010.

In **Chapter 6** the framework developed in Chapter 4 will be validated by using it for the analysis of the implementation process of the ABvM. With the help of the framework reflections about the current situation and the risks for its

realisation in the future will be presented. In addition, the issue of the suitability and full applicability of the framework for the ABvM will be addressed including the results of the interviews.

The major elements, findings and final conclusions are summarised in **Chapter 7**, whereas some reflections about this research project are provided in **Chapter 8**.

# 2. Road User Charging projects abroad

## *2.1. Description of Road User Charging projects abroad*

As already mentioned in Chapter 1, the introduction and implementation of RUC with the objectives to improve and guarantee mobility, to generate revenues for building and maintaining road infrastructure and to charge a fair price per driven kilometre based on a socio-economic marginal-cost principle by internalising external effects is of great importance for our society. Therefore it is not at all surprising that in many countries and cities around the world RUC projects have already been realized or are being planned. Whereas a (limited) number of these projects are now operational or are in the implementation phase, many projects have been planned, but have never been started, and other projects have been aborted during the implementation process.

Most, if not all of these projects, have been initiated to find an operational solution for a very burning traffic congestion problem in a specific area (none of these projects have been realised as test cases for larger-scale projects). This explains why many of these projects are local projects, only applied in a city area like in London, Singapore and Stockholm. Since the implementation of a European standard like EETS takes too long due to the high level of sophistication, it is a specific feature of these local projects that local governments chose for a quick but less sophisticated interim solution to solve their burning congestion problems (Schelin, 2008). Other projects have been implemented to charge specific user groups like heavy trucks (Germany, Sweden), or all cars using specific roads (highways) or road sections, like tunnels, bridges, alpine transit routes (Austria, Switzerland).

The concepts and technical solutions differ, whether the projects address urban or inter-urban traffic. The charging principles, which are being applied, and therefore the technologies used range from a simple tolling system (Brenner highway in Austria, highways in Italy and France) to a vignette-based system (Austria, Switzerland) up to automated vehicle identification by cameras (London) and identification and control systems based on radiofrequency tags (Austria, Czech Republic) and the more complex GPS technology (Germany) (Niskanen & Nash, 2008), (Nash, Menaz, & Matthews, 2008).

As just said above, all these existing RUC systems are of limited size and/or scope. As a matter of fact there exist up to now no nationwide RUC systems covering all roads and all users in a country, although the governments in a number of countries have concrete plans to introduce nationwide RUC systems in the near future (Netherlands, Denmark, Slovakia, Belgium).

The most advanced plans concerning the introduction of an operational RUC system are certainly those of the Dutch government, which had the ambitious goal to start with the roll-out of the system in 2012 aiming for a complete operational system by 2019 (planning status of 3$^{rd}$ quarter 2009). With the fall of the government in February 2010 these ambitious plans were put on hold. Considering the fact that the first plans for such a RUC system in Holland date back to the sixties of last century, but in 2009 the tendering process has just been started, one has to conclude that the actual implementation schedule was extremely aggressive, if not to say unrealistic. Further delays or, if it comes to the worst, a complete cancellation of the plans have to be avoided by all

means, considering the huge investment needed to prepare and install such a nationwide RUC system and the negative effect on the reputation of the government and the stakeholders. Since Holland will most likely be the first country introducing a nationwide operational system, other countries (e.g. Denmark and Belgium) are now watching Holland and wait with the implementation of their systems to learn from the experiences in Holland.

Whereas Chapter 5 will deal with the Dutch ABvM in more detail and discuss the history, status and the reasons for the delays, in this chapter we will first describe the characteristics of the most relevant RUC projects abroad (Section 2.1), before we analyse these existing RUC projects and try to identify those factors which determine the success or failure of a RUC project (Section 2.2). Having identified and discussed these factors and having also studied and analysed the pilot projects in the Netherlands, a framework will then be established in Chapter 4, which can be used as a tool for the analysis of the implementation of a RUC systems.

Without going beyond the scope of this thesis it would not be possible to discuss and analyse all existing or planned (and then aborted) RUC projects (KTA, 2008), (Rye & Ison, 2008). Therefore a selection of projects has been made, which are considered of valuable relevance and significance for the implementation of the Dutch system. Following RUC projects have been selected and their context, status and results will be presented in the following. Each project has some specific characteristics which are considered relevant for the Dutch case:

- London
  - Local, well prepared, successfully implemented, good experiences/lessons learned
- Stockholm
  - Local, successful trial, referendum, operational system after referendum
- Edinburgh
  - Thorough preparation, situation comparable to London, however plans cancelled after referendum
- Austria
  - "nationwide" system, however only for trucks on highways,
  - quick implementation process
- Germany
  - Successfully implemented "nationwide" system (only for HGV on highways and selected main roads),
  - based on satellite technology (as planned for Dutch system),
  - difficult implementation process with serious delays.

The description of these selected examples will give a good overview of the characteristics of RUC systems.

**London** (Transport for London, 2007), (Rye & Ison, 2008), (KTA, 2008):

**Context/background**

Priorities of Mayor of London, Mr. Livingston, concerning transport were:

- Reduction of congestion,
- Improvement of bus services,
- Improvement of travel time reliability for car users,
- Increase of the efficiency of the distribution of goods and services.

The implementation of these priorities lead to the introduction of the "congestion charge".

Strong leadership of Livingston and a dedicated team were crucial for the introduction of the scheme, as numerous barriers had to be overcome. The most important barrier was the opposition of local authorities and retailers. Moreover, the "fear of the unknown" was perpetuated by the media who considered the idea flawed. National political support, a clear objective of Mr. Livingston before his election, and an extensive public information campaign were factors, which enabled the introduction of the congestion charge.
The revenues are used to improve public transport (for the most part spent on improving bus services), which was also important for the good public acceptance.
Although there were a lot of uncertainties in the beginning, the risks were taken and the achieved results can be judged positive.

**Technology**
Automatic Number Plate Recognition (ANPR) (and a trial of "tag and beacon"), labour intensive, therefore expensive in operation.

**Features**
- Started in February 2003 (20 square miles),
- Extended in February 2007 (additional 22 square miles),
- A daily charge (£5 in 2003, £8 as of 2007) has to be paid in advance (e.g. via the internet, by telephone, etc.), when entering the charging zone.
- Enforcement by cameras (entry/exit and mobile), high penalty (£120).

**Status**
Already discussed since 40 years (KTA, 2008).
After introduction, the new mayor Mr. Johnson (elected in 2008) stopped plans for the extension of the system to base the charges on car emission. He also promised to review and to reconsider the area extension to the West. A consultation of the public (2008) resulted in a vote against the "western extension". Although it was promised to withdraw the plans for the "western extension", it is in 2010 still in place. Bus fares also increased since 2008.

**Results** (Lee, 2008)
- reduction of congestion,
- bus service performance improved,
- use of public transport increased.

**Stockholm** (Rye & Ison, 2008), (KTA, 2008):

**Context/background**
Specific characteristics of the infrastructure network (e.g. many islands and bridges) and dense traffic (traffic into and out of inner city of Stockholm) asked for an urgent solution and favoured the introduction of a RUC scheme. Although Stockholm's mayor was not a supporter of RUC (he had promised not to implement RUC), a change in the national government lead to a trial project (initiative of the Green Party).

In addition, positive results from London stimulated the political support.

In the beginning the public acceptance was low. During the trial period, the positive effects, which were felt and recognized by the public, lead to a change in the public acceptability. The referendum held after the trial period showed a majority of supporters. It was part of the chosen political strategy to have a trial followed by a referendum in combination with an extensive communication campaign (e.g. direct communication).

**Technology**
- ANPR
- Dedicated Short-Range Communication (DSRC) (trial)

**Features**
Full-scale trials (January 2006 to July 2006) to test, whether efficiency can be improved:
- Reduction of traffic volume,
- Improvement of traffic,
- Reduction of emissions,
- Improvement of urban environment,
- More resources for public transport.

Toll ring: Tax, which depends on the congestion level, is levied when entering or leaving zone.

**Status**
Already discussed since 20 years (KTA, 2008).
After the positive referendum the trial system was - with a few changes - reinstalled in 2007 as operational system.

**Results**
The trial showed a traffic reduction of 22% (City of Stockholm, 2006). However, nowadays, in the operational system, this positive effect is slightly reduced. Traffic delays and emissions were also reduced. Time differentiating measures were not as effective as expected. The use of public transport increased (thanks to earmarking of revenues) (KTA, 2008).

**Edinburgh** (Rye & Ison, 2008), (Rye, Gaunt, & Ison, 2008):

**Context/background**
- Economic growth led to an increase of population and therefore to an increase of the traffic. The local transport strategy identified RUC as part of a solution for (future) traffic problems.
- The national legislation and transport strategies supported Edinburgh's congestion charging plans.
- Two stage decision-making process.

**Technology**
ANPR

**Features**
- Cordon within the inner city,
- Revenues to be used to improve public transport.

**Status**
Referendum was held before the planned introduction; about 75% of the citizens rejected the proposal.

**Results**
Although the efforts in the process of introducing RUC were extensive and many challenges and barriers were overcome, the proposal was stopped by a referendum, which itself had not even a legal status. As a consequence the local government decided not to further pursue the project. The local authorities had little experience with conducting a referendum.

**Austria** (Schelin, 2008):

**Context/background**
Insufficient funds for infrastructure projects were the motivation for the introduction of RUC.

**Technology**
- Off-the-shelf technology,
- DSRC (ANPR for enforcement),
- Gantries.

**Features**
- Applied on all highways,
- Obligatory only for Heavy Good Vehicles (HGV), i.e. all vehicles with a gross weight of more than 3.5 tonnes.

**Status**
Operational since January 2004 (implementation on time without delays).

**Results**
- High user acceptance,
- good revenues,
- but problems with local traffic diversion to untolled roads.

(Nash et al., 2008)

**Germany**:

**Context/background**
Objectives (Schelin, 2008):
- Generate revenues for (insufficiently funded) infrastructure,
- Introduce fairness by a usage-related cost/payment system,
- Shift freight transport from road to rail and waterways,
- Strengthen German industry (by becoming technology and market leader for road pricing systems).

**Technology**
- Pioneering technology,
- GPS and GSM (ANPR/infrared for enforcement).

**Features**

- Applied on all highways and some selected main roads,
- Only for HGV with total weight of more than 12 tonnes.

**Status**

Introduced in January 2005 (project suffered several severe delays).

**Results**

- Revenues in line with expectations (foreign trucks contributed with 35% to the travelled kilometres),
- Considerable higher average load,
- However, no significant shift in transport,
- Estimation that 5% of HGV traffic diverts to minor roads to avoid charges,
- Increase of number of more environment-friendly trucks.

(Nash et al., 2008)

## *2.2. Identification and analysis of factors determining success or failure*

Having described the characteristics, features, status and results of the five selected projects, in the second part of this chapter we take a critical look at each project case and identify - based on reviews in the literature - the reasons for success or failure for each project. The fact that these existing RUC projects have so different characteristics and features makes their comparison and analysis a quite challenging undertaking, which – not surprisingly – became the subject of a lot of research projects. As a consequence of this extensive research there exists a wide range of research articles and research reports, which have been reviewed and consulted to extract experiences gained, lessons learnt and recommendations. However, since the various authors had their own intentions and expectations and therefore looked at the RUC projects from somewhat different angles, the list of collected parameters is quite long and it takes some effort to identify and isolate those factors which can be considered as the key factors determining success or failure.

**London**

- **Political champion**, political sensitivity, political will, political commitment (KTA, 2008).
  Mayor Livingston (and his team) managed to get the scheme accepted in only 2 years. Although the process was highly intense, complex and demanding, rapid progress was made through the various project phases without delays (whereas delays are usually rather common in such projects) (Lee, 2008).
- **Strong management, timing and rapidity**
  Timing and rapidity were crucial for overcoming political hurdles (Lee, 2008).
  Choosing a simple system (low-technology system and flat charges) supported the fast implementation process.
- **Communication**
  Lee (2008) concludes that London's successful implementation partly depended on strong and efficient communications. This was achieved by integrating the communication team closely with the project management team (Ison & Rye, 2005). The clarity of objectives combined with a strong communication team led to an effective campaign, which guaranteed a high level of clarity.
- **Public consultation**
  Extensive consultation of the public in several "rounds". These consultations were used as input for further establishment and elaboration of the strategy and plans (well exercised participatory planning) (Lee, 2008). In this way the public consultation contributed highly to the general acceptance of the Road User Charging concept (KTA, 2008).
- **Clear objectives and consistency**
  Congestion charging as part of an overall transport strategy (consistent with long-term strategy) contributed to acceptance (Lee, 2008). Important was to clearly differentiate (and not to mix) the objectives: reduce congestion (and thereby reduce other negative externalities) and improve public transport.
- **Use of revenues (earmarking)** (Ison & Rye, 2005)
  In London revenues are used for improving the public transport (Lee, 2008). A large part of the commuters, who daily use public transport,

took advantage of this measure. Even if it was tempting and probably attractive to Mr. Livingstone, he did not use the revenues for simply raising funds for the general budget (Richards, 2008).

- **Implementation agency, project organisation**
  A single implementing agency had full responsibility (Lee, 2008), (Bendixson, 2008).

**Stockholm**

- **Political champion/Political commitment**
  The Swedish Green (environmental) Party in the national parliament was very committed to the RUC project (Rye & Ison, 2008). When this party came to power, this commitment was one of the main factors, which contributed to the successful implementation of the RUC project. The required legislation was passed within two years (KTA, 2008).
- **Problem of congestion**
  The strong political commitment was fostered by the congestion problem, which was seen as a big and serious issue.
- **Clear objective**
  The objective, which was to reduce traffic congestion (and thereby improve environmental aspects), was clear in itself. The objective of raising funds was not really seen as an option, as the (considerable) investments for the implementation, including the national funding (see resources), had to be paid back (Rye & Ison, 2008).
- **Logical consistency**
  The scheme design was aimed at the reduction of traffic, especially in peak hours, and thereby clearly contributing to achieve the objective of reducing congestion.
- **Resources**
  Resources had been made available by the state to fund the scheme. These revenues had to be paid back to the state (Rye & Ison, 2008).
- **Implementation agency/management of implementation process**
  A single implementation agency and a clearly planned implementation process, which did not involve a large number of different actors, contributed to a continuous and smooth process.
- **Communication**
  Communication was experienced as extremely comprehensive in every phase of the implementation process (Rye & Ison, 2008).
- **Public Consultation**
  The idea of a trial, to be followed by a referendum, contributed to remove initial barriers, as the scheme was not seen directly as the permanent RUC scheme (Rye & Ison, 2008). The promised and expected public involvement led to a high acceptance already at an early stage. Public consultation played also an important role besides the referendum (KTA, 2008).
- **Success in London** stimulated the political commitment and will, and triggered the actual implementation of the RUC trial (Rye & Ison, 2008).

Despite of a change of government (leading to political instability, which is often a reason for aborting a running or planned project) the decision was taken to continue the RUC scheme on a permanent basis (Rye & Ison, 2008).

**Edinburgh**

**Congestion** was recognised in Edinburgh as a serious problem (Rye & Ison, 2008). There were, however, too many issues and problems, which prohibited a successful implementation of RUC, which should have mitigated the traffic problem.

During the implementation process **extensive consultations** were undertaken to identify and list these issues. Although some issues came up, which could not be solved e.g. improvement of bus services prior to implementation of RUC, and revenue neutrality (Rye et al., 2008), the public was involved in the process.

Despite all the efforts the **referendum** showed that the majority of the public did not support the proposed RUC scheme. The most important reasons are listed below.

**Negative effects which are reasons for the failure of the proposed RUC project:**

- **Lack of political champion** (Rye et al., 2008)
  In addition to the lack of a clear political champion, there were even two levels of government responsible for the scheme approval. This complex political constellation had effects on the project management and the establishment of the proposed scheme. With one implementation agency (however a relative small team), but two approving bodies, neither of these had control of bus services and power to improve them.
- **Disagreement on objectives** (Rye et al., 2008)
  The lack of a political champion was a reason that the disagreement on objectives eventually led to a lack of clear objectives and doubts whether these objectives would be achievable (Rye & Ison, 2008).
- **Scheme was complex**
  Among other things, the lack of clarity about the objectives was a major reason for the complexity of the proposed scheme. There were some major flaws in the political package. Uncertainties about the scheme and its effects were not resolved (Rye & Ison, 2008). The complexity is illustrated by the public misunderstanding of how this scheme was intended to function. There were also unresolved issues of fairness (KTA, 2008). The complexity was also intensified by insufficient resources for a proper preparation of the scheme and by the lack of a clear definition of the spending plans (Rye et al., 2008).
- **Negative press**
  The complexity of the scheme gave more reasons for disagreement and objections, which resulted in a strong negative press coverage (Rye et al., 2008). The reaction on the negative press was mainly to introduce more consultation. Good communication, like a strong promotion of the scheme, was very limited.
- **(Decision for) Referendum**
  The referendum resulted in a negative vote; specific factors (besides the factors already mentioned) responsible for the failure of the referendum were:
  - Timing of the referendum, since the public support was very low at that moment. The referendum was not held after a successful trial (contrary to what was done successfully in Stockholm).
  - Legal issues of the referendum (which resulted in only limited public funds for public campaign).

  - It was not clear whether the vote was against RUC in general, against the proposed charging scheme or against the local government (for various reasons, like economic downturn).
  - The proposed RUC project became a political issue, since politicians worried about the possible impact on the forthcoming elections.
- **Not enough benefits**
  There were only small improvements of the public transport planned and comparatively only few people would have benefited (Rye et al., 2008). The proposed earmarking was moreover considered insufficient and inefficient, as there were not enough public transport projects to be improved (De Palma, Lindsey, & Proost, 2007).

**Austria**
Fast implementation process, implementation on time without delays.

- **Clear objectives**
  The rationale behind the RUC project was clear. There were insufficient funds available for the realisation of the (expensive) infrastructure projects in Austria. Furthermore, the number of foreign cars and the amount of kilometres driven by those cars was relatively high.
  Two clear objectives, which contributed to the fast implementation:
  - Finance the motorways (earmarking)
  - Distribute costs more fairly according to actual usage (including charging foreign truckers)
- **Technology**
  Simple "off-the-shelf" (and therefore well-known and low-risk technology) was used for the RUC system. The clear-cut objectives and uncomplicated technology provided a basis for the fast and unproblematic implementation process, which took only 3 years, including 1.5 years of construction (Schelin, 2008). Furthermore, user acceptance benefited from a very user-friendly system (Nash et al., 2008) which was made possible by the simple technology.
  The low cost of OBUs was also a positive element of the chosen, simple technology. Due to the low-cost OBUs even occasional users (e.g. foreign truckers) can be obliged to buy and install such a mandatory OBU, which avoids setting up a specific technical solution for occasional users.
- **Acceptance**
  Due to the limited scope and the clear objectives the system is straightforward and was therefore easily accepted by the public. Fairness played also an important role for the high public acceptance, since the costs were distributed more honestly and fair, as the user pays for the driven kilometres, which was not the case before the introduction of RUC, when the international transit traffic crossed Austria without paying a fair price for the infrastructure.
- **Occasional users**
  As already mentioned, occasional users can easily buy and use a low-cost and "easy-to-install" OBU. Therefore the occasional user was not an issue which had to be resolved by a specific technical solution.

**Germany**
Severe delays (technical and design problems, also installation difficulties) (Schelin, 2008).

- **Clear objectives**
  Although there were many objectives, the main goals were clearly defined: generate revenues and provide a scheme, which is fairer than the existing scheme. The other objectives were not ambiguous, and therefore had no negative effect on the clarity.
- **Fairness**
  Foreign trucks could drive through Germany without refuelling and therefore could avoid paying fuel tax (De Palma et al., 2007). The ability to make the foreigners pay for the actual usage of the infrastructure by RUC was seen as fair and contributed to the acceptance of the system. The desire to ensure a maximum level of fairness was the main driver to pursue the selected scheme and to master the difficulties of the implementation process (see tendering).
- **Earmarking**
  The generated revenues are used for infrastructure and other traffic related costs/investments (Schelin, 2008). Earmarking contributed to the acceptance, since the users have to pay for their actual use of the infrastructure and its maintenance.
- **Technology (tendering)**
  Technical complexity was one of the elements which contributed to the difficult tendering/procurement process. This process was that difficult that the project was eventually almost cancelled. After extremely long lasting negotiations between the government and private parties the problems were solved. However, the exact financial deals were not made public.

**Summary of the review and analysis of the reference projects:**
From the critical review and analysis of the five reference projects following factors have been identified, which played a decisive (positive or negative) role for the implementation of the studied RUC projects (These factors are listed in arbitrary order):

- Political champion - London, Stockholm, Edinburgh
- Strong management, timing and rapidity - London, Edinburgh
- Communication - London, Stockholm, Edinburgh
- Clarity/clear objectives and logical consistency - London, Stockholm, Edinburgh, Austria, Germany
- Use of revenues (earmarking) - London, Stockholm, Edinburgh, Austria, Germany
- Implementation agency - London, Stockholm, (Edinburgh)
- Resources - Stockholm, Edinburgh
- Complexity of scheme - Edinburgh, Germany, Austria
- Public transport
- Technology - Austria, Germany
- Fairness - Germany, Austria
- Occasional users - Austria
- Severity of problem of congestion - Stockholm, Edinburgh
- Public Consultation - Stockholm, Edinburgh (referendum)
- Success in London (successful reference project) - Stockholm

From the discussions of the factors found for each project it is already obvious that these factors are not completely isolated, but that many of them are interrelated. Some of them even seem to be interlinked via strong interconnections in a way that striving for optimisation of one factor necessarily

leads to a conflict with another factor. In Chapter 4 we will complement the list of factors with findings from literature surveys of other projects and we will discuss these factors in detail and analyse their interrelations. In the second part of Chapter 4 the complex interrelations between the various factors will be structured and visualized in a framework.

# 3. Road User Charging projects in the Netherlands

## *3.1. Description, characteristics and status of Road User Charging projects in the Netherlands*

In the previous chapter we have presented several RUC projects abroad and discussed the factors playing a role for success or failure of these projects. Now we will take a look at the RUC projects in the Netherlands.

In the Netherlands there are no operational RUC projects yet, not even on city or regional level. Only a number of small-scale pilot projects are currently running or are in the implementation phase, a few more are planned, and two - very small - pilot projects have recently been completed.

In this chapter all up to now existing Dutch RUC pilot projects will be presented, their status will be reported and their characteristics and features will be discussed. After having presented the projects we will identify the commonalities and differences between the various Dutch projects, but we will also compare them with the RUC projects abroad.
An issue to be investigated is also the question in how far these Dutch pilot projects are sufficiently representative for the planned full-scale operational RUC system. Full representativity is a fundamental requirement to be able to apply upscaling to estimate correctly the implementation issues of an operational ABvM.

Before starting with the presentation of the pilot projects a clarification of the terminology "Mobility Project (MP)" is needed: In 2007 the Dutch Ministry of Transport, Public Works and Water Management introduced an initiative to solve the problems related to mobility and traffic congestion. A considerable budget was reserved for the regional entities to find solutions to improve already now (before ABvM becomes operational) "mobility" in the most congested areas, in cooperation with local authorities.

These projects are called "mobility projects", and, amongst other ideas like flexible working times etc., an important element are "RUC pilot projects". Participants of mobility projects are often local authorities and large companies, who solicit the users/participants of these RUC projects. However, before these "mobility projects" were introduced by the ministry, already two forerunner RUC projects (Spitsmijden 1 and 2) had been launched, which – strictly speaking – do not belong to the "mobility projects".

In general, the objectives of these pilot projects are

- to gain a first experience in real-life testing with human behaviour and with the involved technology,
- to get feedback from the users and
- to make the users and the public aware of the idea of RUC.

Of course there remains the question, whether user behaviour and acceptance can be influenced – in time - by these measures.

It is important to understand that these pilot projects are not intended to be a proof for the ABvM. The real test case for the ABvM is a large-scale pilot project which is already in the planning with the clear objective to prove that the technology is mature and ready for an operational system and that the system interfaces are working properly. This large-scale RUC project is called

the "Large practical test" ("Grote praktijk test"). Since it is part of the preparatory phase of the ABvM, it will be described and discussed in Chapter 5.

In the following the **RUC projects in the Netherlands** are presented, sorted by region:

***Metropoolregio Amsterdam* (Amsterdam Metropolitan Area): "*proef betaald rijden* (trial for paid driving)"**
**Contracting entity**: Municipality of Amsterdam
**Goals**: Contributing to improving the accessibility of the Amsterdam region (general goal for mobility projects to reduce traffic, no explicit goal for RUC projects, contribute to other measures).
**Users**: 1.000 (at start) to 10.000 (upgraded in stages), on voluntary basis, commuters in Amsterdam region.
**Location**: everywhere in the Netherlands, but focus on Amsterdam (e.g. rush hour surcharge, participants).
**Schedule**: tender/offer accepted October 2009, scheduled start beginning of 2010 (status February: search for volunteers).
**Technology**: GPS (thin OBU)
**Characteristics of system**: pay for every kilometre driven in the whole country on weekdays, major roads to and from Amsterdam are subject to a rush hour surcharge:

- 80-160 € per month per user
- Rate 6.5 cent per kilometre
- Rush hour surcharge 2, 4, 6 or 8 cents per kilometre from 7:00 to 9:00 and 16:00 to 19:00

**Complexity**: high

Comparable to planned Dutch national RUC project (ABvM):

- Design of the system (in a very simplified way),
- Technology,
- All roads subject to toll charge.

However there are differences due to the reduced complexity as compared to the national system:

- Volunteers (privacy is not a concern, only those road users participate who see a benefit),
- Actual error rate is not of primary concern,
- Fraud is not an issue (volunteers, no penalties, no effort in system design to detect fraud),
- Operating company does not get a target for revenues, which in GPS-based systems can be used to control the private operator.

As in the interview with Mr. Troost-Oppelaar from Municipality of Amsterdam (Mr. Troost-Oppelaar, personal communication, July 2, 2009) became clear, most of the complexities (described later in chapter 4) of RUC systems did not play a role. Due to the limited number of users the effect on the actual road traffic is expected to be very marginal. Therefore no additional supporting measures (like additional parking space, additional public transport) are in preparation. The growth of the system from 1.000 to 10.000 users in a short time is not seen as a problem.

***Stadsregio* (conurbation) Arnhem - Nijmegen (2 pilots): *Slim Prijzen* (smart pricing)**

***Slim prijzen* 1**
**Contracting entity:** "*Stadsregio* Arnhem - Nijmegen"
**Goals**: to reduce the rush-hour traffic congestion at the bridge over the Waal (Waalbridge) during the reconstruction of the roads N325/Prins Mauritssingel
**Number of users:** 6.600 volunteers (initially planned 2.500 users)
**Location**: Waalbridge Nijmegen
**Schedule**: operation September 2009 - June 2010
**Technology**: ANPR
**Characteristics of system:**
Volunteers registered to avoid morning and evening rush hour. The participants receive a fixed (fictive) amount as a credit. When they drive into the city during the morning or evening rush hours, a certain amount will be deducted from the credit. After the end of the study the remaining amount is transferred to the participants.
**Complexity:** low
**Result**: 8-10 % traffic reduction during rush hours on the Waalbridge.

***Slim prijzen* 2**
**Contracting entity:** "*Stadsregio* Arnhem - Nijmegen"
**Goals**: reduction of 3% at the regional ring
**Number of users:** 10.000, on voluntary basis
**Location**: Regional ring Arnhem-Nijmegen
**Schedule**: start of tendering in November 2009
**Technology**: GPS/GSM
**Characteristics of system:** pay per kilometre, extra price for passing bridges and strategic points to reduce number of users, who try to avoid the charge.
**Complexity:** high

***Stadsregio* Eindhoven - 's Hertogenbosch (1 pilot)**
**Contracting entity:** province of Noord-Brabant and the cooperation of the region of Eindhoven.
**Goals**: not yet known
**Number of users:** 3.000, on voluntary basis
**Schedule**: tender awarded December 2009, scheduled start 1st half of 2010.
**Technology**: GPS
**Characteristics of system:** Users pay per kilometre in a certain area. Also focus on Value Added Services (VAS).
**Complexity:** medium

**Haaglanden (3 pilots)**

***Spitsmijden* 1 (*avoidance of rush hours*)**
**Contracting entity**: PPP (e.g. Diverse Universities, RDW, Rabobank, Transumo)
**Goals**: scientific trial in close cooperation with universities
**Number of users**: 340, on voluntary basis
**Schedule**: October 2006 – December 2006
**Location**: A12 (Zoetermeer - Den Haag)
**Technology**: DSRC (single-lane beacons were placed adjacent to the road instead of overhead. Installation adjacent to the road puts higher demands on

the tuning (aiming) of the beacon, which reduces the likelihood of good functioning (Consortium Spitsmijden, 2007).
**Characteristics of system:** A selected group of frequent drivers (340) were rewarded, if they didn't drive in morning traffic over the stretch of the Dutch A12 motorway from Zoetermeer towards The Hague.
**Complexity:** low

***Spitsmijden* 2**
**Contracting entity**: PPP (e.g. Diverse Universities, RDW, Rabobank, Transumo)
**Goals**: scientific trial in close cooperation with universities
**Number of users:** 799, on voluntary basis
**Schedule:** September 2008 - July 2009
**Technology**: ANPR (771 users) and GPS (28 users)
**Characteristics of system**: Participants who avoided the peak period in the morning on the A12 (between Gouda and The Hague) were able to earn a reward of € 4 per zone (total of 2 zones).
**Complexity:** low

***Prijsprikkels door bedrijven voor de bereikbaarheid van Haaglanden* (price incentives by companies for accessibility in Haaglanden)**
**Contracting entity**: District Haaglanden
**Goals**: To have a real and longer lasting (permanent) effect on the behaviour of employees as well as of employers to improve accessibility in the Haaglanden region.
**Number of users**: Not yet known
**Schedule**: tender evaluation first half of 2010; Start of operation end of 2010.
**Location**: Economical center of Haaglanden
**Technology**: GPS
**Characteristics of system:** Originally same system design as in Amsterdam was planned, however, GPS system was simplified. Only the duration of presence in the region (i.e. economical center of Haaglanden) and the time of entrance and exit will be registered (and not the actually travelled distance).
**Complexity:** medium

**Rotterdam (2 pilots)**

***Spitsmijden* A15**
**Contracting entity**: PPP (Conurbation Rotterdam, Port of Rotterdam Authority)
**Goals**: reduction of rush hour traffic by 530 vehicles
**Number of users:** 2.000, on voluntary basis
**Schedule**: October 2009 - 2012
**Location**: A15
**Technology**: GPS (smartphone)
**Characteristics of system**: Users receive a monthly fixed amount (credit), which is reduced, whenever the participants drive on the A15 during the morning or evening rush hour. The planning and timing of the pilot project is linked to the maintenance works on the A15, and the project is intended to improve traffic flow.
**Complexity**: medium

**RITS**
**Contracting entity**: PPP (Conurbation Rotterdam, Port of Rotterdam Authority)

**Goals**: To investigate the options to integrate a travel time function into existing route planning systems.
**Number of users**: Not yet known
**Participants**: Port of Rotterdam Authority
**Location:** Rotterdam
**Schedule**: Start February 2010
**Technology**: Not yet known
**Characteristics of system**: VAS (Value added service) project
**Complexity** Not yet known

**Utrecht (3 pilots)**

***Filemijden* A2 (avoidance of traffic jams)**
**Contracting entity**: "*Utrecht Bereikbaar*" (Utrecht Accessible)
**Goals**: reduction of rush hour traffic by 1.000 vehicles on the A2 and in the city.
**Number of users**: 3.000 - 5.000, on voluntary basis.
**Schedule**: December 2009 to March 2010
**Location**: A2
**Technology**: ANPR
**Characteristics of system**: reward (€ 4) for every time the peak period is avoided
**Complexity:** low

**Utrecht East (SUDOKU)**
**Contracting entity**: Province of Utrecht
**Goals**: reduce traffic in the region of Utrecht
**Number of users**: 7.000
**Schedule**: Start of tendering 2010; Start of operation end of 2010.
**Location**: A1/A27/A28 triangle (Rijnsweerd/Eemnes/Hoevelaken)
**Technology**: GPS
**Characteristics of system**: Reward for avoiding peak hours (Personal mobility budget)
**Complexity:** high

**Galecoppenbridge A12**
**Contracting entity**: Not yet known
**Goals:** Not yet known
**Number of users**: Not yet known
**Schedule**: Start 2010/2011
**Location**: Galecoppenbridge
**Technology**: Not yet known
**Characteristics of system**: Not yet known
**Complexity:** Not yet known

**Characteristics of these pilot projects:**
There are no large-scale projects in the Netherlands (largest user group is Amsterdam, which starts with 1.000 users; expansion to 10.000 users is planned). As the existing small-scale projects are part of mobility projects, they are seen as pilot projects to test various aspects of RUC.

There are no operational RUC systems in the Netherlands, since the pilot projects cannot be considered as fully operational systems (in the strict sense). Amsterdam, however, had planned to install an operational system, as the

increase of traffic led to more and more problems. The Ministry of Transport, Public Works and Water Management, however, put these plans on hold, when new initiatives for a national system were taken. The Ministry considered the existence of operational systems, which would have to be harmonised with the nationwide system, as an additional problem adding further complexity to the introduction of a nationwide RUC system. As compensation, Amsterdam was allowed to start with a RUC pilot, as part of the mobility projects, which will have very similar characteristics as the planned nationwide system.

**Complexity**:

- Participation is on voluntary basis (only those road users take part, who see a personal benefit). The participating group is not a random sample of the population, therefore these projects are not representative for a nationwide system and simple upscaling is therefore not possible.
- Low number of users.
- Complexity is reduced on purpose, or a-priori not of concern.

**Monitoring**:

- Pilot projects are set up and monitored extensively to comply with directives of the Ministry of Transport, Public Works and Water Management.

The direct link between the pilot projects and the planned ABvM is getting weaker due to the delay of the start of ABvM and the scheduled end of the mobility projects in 2011. Today it is not yet clear what will happen to these mobility projects, since the allocated budget would not allow a continuation. A positive effect of the delay of ABvM, however, is the increased probability that the experiences gained in these pilot projects can be taken into account for the implementation of the ABvM.

## *3.2. Comparison with Road User Charging projects abroad*

Due to the fact that pilot projects are part of larger mobility projects their characteristics, as listed below, differ considerably from projects abroad, since many core issues of the projects abroad do not play an important role in the Dutch pilot projects.

**Acceptability:** As the users of the systems are volunteers, the acceptability is no issue for the mobility projects.

**Use of revenues:** mobility projects cost money, no revenues are generated.

**Resources:** Ministry of Transport, Public Works and Water Management provides funding for most projects.

**Political champion/leadership:** as RUC projects are part of larger and wider-in-scope mobility projects, the political leadership is not focussed on just the RUC projects. Moreover, as already mentioned, these projects are financially supported by the Ministry of Transport, Public Works and Water Management.
Leadership is needed to find agreement between public authorities and private companies to achieve the objectives of the mobility projects and to reduce traffic congestion.

**Perception of problem:** the traffic problems in a specific region are a strong motivation for the selection of the location of pilot projects and for the companies to participate in mobility projects and RUC projects in their region. The daily traffic jams in the Netherlands in general can be perceived as the driving problem for the Ministry to provide financial means for the projects. For the direct user, who participates on a voluntary basis, the existence of the traffic congestion is not a driving motivation for participation and therefore not of the same relevance as for the users in projects abroad. The participants in mobility projects are mainly motivated by the financial benefits.

**Consistency of policy:** RUC projects are part of a wider range of measures to improve mobility. They are seen as measures to reduce traffic during the preparation phase of a nationwide system.

**Communication:** Clear and extensive communication; a lot of positive communication and media presence.

**Timing:** No particular timing issues, as these projects are implemented in preparation of the nationwide system. Delays in the preparation and start of these projects are not seen as a serious problem, as the nationwide system is also delayed.

**General transferability:** In principle the transferability between the pilot projects is given, since there are no major differences between the various regions. The transferability with respect to the nationwide system is limited. One of the major differences is the concept of positive financial incentives ("prijsprikkels") for the participants in pilot projects.

**Benefits:** volunteering participants (receiving financial benefits) will make less use of their cars, but the effect on the reduction of the total traffic volume is marginal.

**Legislation:** participants in some pilot projects were compensated for their fixed car taxes, which was seen by the fiscal services as extra income. New legislation was not introduced, however existing rules had to be adapted.

**Organisation of project management:** Knowledge of provinces and municipalities about RUC projects is limited. Often the same private external consulting companies were hired and played a dominant role.

**Efficiency:** No real trade-offs have to be made, as systems are kept as simple as possible, and other issues like acceptability and privacy are not relevant and not applicable. Although overall and specific goals are set for each project, the important results are the experiences gained. The projects will show, which effect can be achieved in reality within the given budget.

**Clear objectives:** Although the objectives are limited, they are specific and in most cases even quantified and therefore measurable (e.g. certain percentage of reduction of traffic during rush hours).

**Technology**: simple and proven technology, thus low risk. Mobility projects are small-scale projects (not operational, just pilots/tests). The use of GPS is still in the planning phase or only applied in micro-scale tests (less than 50 users (e.g. spitsmijden 2a)).

**Specific features of pilot projects compared with projects abroad:**
The Dutch pilot projects are in most cases part of the mobility projects linked to ABvM.
These pilot projects, however, are difficult to compare and are not representative for the ABvM, since they are done on a small scale, at different locations, are differently organised and are - on purpose - only loosely coordinated.

Mobility projects are a cooperation of
- provinces
- municipalities
- major employers
- employer organizations
- trade unions

The mobility projects are intended to:
- tackle the problems of local traffic jams in the short term,
- make motorists and employers more aware of alternative options,
- assess motorist behaviour,
- provide operational experience with the new technology,
- give the commercial sector the opportunity to gain experience with the system.

Within the mobility projects a number of different measures are taken; the RUC pilot projects are one of them:
- Special characteristics of these mobility projects influence the RUC projects.
- Moreover, since the Ministry of Transport, Public Works and Water Management financially supports these projects, there are directives from the Ministry for the planning and implementation of RUC projects.
- Whereas monitoring and evaluation are important aspects of these guidelines, the Ministry however stresses that these projects do not have the status of official trials.
- All the data are stored in a database, which will be made accessible to all participating parties to allow them to learn from the available information.

**Characteristics:**
- PPP constructions
- Participants are volunteers (mostly employees of PPP partners)
- Goals are to reduce traffic and to gain experience, however the real effect on traffic is marginal, as the number of users is limited.
- Amsterdam does not expect noticeable reductions, and no measures will be taken to improve public transport and parking facilities.

**Lessons to be learnt:**
- Lessons from tendering of the pilot project in Amsterdam
  - Recruiting volunteers turned out to be difficult,
  - Procurement of system is complicated, even for small-scale projects causing delays.
- Lessons from Amsterdam probably applied in the preparation of the pilot project in The Hague (as system design changed from being similar to Amsterdam to a less complex system).
- Database of lessons learnt in mobility projects (which is a declared objective of mobility projects) is not yet in operation; scheduled for first half of 2010.

- Although based on proven technology, delays are very usual in the project preparation. The schedule has to be adjusted frequently.
- Even with a small number of users (in the order of thousands) the projects show considerable complexity requiring much time and effort already in the preparation phase.
- Complicated and long tendering process.
- Up-scaling is not tested yet. First results will probably come in 2010.

# 4. Generic framework for the analysis of the implementation of Road User Charging projects

## *4.1. Discussion of success/failure factors and their interrelations*

In Chapter 2 we have identified the factors determining success and failure of the implementation of several RUC projects abroad. In Chapter 3 we have discussed the status of RUC projects in the Netherlands and tried to see whether all the identified factors apply or whether additional factors play a role. Now, in the first section of Chapter 4, we will establish a complete list of success/failure factors and discuss them critically in detail and - recognising their complex relations - try to identify their interrelations and interdependencies.

We start with the list of factors established in Section 2.2 of Chapter 2, but take also into consideration the (somewhat limited) experiences from projects in the Netherlands as well as findings about other projects (from literature surveys), which could not - due to the limited scope of this thesis - be treated and described in Chapter 2. By combining the results from the various project reviews we establish a list of the key factors determining in general the success or failure of RUC projects.

The list established in Chapter 2 contains already many factors, which are considered relevant for the success or failure of the investigated RUC projects. Since a lot of research literature exists about various RUC projects, it is advisable to study and survey also this literature in order to confirm and validate the identified factors and to check whether there are other relevant factors which have not been identified by the review of the selected projects in Chapter 2. A wide range of research articles and research reports have therefore been reviewed and consulted to extract experiences gained, lessons learnt and recommendations in order to derive a rather complete set of success/failure factors.

The various RUC projects have different characteristics and features, which makes a comparison and analysis difficult and challenging. Each author of a study report or review paper had his own intentions and expectations, but also his own research approach and focus. Not surprisingly, the lists of the identified factors are never fully identical, since they depend on the specific research approach and focus on specific factors and dimensions like e.g. technology or politics. Therefore it is not possible to find in the various reports and review papers a commonly agreed approach for categorising these factors (since the choice of the categories depends on the focus), which indicates already the difficulty for establishing easily a framework describing these factors.

Although it is not straightforward to identify and isolate from the long list of parameters mentioned in the various review papers those factors which can be seen as commonly agreed factors determining success or failure, there is a certain overlap in the findings: acceptability is generally considered the key factor for a successful implementation (Schelin, 2008).

However, the level of acceptability is determined and influenced by other factors or a combination of factors, which are - at least - partially under the control of the government and the implementing agency.

Moreover, the list of factors contains a range of different types of factors. Some are:

- elements belonging to the scheme design,
- elements belonging to the implementation process,
- external factors, which cannot be influenced by the actors involved in the RUC project and have to be accepted as given facts.

The fact hat these factors are all of a different type makes categorising and structuring them very difficult. However, it appears that many of these factors influence the factor acceptability in a certain, and sometimes even very significant, way. However, some other factors, which are not considered significant for acceptance, can nevertheless be very crucial for the success of the implementation of a RUC project.

By combining the list of factors found in the review of the project cases in Chapter 2 with the additional findings of the reviewed literature following factors belonging to these different types/categories can be identified as crucial for the success or failure for the implementation of RUC projects:

**Political champion (Political commitment and political will) - London, Stockholm, Edinburgh**

As in the studied cases became clear, the presence of a political champion turned out to be an enormous support for the implementation of a RUC project. Strong political leadership (Rye & Ison, 2008) is necessary to tackle a problem such as congestion. Often unpopular measures have to be taken and only those political leaders, who are ready to take this risk, can make a difference. Such strong leaders are commonly high-level political champions (Schelin, 2008). Such a champion does not have to be one single person, like the mayor of London, but can also be a group of several persons. In Stockholm, the political will and commitment of the Green Party compensated the absence of an actual strong political leader. In Edinburgh, there were no political leaders, no political will and no commitment with respect to the implementation of the planned RUC system, and therefore it was not possible to reach an agreement on objectives. Not only handling the risks of the unpopular measures is important for the political champion, moreover, reaching an agreement and keeping the process going is at least just as important. These champions are crucial at so-called decision points and clearances (Rye & Ison, 2008).

The announcement of plans for the implementation of RUC projects will normally cause a huge wave of public protest and the political champions have to be able and prepared to withstand this first protest. During the implementation process of RUC projects, there will be many challenging phases, and opponents of these projects will take advantage of any situation, where they sniff a chance. The political champions have to be alert and are required to stand up against opposition against these projects during the complete implementation process, especially during the challenging and crucial phases. Good preparation for a public dispute and understanding of the arguments of the opposition is essential.

Fact is that without strong political leadership it is practically improbable that a road user charging policy will be introduced as, for example, Richards (2008)

notes that the lack of willingness of the British political leaders to take the lead in the national transport debate is the most important reason why no action on national level has been taken for so many years.

**Strong management, planning and rapidity (quick processing) - London, Edinburgh;**
**Implementation agency - London, Stockholm, Edinburgh**
Strong implementation agencies are seen as a strong success factor. Even more, it is postulated by Rye and Ison (2008) that the chances for a successful implementation are increased, if the number of the responsible agencies is reduced to one (single agency being fully responsible for the whole implementation process). In London the implementation agency was also responsible for the bus services and could therefore coordinate its improvements with the scheduled introduction of the RUC (De Palma et al., 2007). In Edinburgh was also a single agency tasked with the implementation, however – in contrast to London – this agency had no responsibility for the public transport system and could therefore not implement improvements in the bus services and sell them as benefits of the introduction of the RUC system.

If there are more agencies or authorities involved, it is of utmost importance to be clear on which authority is responsible for the specific implementation steps (Schelin, 2008).
A proven risk mitigation measure (to avoid embarking on a huge project without the possibility to step out) is the step-wise implementation and the introduction of decision points at proper time intervals. The successful implementation in London showed that the good planning (including a sensitive and careful choice of the timing for critical decision steps e.g. a referendum) and rapidity in the process (stimulated by the political commitment and enabled by the low-technology system as chosen in London (Lee, 2008)) are important elements of being successful.

**Communication - London, Stockholm, Edinburgh**
Stockholm and London are examples of excellent communication. The clear and excellent communication campaign, which contributed to the acceptance and thereby the success of the implementation, was the result of the important role the communication team of London was given in the implementation process. The massive information activities of the Stockholm project (Schelin, 2008), which were crucial for the acceptance, also indicate the significance of clear and comprehensive communication. It is possible to address scepticism in the public effectively by providing information in e.g. a good communication campaign, as was done in Singapore (KTA, 2008). On the other hand, the limited communication campaign in Edinburgh was not able to reverse effectively the negative publicity. Edinburgh is just one of many projects (e.g. Hong Kong and Cambridge) which failed in their attempt to implement RUC and where inadequate communication played a crucial role as being one of the reasons for failure (De Palma et al., 2007).

Even if critical factors as a recognised and understood congestion problem, a strong political champion and a consistent policy with clear objectives are taken care of, a project can still fail due to poor communication of the reasons and justifications for the new policy to the public and stakeholders (Rye & Ison, 2008). It is generally emphasized that the importance of good communication in helping to achieve and to maintain agreement on a clear policy direction

shall not be underestimated. The implementation process as well as its status and progress have to be communicated as effectively as possible in regular intervals comprehensively and unambiguously to the public in order to prevent negative publicity caused by misunderstandings.

**Clarity (clear objectives) - London, Stockholm, Edinburgh, Austria and Germany**

The definition of clear project objectives, agreed by all involved parties, is a prerequisite for the definition of clear and unambiguous project requirements, which are in turn needed to define clear responsibilities and an unanimous understanding of the project deliverables (including the conditions for incentives and penalties). The cases described in Chapter 2 demonstrate that in successful implementations always clear objectives were present. In Edinburgh, it was not possible to agree on certain objectives, which had big consequences, e.g. difficult and unconvincing communication of these objectives and of the expected benefits of the proposed scheme (Rye et al., 2008). Eventually this led to a lack of knowledge and to misunderstanding in the public, which both played a role in the negative outcome of the referendum. Clarity in objectives is also confirmed to be important by De Palma, Lindsey and Proost (2007). They state that not only clarity in objectives plays a crucial role, but also clarity in the operation, e.g. the impacts of the proposed scheme on stakeholder groups, which have to be explained clearly.

**Logical consistency (London, Stockholm);**
**Openness (transparency) and trust**

Rye and Ison (2008) conclude that it is necessary that the policy is logical and consistent to achieve agreement on the issue of introducing a RUC project. In addition, the proposed charging policy has to be consistent with the overall political strategy. The best way of implementing a charging policy is to incorporate it into a package of measures, as it is a good opportunity to integrate in the package some compensatory measures, which have a positive influence on the acceptability of the proposed policy and scheme (Niskanen & Nash, 2008).

It is important for being successful in implementing RUC policies, that there is public trust in the government. First of all, this public trust has to be supported by transparency. Transparency is required during the planning and implementation process (KTA, 2008), but also the plans themselves have to be transparent. By being transparent the consistency of the policy can be assessed by the public. This, however, makes the policy more vulnerable to opposition, as the potential "losers" of the proposed scheme will be easily identifiable, and the actual impact on those losers becomes clear. Nevertheless, it can be said that overall transparency will help to implement RUC successfully, since general acceptability on the long term is clearly improved by it. Secondly, the trust will be influenced by the credibility that the proposed policy will be actually carried out, and moreover, carried out as promised (De Palma et al., 2007). Any form of suspicion of a "hidden agenda" will undermine the proposed scheme and will make its successful implementation unlikely.

**Use of revenues (earmarking) – London, Edinburgh, Austria, Germany**

The use of revenues influences many aspects, which are crucial for infrastructure charging policies. Efficiency and acceptability are affected by the

way the revenues are being used; however, the use of revenues has to be consistent with the policy. Earmarking of the revenues for a clear purpose like the improvement of the road infrastructure plays an important role (Schelin, 2008). Although earmarking is in general a controversial issue (De Palma et al., 2007), earmarking improves the acceptability of RUC projects, which is shown e.g. in London and confirmed in other studies.

On the other hand, negative consequences of earmarking have been identified for acceptability (if revenues are targeted to a too small specific group, they are perceived as unfair and therefore cause an additional negative effect on acceptability) and efficiency (if revenues have to be spent on a specific sector, but there are not enough efficient and attractive projects in this sector). However, if used in a correct way, the probability of negative effects can be minimized, e.g. by ensuring that the revenues will provide benefits for a relevant and large group of stakeholders. A good example is shown in London, where revenues are used for improving public transport (Richards, 2008): a large part of the commuters, who daily use public transport, took advantage of this measure. However, the rather straightforward case of London is not fully representative for other scenarios, as it is often much more complicated to identify clearly such a user group as the London commuters.

**Resources - Stockholm, Edinburgh**

The studied cases show that resources can be a crucial element in the implementation process. As most RUC projects are complex processes with many years of implementation and preparation, this project preparation has to be very thorough, as many aspects have to be elaborated, and will require substantial resources in terms of budget and manpower. In Edinburgh, there was a definite lack of resources, as development funds of around £8 million were seen insufficient to fund all the development and communications work required (Rye & Ison, 2008). As a result, the scheme was not sufficiently developed and therefore vulnerable to be attacked and criticised by the opponents of the proposed scheme. For small-scale projects, it can be important to get financial support from the national funding agencies for the development of RUC projects, like it happened with the Stockholm project, where the major funding was provided by the state (KTA, 2008).

**Complexity of scheme - Edinburgh, Germany, Austria**

Among others, the complexity of the proposed scheme was a factor, which resulted in the failure of the implementation in Edinburgh. As already said, this was shown by the fact that the public was not able to understand the proposed scheme. De Palma, Lindsey and Proost (2007) note that many research projects have confirmed that the public dislikes complex tolling systems. Since all people have to adapt to the system, charging schemes have to be simple and clear and with limited options in order to be understandable for the broad public. A proposed scheme, which is simple and transparent, is easier to explain. Explaining the goals and justifying the need for RUC (De Palma et al., 2007) is much easier, when the scheme is kept as simple as required. As a consequence, the complexity of a scheme does not only influence the actual implementation (resources, uncertainties about the effects, risks), but is a problem affecting the acceptability as well.

**Technology – Austria, Germany;**
**Occasional users - Austria**

For many years, technology has been considered an essential barrier for the introduction of national road pricing initiatives. Even in 2005 the Secretary of State for Transport in the UK, Mr. Alistair Darling, was advised by an independent Steering Group that a national road pricing scheme was not likely to be "technologically feasible" (Richards, 2008). These technological issues, however, were not seen as problems and barriers for local RUC projects, since these local projects should act as pilots and pathfinders to provide new insights and better understanding of the technologies involved. Also Bendixson (2008) notes that local or city-regional projects should be the first step on the road to a national charging scheme.

Although it is often mentioned (Schelin, 2008) that new communication and location-based technologies will enable new ways of charging (e.g. new methods and techniques for vehicle-to-infrastructure communication), these new technologies have only been used on extremely small-scale test projects. There is still much research and development effort needed, before these technologies can be implemented on large scale. It is therefore important that the basic principles of these new technologies and their functioning in an RUC system – due to their innovativeness - will be demonstrated in pilot projects to the different groups of stakeholders (Schelin, 2008). Until these new systems will be fully operational, the focus should be on simple, low-technology systems, as this will facilitate a successful implementation, as shown in Austria and London. A phased approach by starting with simple technology and then later gradually shifting to more sophisticated solutions is often recommended.

The issue of interoperability plays an increasingly important role already between countries with local RUC projects, but even more pronounced in larger perspective, e.g. on European level. This will influence the choice of technology in the future even more, especially within Europe, as there are already EC directives, which lay down the obligation for interoperability of the installed systems in the near future (whereas standardisation turns out to be very difficult, the legal framework is however already in place (European Commission, 2009)).

The EETS standardisation process can be partly compared with the European Railway Traffic Management System (ERTMS) standardisation process, which has also not been based on "off-the-shelf technology". Over more than 10 years experts of European governments and industry are taking part in an initiative of the European Union which strives to achieve interoperability of the rail systems. Such complex standardisation processes have a certain lead-time, which cannot be shortened without consequences for the quality and the cost of the standardisation product (Stoop, Baggen, Vleugel, Kroes, & Vrancken, 2007). A further characteristic of these long standardisation processes is the development of intermediate standards for national systems, which is certainly a sub-optimum scenario, since it adds extra complexity to the process, but is unavoidable (Stoop et al., 2007). The incremental development of such a standard is a difficult and time-consuming process. National RUC systems with some (limited) integrated interoperability (see RCI and CESARE projects) will eventually lead to a European standard. Waiting for a completely new European standard, which has to be developed from scratch, would hamper the implementation of RUC projects for a long time. Thus it is very important to consider interoperability issues and to incorporate certain interoperability features, but complying with a standard which is not yet available is simply not

possible. Therefore it would be of advantage to take an active role in the European standardisation process (Stoop et al., 2007).

For the implementation of a nationwide RUC system one has also to consider the scalability of the system and has to take into account the system-inherent scaling issues. These RUC systems have to be designed for a very large number of users, especially if the charge will be applicable to all vehicles (like in the nationwide Dutch RUC system). Usually many elements of the designed system will be tested prior or during the implementation. Whereas the integration of these elements is already a difficult task, an additional difficulty will be caused by a very peculiar "law of large numbers" (Weinstock & Goodenough, 2006), which applies, when a system is scaled up. This "law of large numbers" means that some defects of the system, which hardly play a role during tests with small numbers of users, because the defects are so rare, will occur more frequently and thus will become more noticeable. This scaling issue has to be recognised already in the design phase and sufficient time and resources have to be allocated in the test phase to solve these emerging issues.

A technological challenge in many systems is the occasional user. Simple technology makes this challenge often less problematic, as again is shown in the projects in Austria and London. Germany has solved this issue by implementing a secondary system for its occasional users, since the purchase of the expensive on-board unit is not affordable for this group of occasional users.

**Fairness - Germany. Austria;**
**Occasional users - Austria**

Already for many years, fairness is seen as an important factor. Especially the opponents of RUC have used fairness (equity discussions about different income groups) as an argument to successfully get RUC proposals rejected (KTA, 2008). However, it is recognised that this is not the main issue anymore. It seems that nowadays with respect to fairness other aspects are of higher importance: that the chances of evading the charging scheme are limited, that there is full opportunity to participate during the developing phase of RUC policies and schemes, that fairness to special groups is well regulated. However, the most important fairness issue is that users, independent of their location and their frequency of travelling, are treated equally; this issue is relevant for occasional users as well as for users in more isolated areas (as typical for larger RUC systems).

Eventually the principle that the user pays for the usage of the road network is seen as an important element of fairness (Germany and Oslo (De Palma et al., 2007) are good examples, but also the case in Austria makes clear that this principle is accepted widely). What really counts as a factor for successful implementation is that the proposed scheme is perceived as fair (Schelin, 2008). This means that the scheme has to be fair to all road users, which means that equity must be ensured and exemptions (which are unfortunately unavoidable in real life) must be individually studied and well justified for each individual case (KTA, 2008). Nevertheless, fairness is overall still an easy to use argument for the opponents of RUC, as the equity issues are difficult to solve and the perception of fairness is an arbitrary and subjective matter. This means that the issue of fairness has to be addressed carefully and elaborated very thoroughly.

An important aspect in the context of fairness are the measures taken for enforcement and fraud prevention. A user who pays correctly his fee will not perceive a system as fair, which does not have sufficient measures for fraud prevention incorporated, which at least gives the user the perception of a highly fraud-tolerant system.

**Severity of problem of congestion - Stockholm**
Lee (2008) as well as Rye and Ison (2008) state that the degree (or severity) of congestion is a critical factor for the successful implementation of (local) road charging projects. Surprisingly it is not just the level of congestion itself, which matters, but more important seems to be the perception of the severity of this congestion (Lee, 2008). As this perception is mainly determined by local factors and influences, there can be differences even within a country. A survey in Germany (De Palma et al., 2007) indicated that congestion is seen by the road hauliers as a severe problem (loss of time and money). The targeted stakeholder group (HGV and therefore the hauliers) perceived the problem as severe, which made the new charging policy more acceptable. Not only congestion, but also other issues as air pollution and accidents (KTA, 2008), however all being problems clearly related to traffic, can contribute to the acceptability of RUC, if these problems are perceived severe enough to accept the proposed measures, provided that there is a credible perspective of a change for the better.

**Public Consultation – London, Stockholm, Edinburgh (referendum)**
London (well exercised participatory planning) and Stockholm showed that this is a good way to get the public involved and as mentioned above, this is seen as fair by the public. In Edinburgh, there were also great efforts made to involve the public in the process to get RUC implemented. Eventually the project initiators did not succeed in the implementation, because of the negative result of the referendum. The consultation of Edinburgh's public showed also that these public consultations can result in issues which cannot be resolved. The fact that it is often difficult to explain and to justify, why these issues cannot be resolved, makes the implementation of RUC less likely. Despite of these negative elements of consultation it is confirmed by other literature (Niskanen & Nash, 2008) that it is important to get already from the beginning the general public and the stakeholder groups involved in the preparation of the proposal. Although this involvement will take time, it will pay off to include all interests (KTA, 2008).

**Benefits, Public transport**
The benefits of RUC policies are difficult to demonstrate, as they largely become evident only after the implementation of RUC. The expected benefits, however, are the main justification for the RUC policy. Mobility, environment, equity and energy-related benefits are mostly desired benefits, but not confirmed until the actual operation of the system.
A problem is that there are often "large-scale losers" on one side, and the "society as a whole" as winner on the other side (Bergh, Leeuwen, Oosterhuis, Rietveld, & Verhoef, 2007). These losers will often have the power to stop RUC initiatives, because they know how to get organized in order to efficiently fight the RUC projects. Important is that these losers have to be compensated in a certain way and that the benefits, i.e. that the society is the winner, should be communicated more clearly and frequently.

As there are already experiences with RUC which show positive effects, e.g. improved mobility (10-30% traffic reduction and a higher average speed) in Singapore, Stockholm and London (KTA, 2008), it can be of benefit for the implementation that these results are shown to the broad public and made fully understood by the public (Schelin, 2008). In general, RUC projects have generated positive benefit-to-cost ratios.

It is also postulated that some benefits should be delivered already prior to the start of the system (Schelin, 2008), (KTA, 2008) in order to win the support of the public. However, this is only possible on a limited scale, e.g. to improve public services, and only possible, if there are enough resources available already before the start of the RUC system. Moreover, these benefits are in a certain way felt only indirectly (revenues from the system) and often have to be seen as a compensation measure.

**Legislation**

Various aspects of legislation play a role in the implementation process. First, the legislative context (Rye & Ison, 2008) is of great influence on the implementation process. In most cases new legislation is required in order to have a legal basis for charging road usage. Although the preparation of this legislation is already a difficult job itself, the right moment of introduction of this new legislation is even more crucial. The tendering process in most cases depends on this new legislation. Moreover, other factors as communication and acceptability are also affected by a new legislation. Therefore, this moment of introduction has to be chosen carefully and prudently. However, there is no real agreement in the literature on when this legislation should be in place (Schelin, 2008). There is a dispute whether the legal framework should be established before the resolution of the technology issues or afterwards.

A legal framework is important to ensure a correct and efficient procurement process, but can also limit the possible modifications later on in the process. The difficulty is that when the technological options are not yet known, this legal framework can be very limiting and restrictive. On the other hand, the case of Stockholm showed that the lack of a "consistent and robust" legal framework at the start of the implementation process forced the implementation agency to change the technology, as the required enforcement process turned out to be not feasible.

The implementation of local RUC systems showed that in most cases new or adapted legislation is needed on national level (e.g. London and Stockholm). For nationwide systems this is always the case. On national level often several government departments are involved (e.g. there are taxation and traffic elements) (Bendixson, 2008), which makes this legislation process difficult.

It is obvious that legislation plays a very important role in the implementation of RUC projects, since such projects represent a significant change for the society, but also for the government and the administration. A more detailed discussion of all the issues related to legislation goes beyond the scope of this thesis and would deserve a dedicated research project.

**Efficiency**

With having optimum efficiency in mind as utmost target, project developers would go for the first-best pricing scheme. This concept plays an important role in earlier literature, but seems to be practically unfeasible. Despite an EC policy

to apply the concept of marginal social cost pricing this concept has not been implemented up to now (as seen in Switzerland, Germany and Austria) (Nash et al., 2008). In practice trade-offs between the different factors like efficiency, equity and acceptability had to be made in most projects (De Palma et al., 2007). In order to get sufficient public and political support compromises with respect to efficiency have to be made and second-best solutions, which are however more complex, have to be adopted. This indicates that the establishment of a charging scheme is always a trade-off, which has to be well justified and communicated to be acceptable to the public.

**Timing, stable political environment**

A stable political environment definitely is a good starting point and an essential prerequisite for the introduction of a RUC. The higher the number of times an agreement must be repeated (Rye & Ison, 2008), the higher are the chances that suddenly there is no majority anymore for a new RUC project. Especially since nationwide RUC projects – due to their size and complexity - cannot be developed and implemented within a single ruling period of an elected government (Richards, 2008), this political stability can be very crucial, as RUC becomes often a political issue in the time of elections and the standpoints of politicians and parties can change quickly in view of an upcoming election. Eventually the window of opportunity of political stability has to be seized, and besides all other enabling factors, which have to converge, also good luck is needed to maintain this political stability during the implementation of RUC (Schelin, 2008).

**General transferability;**
**Success in London (Successful reference project) – Stockholm (Transferability)**

The transferability of RUC policies is limited (Richards, 2008) and depends on many local factors as congestion levels, the marginal cost of public funds, public trust in local governments (see London, Edinburgh as example) (De Palma et al., 2007), cultural impacts on user response and acceptability (Curacao, 2009). As mentioned above, the commuters in London were easy to please with an improvement of public transport. However, suburban residents are less likely to be won by for example better bus services, as there is not such a dense network of public transport that they can benefit from a higher bus frequency (Lee, 2008). This shows that even within the same country there are difficulties to transfer the policy of RUC. This is confirmed by other studies (Curacao, 2009). Moreover, these transferability issues are also valid for so-called "vertical" transfers, simple scaling up and scaling down of policies. First of all, it is necessary to understand the political context in order to assess whether a transfer of policy is possible. Adopting a policy or scheme without adaptations and modifications will result in problems for the implementation. It is however an option to use an existing (well working) scheme or policy for a demonstration in its new context. This will show, although in a limited way, its intentions and effects, but moreover, will make clear which improvements and adaptations are wanted and needed. That the concept of a successful RUC project can be "transferred" is shown by the RUC project in Stockholm: The success in London was of major importance for the implementation of the Stockholm scheme, as it created a political opportunity to start with a trial.

**Acceptability**
Acceptability is generally seen as the key factor for the success of RUC projects, as convincingly demonstrated by London (Lee, 2008) and Stockholm (Rye & Ison, 2008). A lack of acceptability will in almost all cases lead to a failure (for example Edinburgh). In most cases the importance of this factor is well understood and not underestimated, and is therefore often taken into account during the design and implementation of RUC (Richards, 2008). Acceptability, however, cannot be treated as an isolated factor, since nearly all other factors have a certain influence on acceptability, which complicates the discussion and description of this factor.

First of all, it is important to understand the reasons why acceptability plays such a crucial role. One of these reasons is that road pricing is seen as a huge intervention into our daily life. Resistance is quite normal in cases of changes in general, but in particular, when new regulations are introduced. In addition, RUC becomes for many people in particular a big issue, since it affects our wish for unlimited and cheap mobility (Mobility is seen as a "vested right"). This makes plans for RUC and thereby changes of the way how road users are used to be charged, extremely vulnerable to acceptability issues, in comparison to other changes or transitions. Lee (2008) identifies the public aversion as one of the two key challenges for acceptability, which indicates the difficult starting point for the implementation of RUC. De Palma, Lindsey and Proost (2007) state that acceptability is a "conditio sine qua non" for reforms of transport policies. This illustrates that acceptability is extremely important (as confirmed by even more authors (Curacao, 2009)), but also a very delicate issue. As already mentioned above, the importance of acceptability is often understood, however the factor itself is difficult to understand. As already indicated, many factors influence, directly or indirectly, acceptability. What makes the process even more complicated is the fact that the interaction also works in the reverse direction: when efforts are made to make RUC projects more acceptable via a specific factor, e.g. increased consultation efforts, it will also influence positively other factors, like e.g. communication. Since it is difficult to control acceptability directly, one has to try to manipulate those factors, which influence acceptability. The fact that there is a lack of widespread successfully implemented RUC projects shows that this turns out to be a very difficult process.

In the following **the factors which are identified of being of major importance for the acceptability of RUC projects** will be discussed:

**Clarity in the objectives** and **logical consistency** are important for RUC projects, since these factors make the goals of RUC explainable to the general public. A low or moderate **complexity of the scheme** can also play a positive role in this matter.

The **use of revenues** plays also a significant role for the acceptability and has to be in agreement with the clarity of objectives and consistency. Often the revenues are earmarked to be exclusively used for traffic and transport related expenditures and investments. This makes RUC schemes more acceptable, as the collected money will not be spent at random (e.g. in the national budget), but will be dedicated to traffic related areas.

The earmarking of the revenues concerns also the **benefits**, as there are some benefits of RUC, which will only be tangible after revenues have been spent for e.g. the construction of extra roads or for compensational measures as improvements of the public transport. On the other hand, there are also other

benefits, which are however less evident for the public, as for instance environmental improvements or an improved mobility. It is of paramount importance that these benefits will be communicated extensively to contribute to an increased acceptability.

Moreover, **communication** itself is a very important factor affecting acceptability. As already mentioned, communication can tip the balance in the positive or negative direction. Even if other factors are present, which influence the acceptability positively, a bad communication (both, the communication plan as well as the execution of this plan, e.g. the reaction on media) can have a decisive effect on the general acceptability of a planned RUC project. On the other hand, communication can compensate the lack of some other positive factors, although the presence of other factors as sufficient clarity and consistency makes the communication task much less complicated. The presence of other positive factors makes the communication more likely to be successful and amplifies the positive effect on the acceptability of RUC.

Another factor, which also influences the public opinion and is therefore a crucial element in the implementation process to get the planned RUC project accepted by the public, is the **consultation** of the public. Consultation and dialogue with the users, however, must not to be confused with communication (example Edinburgh).

In the consultation process it often becomes clear that the (perceived) **fairness** of the proposed RUC scheme is a crucial factor with respect to the acceptability. Fairness and equity (which includes the treatment of occasional users and the aspects of enforcement and exemptions) however is a difficult issue, as fairness can be perceived differently by different people and groups, and therefore well considered trade-offs are essential.

A major factor for a high acceptability is the **severity of the problem** to be resolved by the planned RUC project, namely the congestion, or - better said - the perception of this problem by the public. First, it has to be clear beyond any doubts that there is an actual problem caused by traffic jams and congestions. In addition, the severity of this congestion problem has to be so serious that the proposed measures, i.e. implementing an RUC scheme and changing the taxation scheme, seem to be well justified and there is confidence in the public that the introduction of the RUC scheme will actually have a positive effect on the congestion problem and that the chosen pricing scheme will be efficient.

A factor, which presumably influences acceptability and therefore has to be mentioned in the context of technology, is **privacy**. However, Ison and Rye (2007) found that in London privacy was not a determinative factor. They noticed that due to the introduction of other technologies used for public surveillance, like CCTV and the registration of emails and mobile phone calls, the public is getting used to this sort of privacy invasion. Also in other cities with RUC projects this lack of anxiety of intrusion of privacy was confirmed (PRoGRESS Project, 2004).

Whereas political stability has only a marginal influence on acceptability, the presence of a strong political leader, a so-called **political champion**, is not a necessary requirement, but certainly a positive element for high acceptability and success of implementation. Then the public can identify such a political leader as the driving force behind the proposed RUC scheme and can build up

trust that the government is a resourceful, responsive partner ensuring a fair and efficient implementation (KTA, 2008).
As acceptability is subject to many influences, acceptability is not a stable factor, but will change constantly before and during an implementation process. It is even stated (KTA, 2008) that acceptability will grow over the period of operation, since the public gets used to the new scheme and can see the positive effects. Trials can therefore be important for the acceptability of RUC, as shown in Stockholm. This is confirmed by Schelin (2008), who provides evidence that the acceptability can be improved by demonstrator projects and pilots.

## *4.2. Design and description of the framework*

From the discussion of the factors in the previous Section (4.1) we can already see that many of these factors, which are recognised as determining the success and failure of RUC projects, are not independent factors but highly interrelated, which can be seen as a strong indication that RUC projects are generally quite complex projects.

In the domain of "system engineering and policy engineering" it is a commonly used research method to establish a theoretical framework, which can be used to get some order into the spin web of factors of a complex system by putting the factors into a structured model (= the framework) and visualising somehow the interrelations between the various factors. The driving idea behind the framework concept is the hope and expectation that such a framework can serve as a tool for a structured analysis of complex processes and interrelations. Examples of areas for the application of frameworks are processes and projects in the ICT domain (Bondavalli, Brancati, Ceccarelli, & Falai, 2009), (Silva, 2009), in the political domain (Miller, 2009) and in the engineering domain (Chiaradonna, Lollini, & Di Giandomenico 2007).

It is of course not a farfetched idea to apply the framework concept also to the analysis of the implementation of RUC projects. The list of the success/failure factors identified and discussed in Section 4.1 represents already a simple framework, which can facilitate the analysis of the implementation of RUC projects and help to identify risks and dilemmas:

- Political champion
- Strong management, planning and rapidity
- Communication
- Clarity
- Logical consistency, openness and trust
- Use of revenues
- Resources
- Complexity of scheme
- Technology
- Fairness
- Severity of problem of congestion
- Public consultation
- Benefits
- Legislation
- Efficiency
- Timing (political environment)
- General transferability
- Acceptability

Several authors of review papers dealing with RUC projects have taken a similar approach and represent the factors or actors involved in RUC projects in simple lists or tables. Some of them introduced a certain structure in their analysis by organising the factors or actors into categories (KTA, 2008), (Rye & Ison, 2008), (Ison & Rye, 2005), (Schelin, 2008). It has to be noted, however, that the classification of the factors into certain categories is not straightforward, since some factors can be assigned to two or more categories depending on the somewhat arbitrary and personal perception of the authors. Only one author (Schelin, 2008) presents the factors in a (simple) graphical visualisation. A certain shortcoming of the frameworks found in the literature is the lack of a clear visualisation of the interrelations between the factors and the lack of an indication of the strength or significance of their interrelations.

Concerning the added value of a framework it is important to note that the objective of a framework is not to contain and provide additional information, which cannot be also described in text or table form. The specific objective of a framework is to make the structure of the involved actors and/or factors clear and visible. Often a graphical presentation can be used to visualize the structure making the interrelations and interdependencies more easily comprehensible. A framework shall serve as a tool, which helps – thanks to the visualisation of the factors – to understand and analyse quicker and more intuitively the complex processes and its implementation.

A first attempt to visualize the identified factors and their interrelations in a framework leads to a framework based on circles. One of the important findings of the discussion and analysis of the factors in Section 4.1 - fully in line with all the review papers in the literature - was the identification of acceptance as the most important factor for determining success and failure of an RUC project. Therefore it is rather obvious to assign to the factor "acceptance" the significance of a "super-factor" and call it the "key criterion" for success and failure. For a visualisation framework this would mean that this key criterion has to get a central position in the framework with the other factors placed around. Since in the discussion of the factors it became clear that some factors have a very significant influence on the key criterion "acceptance", whereas other factors have an impact on success or failure, but not significantly on "acceptance", a reasonable display option is to arrange the factors in an inner and an outer ring.

The resulting framework shows the key criterion "acceptability" as a concentric ring completely surrounding "successful implementation of RUC project" indicating that the successful implementation of an RUC project has to be fully embedded in the key factor "acceptability". This graphical representation correctly emphasises the absolute importance of acceptability for the success of the implementation of a RUC project.

The eight factors, which significantly influence and determine the level of acceptability, are placed in this concentric ring. The other factors also determining success and failure of an RUC project are placed around the "acceptability circle".

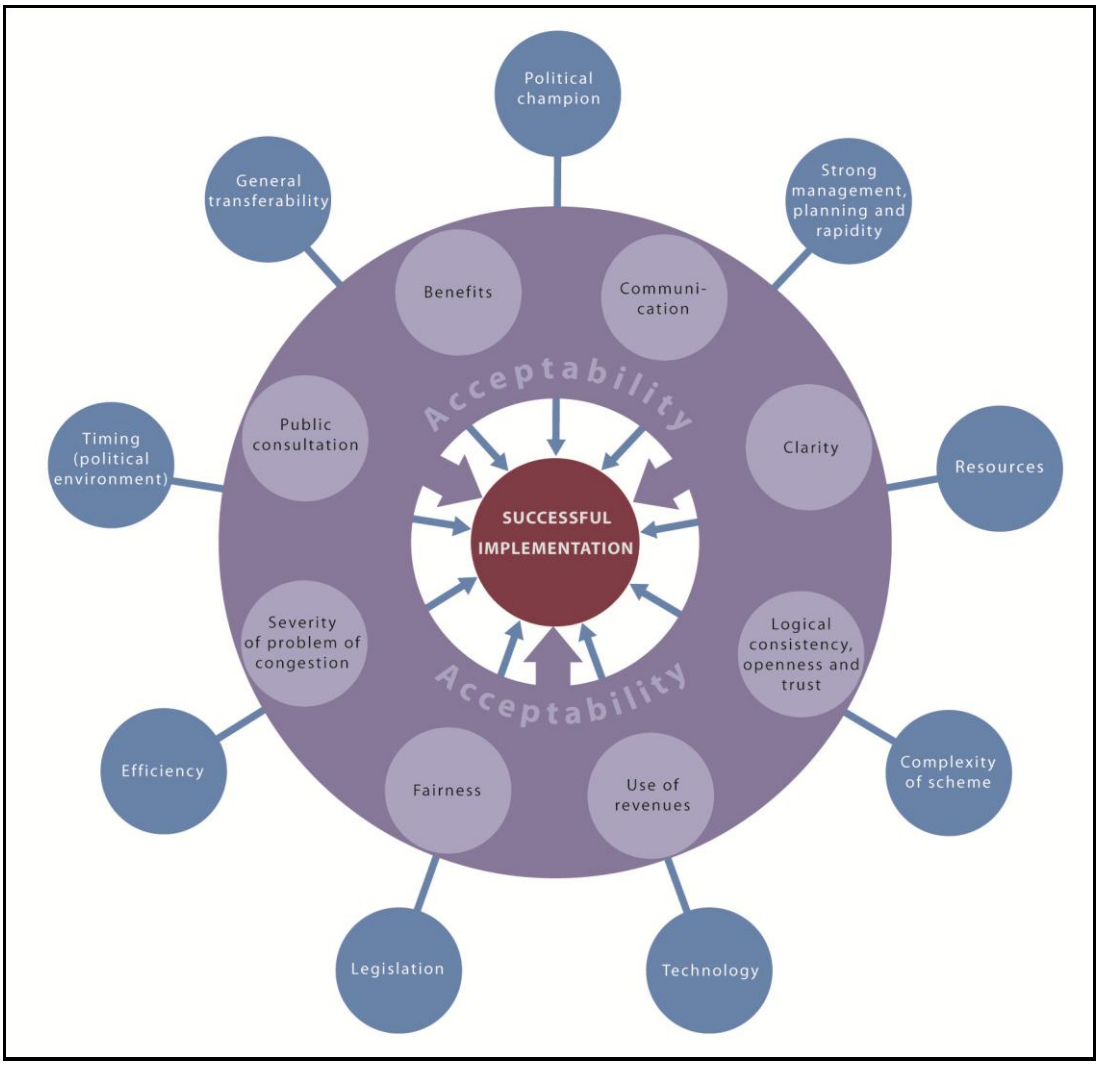


Figure 4.1: Framework showing the factors determining the successful implementation of RUC projects. The factors in the inner ring have a significant influence on the acceptability, which is a key factor for success or failure of RUC projects.

A further step to expand this framework by implementing additional information (as analysed and discussed in Section 4.1) into the graphical visualisation is to indicate the interrelations between the various factors with the help of arrows. The strength of this interrelation (or interaction coefficient) could be visualized by the thickness of the arrow. Whereas the described approach is certainly feasible and would result in a framework completely describing the interactions of the factors playing a role in the implementation of RUC projects, the insertion of all the arrows indicating all the complex interrelations would lead to a rather "overloaded" and cluttered drawing.

A possible way out of this display dilemma is the creation of a "cross-correlation table" which complements the "circle" framework described above. This cross-correlation table shows the interrelation of the various factors (including the "super-factor" acceptance). The strength of the interrelations is indicated by different symbols (no interrelation, weak interrelation, or strong interrelation).

| | Political champion | Strong management, planning and rapidity | Communication | Clarity | Logical consistency, Openness and trust | Use of revenues | Resources | Complexity of scheme | Technology | Fairness | Severity of problem of congestion | Public Consultation | Benefits | Legislation | Efficiency | Timing (stable political environment) | General transferability | Acceptability |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Political champion** | | ~ | +(+) | ~ | + | - | ~ | - | - | - | ~ | + | - | + | - | + | - | + |
| **Strong management, planning and rapidity** | | | + | ~ | ~ | - | + | + | ~ | - | - | + | - | + | - | - | ~ | ~ |
| **Communication** | | | | ++ | ++ | + | + | ++ | + | ++ | + | ++ | + | + | ~ | - | + | ++ |
| **Clarity** | | | | | ++ | + | + | + | - | ~ | + | ~ | + | + | ~ | - | ~ | ++ |
| **Logical consistency, Openness and trust** | | | | | | ++ | ~ | ~ | ~ | + | + | + | + | ~ | + | ~ | + | ++ |
| **Use of revenues** | | | | | | | ~ | ~ | - | + | - | + | + | ~ | ~ | - | + | ++ |
| **Resources** | | | | | | | | ~ | - | ~ | ~ | + | + | - | - | ~ | - | ~ |
| **Complexity of scheme** | | | | | | | | | ++ | + | - | + | - | ~ | +(+) | - | ~ | + |
| **Technology** | | | | | | | | | | ++ | - | ~ | ~ | + | ~ | - | + | + |
| **Fairness** | | | | | | | | | | | ~ | + | + | ~ | + | - | ~ | ++ |
| **Severity of problem of congestion** | | | | | | | | | | | | ~ | ++ | ~ | ~ | + | ~ | ++ |
| **Public Consultation** | | | | | | | | | | | | | + | ~ | + | - | - | ++ |
| **Benefits** | | | | | | | | | | | | | | - | + | - | + | ++ |
| **Legislation** | | | | | | | | | | | | | | | - | + | - | ~ |
| **Efficiency** | | | | | | | | | | | | | | | | - | - | + |
| **Timing (stable political environment)** | | | | | | | | | | | | | | | | | - | ~ |
| **General transferability** | | | | | | | | | | | | | | | | | | + |
| **Acceptability** | | | | | | | | | | | | | | | | | | |

Figure 4.2: cross-correlation table showing interrelations between the factors (++ very strong interrelation, + strong interrelation, ~ weak interrelation, - no interrelation, red/underlined = potential conflict)

The added value of this cross-correlation approach is the possibility to indicate whether strong interrelations could possibly lead to conflicts and dilemmas between factors, when optimisation trade-offs have to be performed. This table turns out to be quite a useful tool: it allows to identify the real critical factors for success/failure, which require full attention in the preparation and planning phases as well as during the implementation of a RUC project. These critical factors require often a trade-off to arrive at a decision to be taken by the responsible parties, which then has to be properly justified and communicated to ensure acceptance. This feature of the cross-correlation framework, namely to identify factors which could lead to conflicts and dilemmas, will be used with benefit in the analysis of the ABvM in Chapter 6.

# 5. ABvM, the nationwide Road User Charging project in the Netherlands

In Chapter 4 we have constructed a framework for the analysis of the implementation of RUC projects in general. In Chapter 5 we will now describe the characteristics, history and status of the implementation of the RUC project ABvM in the Netherlands. This detailed review of ABvM is important to show clearly the extreme complexity of the system and of its implementation, but it is also of value, since a comprehensive review of the implementation process of ABvM cannot be found in the literature. In chapter 6 we will then make use of the developed framework for the analysis of and reflections on the implementation process of ABvM.

## *5.1. Description and characteristics of ABvM*

**The basic concept of the "Kilometre price"** is based on research and consultation (see below in Section 5.2):

- Car user pays per driven kilometre
- Base tariff (Based on car characteristics, e.g. emission)
- Rush hour surcharge

Following principles and boundary conditions have to be observed (Ministerie van Verkeer en Waterstaat, 2007a), (Ministerie van Verkeer en Waterstaat, 2009f):

- "honesty principle" = fair, cost-neutral charging system, i.e. in total car users will not pay more than now; only the distribution between users changes. Introduction of kilometre pricing has to go in hand with a proportional reduction/elimination of fixed car taxes.
- Societal support (public support essential for such important and serious changes of law and taxation scheme).
- Affordability (costs of system implementation and operation must be reasonable and affordable); includes affordability for the user.
- Contribution to improved accessibility.
- Revenues earmarked for the infrastructure fund (road maintenance, new road constructions, public transport) (Ministerie van Verkeer en Waterstaat, 2009a); proportional reduction of contribution from general budget.
- No unnecessary administrative effort and related costs.
- Transparent, user-friendly and reliable system.
- Data protection and guaranteed privacy.

**Objectives** (Ministerie van Verkeer en Waterstaat, 2009h):

- To improve accessibility over roads in general, but in particular in congested areas (thanks to rush hour charge),
- To contribute to an improved environment (reduction of emission and noise pollution),
- Fair charging/taxation scheme (user pays for actual usage).

**Expected (= desired) effects** (Ministerie van Verkeer en Waterstaat, 2009g):

- By paying for usage the owner of a car will become aware of the actual costs of using a car to bridge a certain distance at a certain time. He will carefully think about choosing the time of the ride and, since the real costs will be more visible to the user, he will make a trade-off between public transport and the use of the private car. A decrease of the amount of traffic can be expected.

- Despite of a growing number of cars the introduction of a kilometre pricing will reduce the usage of cars.
- Overall, there will be a reduction of the total emission of the private cars, since the composition of the vehicle fleet will change towards more low-emission cars and the accumulated driven distance will decrease.
- Welfare gain (industry, car industry, less and shorter traffic jams, higher safety due to fewer accidents).

**Design (process)**
- Registration of kilometres driven,
- Sending aggregated data,
- Processing aggregated data into an invoice,
- Collecting payment of the invoiced amount,
- Monitoring observance and enforcement.

**Organisational model**
Market orientated organisation model for (better) innovation and higher efficiency (Ministerie van Verkeer en Waterstaat, 2009h), which should have a positive effect on the cost of implementation and operation of the road pricing system:
- provides optimal conditions for innovation and efficiency,
- provides assurances for alignment with standards to be developed internationally,
- guarantees continuity of the government revenue stream,
- offers the registration holder optimal options.

An important and specific feature of the chosen **organisation** model is that it consists of **two tracks** connected by switches: the main track and the guarantee track (Ministerie van Verkeer en Waterstaat, 2009a):

**Main track ("hoofdspoor")**

This is the baseline concept. Private parties shall play an important role in the implementation and operation of the system. The major part of the system (various tasks as mentioned above in "design", dependent on organisation model) shall be operated by the commercial sector.
A Multiple Service Provider model was found to be the best solution for following reasons (Ministerie van Verkeer en Waterstaat, 2007c):
- Costs
- Efficiency
- Risk management and mitigation
- Performance
- Quality for end-user (end-user friendliness)

**Certification** shall provide "open markets", in which certified providers can participate.

**Market parties** will play a significant role in this main track (Ministerie van Verkeer en Waterstaat, 2009b):
- Market parties will be responsible for the registration of kilometres driven and for sending aggregated data,
- A free market for products (certified OBUs) and services,
- installation of OBU by certified installers,
- service (registration and sending) by certified service providers.

These service providers are free to provide additional services, i.e. Value Added Services (e.g. navigation, tracking). They can also provide the whole package: OBU, installation of OBU and services.

The **role of the government**:

- Overall (top-level) coordination and supervision (e.g. certification, recognition of providers/suppliers),
- Invoicing,
- Fee collection,
- Enforcement

**Under consideration:** to give end-to-end responsibility to the private parties (Ministerie van Verkeer en Waterstaat, 2009b). This means that tasks of the private parties will be extended and the private parties will become responsible not only for registration and sending data, but also for invoicing and fee collection (including enforced collection). The government role will then be limited to the overall coordination (supervision) and enforcement. The market consultation about end-to-end responsibility for private parties has already taken place; however, the government has not yet taken a decision.

**Guarantee track ("Garantiespoor") = Backup organisation** (Ministerie van Verkeer en Waterstaat, 2009e)

Since it cannot be guaranteed that the baseline concept will be implemented without delays (no business case for private companies, companies not yet ready etc.) and in order to maintain the speed of introduction ensuring that the kilometre price will be implemented in time, the Ministry decided as a risk mitigation measure to pursue in parallel to the Main Track a backup organisational line, called the Guarantee Track, which will be completely operated by the Ministry:

- Based on an extension of the proof-of-concept test (large-scale operational test, GPT).
- If commercial sector is not ready or not commercially interested, the (nationwide) test system and organisation will be successively expanded into
  - Nationwide system for heavy goods vehicles (200.000 users)
  - Nationwide system for all other vehicles (8.000.000 users)
- The (certified) commercial companies shall take over parts of the system as soon as possible.

Advantage of the "Guarantee Track": The commercial sector has time to get prepared thoroughly; there is no sharp committing deadline for operational involvement.

**Technology**

- Combination of satellite and GSM technology.
- Obligatory On Board Unit (OBU) in each vehicle, tracks kilometres driven in the Netherlands and registers at which rate.
- Thick OBU, which means data is aggregated in OBU and only the total amount of driven kilometres and corresponding rates are sent. In that way privacy should be guaranteed. Dutch Data Protection Authority has been consulted extensively and approved proposed design, which is also compliant with all applicable European directives on the protection of privacy (Ministerie van Verkeer en Waterstaat, 2009f).
- Only in case of explicit permission of user (because of specific interest, e.g. free-of-charge OBU) and of service provider, specific data about the movements can be sent by the OBU (only applicable for main track).

**Enforcement**
Only compliance checks (checking that OBU is fully functional) are possible, which is a particular characteristic of the satellite technology. As there are no real-time charging transactions, as with other technologies (DSRC gates), the enforcement equipment is therefore not able to check whether toll transactions are correctly made, when vehicles pass an enforcement gantry (Furch, 2008). It will not be possible to check e.g. if the OBU is registering correctly the actual location, and/or applying the correct rate, and therefore to verify the correct calculation of charge etc. This is also not possible afterwards, since only aggregated data is sent to the back office. Compliance checks are made at gates as well as by mobile equipment. Irregularities (jumps in recorded location, loss of satellite signal, power failures etc.) are registered by the OBU itself and the information is passed on during compliance checks.

**Fraud prevention** (Ministerie van Verkeer en Waterstaat, 2008b)
As every car user (nationwide) is obliged to participate, there is a realistic chance for fraud. It is necessary to implement measures for fraud prevention, as fraud will not only cause financial losses for the government, but can also lead to a decreasing societal support. A further risk is that the desired effects of the kilometre price will not be achieved.

Following anti-fraud measures will be implemented:

- OBU
  - OBU type will be certified,
  - OBU will be installed by certified companies,
  - OBU will include a 'Trusted Element' (a chip similar to the SIM card in a mobile telephone). This chip provides the security for the data sent, e.g. by defining a unique identity for the OBU, which will be linked to the number plate of the car.
- Quality of GPS signal (preventing disturbance of signal): The Radio Communications Agency (Agentschap Telecom) will ensure the signal quality by regulating the production, trafficking and sale of equipment that can disturb and disrupt the GPS signals.

## *5.2. Process and status of implementation of ABvM*

### 5.2.1. The preparatory (early) phase of ABvM

During more than 20 years, various projects were initiated and reached the preparatory phase, but were never completed (See Chapter 1), mainly for reasons of lack of political and societal support (people will remember names as e.g. "rekeningrijden", "kilometerheffing").

**Start of ABvM in 2004 "Nationaal Platform Anders Betalen voor Mobiliteit":**
In September 2004 the government issued the "Nota Mobiliteit" (Ministerie van Verkeer en Waterstaat, 2004), sketching the vision of the government for the development of the mobility in the 20 years to come. A dramatic growth of the kilometres driven by cars was forecasted linked with the expectation that this would lead to a reduced accessibility in spite of the infrastructure programme planned for the coming years. The government hoped that a "different approach for paying for the use of cars" would be a proper countermeasure. Drawing from the experiences from previous unsuccessful attempts for RUC, the government decided to work on gaining sufficient public support before elaborating a new proposal for RUC. For the first time the initiative for elaborating a new approach/proposal for RUC was given to the societal parties

and other organisations of the state ("overheden"), and not to the government. For this task the government created a new platform (task force) called the "Nationaal Platform Anders Betalen voor Mobiliteit". This was a commission of commercial, governmental and societal organisations (headed by Mr. Nouwen, former director of the Royal Dutch Touring Club ANWB and in the past opponent of RUC, appointed by Minister Peijs), which was tasked to report to the Ministry of Transport, Public Works and Water Management and the Ministry of Finance about the various possible methods for a different way of charging car users for their actual usage of cars. These new methods had to fulfil the objectives of the government, namely to improve the accessibility and to gain sufficient societal support.

**In May 2005** this commission recommended the introduction of a scheme (Ministerie van Verkeer en Waterstaat, 2005) based on a payment per driven kilometre differentiated by

- time
- place
- environmental characteristics

Introducing a price per kilometre would also require consequently an elimination of the fixed car taxes (purchasing tax and motor vehicle tax) to avoid a double taxation, which would not be cost-neutral and would violate the "honesty principle". More recommendations were issued, e.g. on the use of revenues, communication etc.

**During 2005 and 2006:**
In this period joint fact-finding, research and market consultation activities took place.
Societal parties were also closely involved (Ministerie van Verkeer en Waterstaat, 2007a) in the discussion of e.g. technology, implementation, cost-benefit analyses, taxes, effects on environment and traffic.

**Coalition agreement in February 2007**:
The coalition parties decided to take initial but irreversible steps for the development of a nationwide RUC within the coalition term (= government period), based on a phased introduction and implementation. Mr. C. Eurlings was nominated Minister of Transport, Public Works and Water Management and became the leading figure for the implementation.

To achieve the introduction (and possibly the full implementation of an operational HGV system) within the coalition term, it was necessary to start some **processes in parallel** (Ministerie van Verkeer en Waterstaat, 2008a). In an optimum scenario (without delays) following goals (milestones) were considered feasible within the four years of the coalition term (Ministerie van Verkeer en Waterstaat, 2007a):

- Legislation has passed (until legalisation has passed, project plans can be stopped practically immediately). In case of passed legislation, a new government has to start a lengthy "change of legislation" procedure, if they wish to introduce changes or even withdraw the law.
- Transition of fixed tax from vehicle purchase tax to motor vehicle tax is on its way.
- Back office is ready.
- Technology has been tested.
- Experiences have been gained with different ways of pricing (Mobility Projects).
- Tendering for HGV has been finished.

- System for HGV is in operation in 2011 (if acceleration of process of legislation and tendering and shortening of critical path of preparation turns out to be possible).

**The planning/schedule** of the coalition agreement was very aggressive and compressed (compared to schedules proposed by the "advies platform" and the "Ministry working group") (Ministerie van Verkeer en Waterstaat, 2007b).

**Processes to run in parallel** (Ministerie van Verkeer en Waterstaat, 2008a):

- Preparation and rollout with respect to tax restructuring,
- Preparation and rollout with respect to the technical system for road pricing,
- Development of the proposed road-pricing legislation,
- Preparation and rollout with respect to communication to road users closer to the time that the road pricing system will begin to function.

After the general agreement in the coalition negotiations to go ahead with kilometre pricing the concept was further elaborated including the definition of a more detailed schedule. **In May 2008** this concept was announced in the form of the **"Basic Report"** (Basis rapportage) (Ministerie van Verkeer en Waterstaat, 2008a), to which the House of Representatives (= Lower House of Parliament) assented in early July 2008. Also a decision on the transition of the current tax scheme was taken.

**Schedule:**
Schedule changes disturbed the synchronisation between the main track and the guarantee track leading to a partial loss of the parallel implementation (e.g. tendering process for the guarantee track needs more time for a better and more precise description of the tendering lots). Although the risks of the parallel implementation were recognised in the beginning, they were later on considered as too high. The facts have shown that the planned measures for an accelerated process after 2011 were too ambitious and unrealistic, since they increased the risks leading therefore most probably (based on realistic probabilities) to a further delay instead of an accelerated implementation.

A "tenderingboard", which was established by the Minister to provide the project organisation with expert advice in the certification and tendering processes, recommended in December 2008 to "seriously reconsider the complete synchronisation of the two tracks" (Ministerie van Verkeer en Waterstaat, 2009d) due to the extreme complexity of the process and the interrelations of the various factors which are difficult to oversee and to control. Main concern about running the tendering for the guarantee track in parallel with the consultation about the certification process was the enormous managerial pressure and workload on the project organisation, but also the potential conflict of interest between the parties involved in the tendering process as well as at the same time in the consultation about certification. The board recommended for the rollout of the main track to wait for the results of the tendering process in order to use them for the specification of the certification requirements. The acceptance of the recommendations of the tenderboard resulted in a partial serialisation of the processes instead of running them in parallel (adding directly a 3 months additional delay on the critical path). Whereas the tenderboard appreciated the risk reduction by the simplification of the process, it warned that still "extraordinary efforts will be needed what concerns the controllability of the process".

The schedule changes as occurred in the course of the implementation are reflected in the half-yearly progress reports (half-yearly progress reports are obligatory for all projects in the Netherlands, which are identified as "large projects" by the House of Representatives). The schedule as presented in the last progress report from June 2009 was still valid in February 2010 at the time of the fall of the coalition.

### 5.2.2. Decisions steps for the government

The project "Anders Betalen voor Mobiliteit" falls under the governmental category of "large projects". One of the conditions for running such "large projects" is the definition of clear and unambiguous "go/no-go" decision points in the decision process, at which an explicit political decision will be taken about the continuation or cancellation of the project (Ministerie van Verkeer en Waterstaat, 2009h).

Following decision points have been incorporated in the decision process:

- **Submission of the bill:** the government submits the new law "kilometre pricing" to the House of Representatives for discussion and assent.
- **Definitive Implementation Decree (Definitief uitvoeringsbesluit, DUB):** contains all elements and partial decisions which are required for an operational system and releases the financial means needed up to system implementation.
- **Implementation decision:** this represents the definitive act of starting with the actual implementation and rollout of the kilometre pricing system.

In preparation of the implementation process the government submitted in June 2008, prior to the Definitive Implementation Decree, a **Partial Implementation Decree** (Partieel uitvoerings besluit, PUB) (Ministerie van Verkeer en Waterstaat, 2009c) in order to enable the execution of time-critical activities like:

- preparation of implementation
  - to prepare a draft bill and submit it to the House of Representatives for discussion and approval,
  - to decide on the assignment of responsibilities and roles in the public domain.
- start of implementation with tendering of time-critical and essential elements,
- to be sufficiently prepared that the House of Representatives can release funds for further tendering.

A decision was taken to go ahead with the certification of multiple service providers and the tendering for elements on the critical path for the GPT (OBE, collection, enforcement, trusted element, verification and validation) was approved to start prior to the Definitive Implementation Decree.

**Next steps, if government would not have fallen, would have been:**
After discussion of the bill in the House of Representatives (draft bill was submitted to the House of Representatives in November 2009) and the bill passed, the **Definitive Implementation Decree** has to be prepared taking into consideration the results of the discussion in the parliament, and has to be submitted to the House of Representatives for approval (this was scheduled for June 2010 (Ministerie van Verkeer en Waterstaat, 2009d)). In the Definitive Implementation Decree the government will decide on

- the detailed design,
- the procurement,
- the rollout of the system,
- the approval for start of tendering of those elements which fall under the responsibility of public parties.

A specific formal decision is needed for the operational extension of the system implemented for the GPT, which is called the **Realisation Decree** (Realisatiebesluit), e.g. to release the procurement of equipment for the HGV system.

**Definitive decision for implementation of operational system ("implementatiebesluit"):**

- Decision by government,
- Assent by the House of Representatives,
- Start of implementation of HGV system (starting point Guarantee Track), but only after successful large-scale test (GPT),
- Goal of GPT: test of technology, but also test of organisational interfaces and operability.

## 5.2.3. Implementation activities

In parallel with the decision processes, following implementation and legislation activities took place, are currently taking place or will have to be started soon (Although these processes are described in sequence, they took place in parallel, which leads to a further complication):

**Consultation activities:**
After the market consultation in 2006 and before the tendering process, additional research is in progress and tests are in preparation. During the preparation of the implementation plan (and the elaboration of the concept) for RUC the project team in the Ministry of Transport, Public Works and Water Management responsible for ABvM discussed topics with the private sector as well as with other ministries, public organizations and authorities (Connekt, 2008).

**Connekt** (Connekt is an independent network of companies and authorities that connects parties in order to work, on trust, on the sustainable improvement of mobility in the Netherlands) was commissioned by the Ministry of Transport, Public Works and Water Management to organise thematic meetings and workshops on road pricing in order to facilitate contacts between the project organisation and the relevant expert private sector parties, and to advise the Minister (Connekt, 2007). Connekt created the "Special Knowledge Group ABvM". Meetings were held on a regular basis (first meetings took already place in 2006). Interested (private) parties, industrial organizations and experts discussed various issues:

- Organisation model
- Technology
- Implementation
- Communication with end-user
- Integrated system approach
- Enforcement
- Tendering
- Market (scenarios, opportunities, involvement)

A dialogue with the **private sector** during the stage of preparation of the decision-making for RUC was considered by the Ministry very useful for the project organisation (i.e. the project team in the Ministry responsible for the ABvM) (Ministerie van Verkeer en Waterstaat, 2008b).

The results of these broad consultation processes were used as input for the legislation activities. As these consultation processes proved to be very useful, the Ministry intends to maintain a dialogue with various involved parties (users, providers, stakeholder organisations) during the preparation of the implementation, but also during the implementation itself and during the operational phase (Ministerie van Verkeer en Waterstaat, 2009f). A concrete consultation process with selected companies, organisations and parties has been started and is now in progress for the definition of the certification activities.

**Legislation activities:**

- Modify existing law/legislation,
- Introduce new law, the "road pricing act" (as stated in *Platform Anders Betalen voor Mobiliteit* "the existing legislation in the Netherlands does not provide sufficient basis for the introduction of a new method for road pricing" (Ministerie van Verkeer en Waterstaat, 2005)).

**Adaptation of current tax scheme:**

As it is not practicable to eliminate the vehicle purchase tax (which is paid once, at the purchase of a new car) completely in one go (cars (new ones as well as used ones) would become instantly much cheaper; the market would be disturbed), this tax has gradually to be converted into the motor vehicle tax (which is paid per month, per quarter or per year). The vehicle purchase tax is already stepwise reduced (5% per year, since 2008, in following years higher percentage) and at the same time the motor vehicle tax is increased. The basic idea is to replace eventually the motor vehicle tax by the kilometre price (As of today further tax-conversion is postponed, since road charging is declared "controversial" by the parliament after the fall of the coalition).

**New law: the Road Pricing Act**

It is a comprehensive law, which mainly regulates the rights and obligations of motorists. The important elements are:

- Tariffs (basis tariff, rush hour surcharge)
- Regulations/rules and exceptions
- Requirements and specifications for implementation (OBU, trusted element, certification of OBU installation companies)
- Execution and enforcement
- Introduction of scheme (tax transition etc.)
- Organisation model
- Data protection (privacy)
- Invoicing and fee collection

Any **lawmaking process** is usually a lengthy process taking quite some time. For the ABvM this process took even much longer than expected, since the Road Pricing Act is very comprehensive covering all aspects of implementation and operation, which had to be elaborated in the necessary details. Being aware of the sensitive and potentially controversial issue of kilometre pricing, the Ministry preferred to pursue a "process of extensive alignment with societal parties and decentralised governments" (Ministerie van Verkeer en Waterstaat, 2009a) in order to ensure a broad societal basis of support, which also contributed to the long process.

As a result of the advice of the "societal parties and decentralised governments" to submit the draft bill only as a complete document (Ministerie van Verkeer en Waterstaat, 2009a), i.e. including the tariffs, the submission of the **draft bill** to the House of Representatives was delayed **until November 2009.**

It is worthwhile to note that the Ministry had expected a much faster process. According to the original planning of the coalition agreement, the lawmaking process should have been completed in autumn 2008. This date shifted continuously. The Ministry was still very optimistic as documented by the fact that in October 2008, only few months before the planned submission of the bill, the Ministry believed in a submission of the bill in February 2009 and expected that the discussion in the House of Representatives and the Senate (= Upper House of Parliament) would be finished in 2009 (Tweede Kamer, 2009).

As usual, the draft bill had to be submitted to the Council of State (the advisory body to the government) for advice, prior to submission to the House of Representatives. The task of the Council of State is to review the new law with respect to its impact on the citizens and to check whether there is a potential conflict with other laws. Since the kilometre pricing will have a major impact on all citizens, the Council of State paid in his review special attention to the proposed tariffs, which took also quite some time, since the Council of State asked for a revised proposal of the tariffs (Ministerie van Verkeer en Waterstaat, 2009d).

In addition, further delays might occur, since plans for adapting the draft bill have already been announced: The breakdown of tasks/responsibilities in public and private tasks shall be reconsidered. At the time of this discussion (November 2009) (Ministerie van Verkeer en Waterstaat, 2009b), a minimum additional delay for the lawmaking process of one year was anticipated, if the bill has to be adapted.

Although the draft bill was presented to the parliament in November 2009, a discussion of this legislative proposal in the House of Representatives and the Senate has not yet taken place and will not take place in near future due to the fall of the government in February 2010.

**Testing activities (Ministerie van Verkeer en Waterstaat, 2009f):**
These tests concern the methods and techniques for registration, the sending of user data from car to collection office, the calculation of the charged amount, the invoicing, data integrity/security and fraud detection:

- Technical tests,
- Proof of concept/large-scale operational test (GPT, with 60.000 users),
- System improvements based on results of test (GPT is not a simple yes/no test).

**Roll-out activities** (Ministerie van Verkeer en Waterstaat, 2009f):
The actual roll-out can only start after the "decision for implementation". The roll-out has to be done in steps, since the introduction of the "kilometre price" for all users is not feasible in one go for technical and organizational reasons, e.g. the installation of OBUs in all cars will take a lot of time.

**Tendering activities (guarantee track):**
**Preparation of tendering:**
In the second progress report it was announced that more time was needed to start the dialogue. More possibilities to optimise the way of contracting and cooperating with the market had to be investigated. The objective was to stimulate the cooperation of the market parties in order to manage better the integration risks and potential modifications during the realisation phase (These investigations caused a 3-months delay on the critical path). These investigations resulted in a cooperation agreement with the goal to ensure the cooperation between the contracted parties, but also with the government in order to guarantee a timely and correct execution of the various project phases leading to the Implementation Decree. A consultation structure and a bonus plan were created to stimulate the cooperation.

**Advice from legal adviser ("landsadvocaat") concerning the placing of contracts:**
Contracts shall be placed as one single contract, not in parts, but with good opt-out options, which allow the termination of the contract at any time with the lowest possible financial consequences. By applying this contractual construction the full financial mandate will only be needed at the time of the Definitive Implementation Decree. Only at the time of placing the contract the Minister will engage in a financial commitment. Until the Definitive Implementation Decree money will be spent only for running the project organisation.

**Concept and planning of tendering: phased tendering**
In line with the challenging schedule established in the coalition agreement the elements on the critical path need to be already tendered before the Definitive Implementation Decree, which creates a certain dilemma, since for the tendering the specifications have to be frozen, which predefines a certain direction and reduces flexibility for later tenders.

**Tendering process:**
- started in December 2008.
- "competition-oriented dialogue" (the components of the system, and thereby the requirements, are worked out in cooperation with a number of market parties).
- Prequalification of tendering parties in June 2009, 18 (out of 47) companies have been selected and invited to participate in the dialogue.
- Three parties, which were not selected, filed a suit against the selection decision, which was eventually unsuccessful, but led to a three-months delay (critical path) (Ministerie van Verkeer en Waterstaat, 2009d).
- Consultation and dialogue phase (two rounds) started in September 2009.
- Registration (submission of tender) for the five lots was scheduled for first half of 2010 (award of contract scheduled afterwards).

The other elements of the system (guarantee track) can only be tendered after the Definitive Implementation Decree.

**Status today:**
The tendering activities have been postponed (by letter of Minister dated 17 March 2010 (Ministerie van Verkeer en Waterstaat, 2010a)), but running activities will be completed as needed to achieve and safeguard an intermediate result.

**Certification activities:**
Consultations on the basic principles of the main track and the certification framework (Ministerie van Verkeer en Waterstaat, 2009a) took place:

- Formulating a certification framework that best serves the public interests of a market-oriented road pricing service which operates sustainably.
- Competition encourages efficiency, customer focus and innovation.
- This is only possible, if the market parties are able to meet the requirements and an attractive business case emerges for them.

The consultation process covers the participation of the market parties, certifying institutions, umbrella organisations and public organisations.

There is a formal link between the tendering for the guarantee track and the certification for the main track, since the same set of requirements has to be fulfilled. The synchronisation and fine-tuning of these two processes is a delicate and difficult task.

**Consultation of basic principles of main track** (Ministerie van Verkeer en Waterstaat, 2009b):

For the implementation of the maintrack some policy and management decisions have to be taken, which have not yet explicitly been decided in the Partial Implementation Decree. In order to make use of the vision and experience of the participating parties, the Ministry decided to treat in the consultation process:

- Market model (number of players, access, responsibilities, etc.),
- Service model (end-to-end, portability, Value Added Services (VAS), EETS (European electronic toll service),
- Revenue model (business case and payments).

The so-called basic principles can be discussed with the market decoupled from the consultation about the certification framework. Four individual rounds of talks took place (May to October 2009). An advice was delivered to the office of the Minister, but no political decision has been taken on e.g. end-to-end responsibility. The decision will have consequences for the legislation process (further delay).

**Consultation on certification framework:**

(Expert) companies (parties considering supplying products or services and certifying institutions) participate in this market consultation of the government. This consultation is needed by the government for the establishment of a certification framework:

- certification requirements (requirements that must be met),
- certification table (method of certification),
- certification structure (description of the parties involved in certification).

The consultation process for certification is divided in three parts (Status November 2009):

- OBE, and manufacturers of OBEs (qualification and invitation of participants, consultation started in January 2010 (structure and timetable), March 2010 (requirements)),
- Installation and installation stations (started in March 2007, second round started in December 2009 (requirements), January 2010 (structure and timetable)),

- Service providers and their services (Started in March 2007, second round started in December 2009 (requirements), January 2010 (structure and timetable)).

**Status and current planning of certification activities** (March 2010)**:**
After the publication of the detailed "consultation documents on certification" ("leidraad certificering kilometerprijs") 18 parties applied for the consultation rounds of the certification framework. The certification activities for registration and service providers have been postponed (letter of Minister dated 17 March 2010 (Ministerie van Verkeer en Waterstaat, 2010a)), but running activities will be completed as needed to achieve and safeguard an intermediate result.

**Communication activities:**
Communication in first phase (until submission of bill) (Ministerie van Verkeer en Waterstaat, 2009d):

- Focus on stakeholders and interested parties/people,
- Focus on developments of implementation and actual implementation and context of implementation (goals, other measures, etc.),
- Limited/restricted communication, as policy was not yet formally decided (too early/premature communication to a wide audience was seen as a risk giving potentially room for speculation and rumours).

Due to the current political situation (political instability) communication is still a sensitive and vulnerable issue: communicating too many details at a time, when the issues are not yet fully decided, can require frequent modifications and revisions of the message leading to a loss of credibility and trust in the public.

The follow-on short-term communication strategy focussed specifically on the submission of the bill, the promulgation of the draft bill and plans (The communication strategy was established after (again) extensive consultations with e.g. market parties, societal parties, ministries and local governments (Ministerie van Verkeer en Waterstaat, 2009a)):

- Aimed at public (wide audience),
- Focus on eliminating lack of knowledge in the public
  - Explaining reasons/logic for road pricing ➔ doing nothing is not an option (on the long term),
- Focus on effects of kilometre price (impact on various target groups) e.g. example cases with insights into effects per target group; calculation tool (to be developed together with societal parties).

**Now the focus lies on retaining public support:**
The originally intended basic message (Ministerie van Verkeer en Waterstaat, 2009a) was:

- pay for actual usage,
- less congestion,
- a better environment.

The actual message now is: majority of car users will pay less.
As a matter of fact the societal parties take actively part in the public debate (One could get the impression that this could be part of the strategic communication plan, but there is no evidence that this was actually planned).

**Indirect contribution to communication:**
Positive reporting about Mobility Projects (announcement of plans and reporting of achievements) will contribute to a more positive public opinion about road pricing in general.

## 5.2.4. Situation of today

**Reaction of stakeholders and media after submission of bill:**
In all the years there was occasionally media attention. However, a crucial point was reached, when the bill was sent to the parliament. Only then important elements of the ABvM like the exact tariffs and the enforcement scheme, which both have significant impacts on the individual user, became public and official. As long as the bill was not officially submitted and the details like tariffs were not known to the public and media, there was a lot of room for rumours and misleading statements. As a matter of fact there was no leakage of details prior to the submission of the bill, which is quite unusual. The Ministry was fully aware of the potential impact of the submission of the bill, since an immediate media attention and strong responses from the public and stakeholders were expected. The Ministry and the societal parties were therefore prepared to face a strong public opposition.

In 2010 the media (e.g. "De Telegraaf") started a campaign against the planned kilometre price. Under pressure of the media, the ANWB (Dutch Automobile Association, considered as one of the important societal parties) had to reconsider its (originally supportive) position, recognising that certain elements of the scheduled kilometre price were seen problematic or not sufficiently clear. The ANWB decided to hold a referendum among his members.

Although the referendum had certainly no legal status, it became crucial for the Minister, who had declared that public opinion and public support are essential for continuing with the implementation. The referendum (held as an on-line survey) however was not a simple referendum, which would result in a "yes" or "no", but more an extensive consultation of the public to identify the concerns about the kilometre price.

The House of Representatives decided to wait with the discussion of the bill until the announcement of the results of the referendum, since, like the Minister, also the House of Representatives is interested in the results of the referendum, as the ANWB represents a large part of the user community. In principle the House of Representatives is not at all obliged to take the results of the referendum in consideration. However, it decided to wait for the results of the referendum, since even within the coalition parties several crucial issues are not yet fully agreed and the politicians preferred to probe the public opinion.

**Situation and consequences after the fall of the government:**
After the recent fall of the government the parliament declared the kilometre price a "controversial" issue (as one of the most controversial issues), and therefore further decisions (and considerations etc.) were postponed until after the new elections (held in June 2010). The approval of the road pricing act and therefore the implementation of the proposed kilometre price are now uncertain, since road pricing is considered to become a crucial issue during the coalition negotiations. As of today not all parties have already formulated a clear position, which makes it impossible to predict the further proceeding.

It is uncertain what will happen with the preparatory activities, which are currently running (e.g. tendering, certification), even if funds have already been approved. What will definitely be considerably delayed are all activities to be approved by the Definitive Implementation Decree, which can only be

approved after the Road Pricing Act has passed the House of Representatives under a new government.

In his letter of 17 March 2010 (Ministerie van Verkeer en Waterstaat, 2010a) to the chairman of the House of Representatives Minister Eurlings listed the consequences following the declaration of the project ABVM as a "controversial" issue:

- No new financial commitments for ABvM,
- Rigorous downsizing of the project organisation and team,
- Putting on hold the processes of tendering and certification,
- Stopping the preparation of the roll-out of the system.

The registration dossier for the tendering process shall not be sent to the participants. The dialogue for the certification of the registration units and the service providers will be put on hold. The already committed mobility projects will go ahead, since they will play a role in the improvement of the regional accessibility, even if the ABvM will not be implemented. In addition they will contribute to the learning process, which will be of benefit for the introduction of any scheme of RUC at a later stage. Knowledge and expertise gained and accumulated within the project organisation will be adequately conserved. A number of project products will be completed up to a level to be useful as intermediate results. This concerns the documentation for the tendering process as well as the certification, and a number of already started research projects. The discussions on European level in the frame of EETS will be continued. Finally, the half-yearly project reports as requested in the context of "large projects" will be issued. The Minister confirmed that only those activities will be continued, which leave the choice to a new government to definitely stop the project or to take it up again without unnecessary delay.

# 6. Validation of the framework and reflections on the implementation of ABvM

In Chapter 4 we have constructed a framework for the analysis of the implementation of RUC projects. In Chapter 5 we have described the characteristics, history and status of the implementation of the RUC project ABvM in the Netherlands showing the extreme complexity of the system and of its implementation. In this chapter we will make use of the developed framework for the analysis of and reflections on the implementation process of ABvM. In doing so we will assess the suitability and applicability of this framework to serve as a tool for the targeted users, who are the authorities responsible for the planning and implementation of large-scale RUC projects of the size and complexity of ABvM. The potential users of the developed framework are typically the staff of the responsible ministry (e.g. ministry of transport) of countries preparing the implementation of a RUC project or new stakeholders and organisations joining an RUC project during the implementation phase (this could for instance be the case, when the new Dutch government decides to take up again the implementation of ABvM). Therefore two representatives of the Dutch Ministry of Transport, Public Works and Water Management were approached and were asked to assess the suitability and applicability of this framework in order to provide an external validation.

## *6.1. Analysis of ABvM using the framework and assessment of its applicability*

In the following we will investigate, whether each of the factors, which were identified in Chapter 4 as playing a role for the success and failure of RUC projects in general, can also be found to be of influence in the specific case of the ABvM. We will also discuss which role these factors played in the implementation process up to now.

### 6.1.1. Analysis of ABvM using the framework

**Political champion (Political commitment and political will)**

Champion

Minister Eurlings was seen and accepted as a real political champion thanks to a strong performance as politician. He was able to cope with the opposition to his plans in a decisive manner and therefore very positive for pushing the ABvM project through political difficulties. Minister Eurlings is also seen as the driving force behind the progress of the implementation process (although there are rumours that the Minister as private person was not a devotee of the RUC scheme). Nevertheless, Eurlings was a strong advocate of the idea (especially of the basic principles) of ABvM. He emphasised that, if the RUC scheme would comply with these principles, it will be a much fairer scheme compared to today's scheme. Thanks to the phased decision process and the obligation to deliver regularly accounting/progress reports (Voortgangsrapportages etc.), there were many occasions for discussions with the political opponents.

Is has to be said, however, that the role and decision power of such a political champion in the Netherlands is not unlimited, as the political system is heavily dependent on the coalition parties and the coalition agreements as well as negotiations. For this reason the art of "wheeling and dealing" is of great importance for gaining political support in a coalition. Considering his somewhat limited role, minister Eurlings however performed well.

Commitment
The political commitment and political will are well documented by the clear and unambiguous statements in the coalition agreement. However, in the parliament it remains a controversial issue, although even parties not represented in the coalition (e.g. Green Party, D66) support the RUC scheme.

**Strong management, planning and rapidity (quick processing); Implementation agency**
The whole implementation process cannot be judged as quick and rapid. Despite of many years of research, there are still many elements not yet elaborated. The schedule had to be revised frequently. The planning and schedule are still not very realistic and reliable, as there is a big element of uncertainty incorporated (partly due to the innovativeness of the scheme and its technology).

During the planning and preparatory phase up to now one implementation agency (Ministry of Transport, Public Works and Water Management) had the full responsibility, but several other ministries were involved. (e.g. the Ministry of Finance). This involvement of several ministries was one of the reasons that the legislative process has been taking so long.

However, the actual introduction of RUC and the operation of the system will be entrusted to many private companies. This element of the actual introduction is still under elaboration and the effect of the high number of involved companies is not yet clear.

The cancellation of RUC projects already planned and the strong political element of the project are possibly reasons reducing somewhat the attractiveness of working in the project team of ABvM. It could have therefore been not always possible to hire the best people, which would have been a prerequisite for a strong project management.

**Communication**
Communication activities were limited as long as the policy for the introduction of the RUC scheme was not yet approved by the House of Representatives, as the execution of a large communication campaign and the related expenditures were not allowed prior to the approval. It was planned that after this approval the communication activities would have been expanded. Prior to this approval the first real communication actions were already undertaken after the presentation of the concept of the bill: e.g. the website of the Ministry was modified to be more aimed at the general public by adding explanations and calculation models for the assessment of the personal impact of the new scheme. Further increased communication activities were however not noticeable, except the appearances of the Minister in the media.

The communication focused on the fairness of the system. In particular, it was emphasised that the majority of the public will pay less than they do nowadays, which was seen as a big selling point. This aspect is an example of an argument which is easy to communicate and which obviously contributes to an increased acceptability.

As expected, the presentation of the draft bill aroused criticism. The focus of the opponents was mainly not on the basic principle, but on more specific elements of the proposed scheme and system. As many of these aspects were not yet elaborated in sufficient detail (e.g. roll-out, adaptation of taxation), it

was difficult to cope with the criticism and to provide counterarguments. Therefore the project stayed vulnerable for criticism.

**Clarity (clear objectives)**
Although there were several objectives linked to the introduction of the RUC, the basic principles were clear and understandable. From the start of the project strong emphasis was put on these principles. By adhering to these principles, the support for the implementation was positively influenced.

This positive statement, however, counts only for the basic principles. The large number of different (lower level) objectives contributed to confusion and made in the end the objectives unclear. The consequence of these not completely unambiguous objectives is a complex scheme which eventually is very difficult to explain and justify, especially what concerns the need and combination of the various components.

**Logical consistency, openness (transparency) and trust**
RUC is clearly a part of the general policy ("pricing, utilize, build") and thereby was accepted as part of the measures to improve mobility. The Minister emphasized that the "building" part of this policy was also supported and promoted by him, but he made also clear that only a combination of these measures can lead to a viable solution for the traffic problem. Many aspects of the scheme have still to be elaborated; therefore the details of many explicit measures are not yet known. Until the publication of the draft bill, many aspects of the new scheme were kept secret on purpose and therefore unknown to the public. With the publication of the draft bill, many aspects as tariffs and exemptions became clearer. However, full transparency in all issues is not yet achieved, as the controversy about the secret technical briefing given to the parliament shortly before the fall of the coalition in February 2010 demonstrates (Naaktgeboren, 2010).

Due to the bad experiences with serious difficulties and failures of public ICT projects in the past, the general trust in large ICT projects under the responsibility of the Dutch government is rather limited in the public.

**Use of revenues (earmarking)**
Revenues of the new RUC system are not allowed to be higher than the taxes levied in the current system. This principle led to a serious issue regarding the use of revenues, since current taxes are partly local (provincial) taxes. As the new revenues were not allowed to be distributed among the provincial authorities, they would loose this income in the new system.

The revenues are intended for infrastructure funds. This means clear earmarking of the revenues for a specific purpose, which is also seen as a basic principle of the new scheme, and thereby contributing to the acceptability of the new scheme. The issue of the operational costs are not yet solved. They should not exceed 5% of the revenues, which was often emphasised by the Minister.

**Resources**
Due to the phased decision process, a reasonable budget was allocated for the preparation phase, but also a relative large budget was reserved for mobility projects. The project team was growing constantly; however, there was criticism about the high number of external consultants (over 50%).

Moreover, one should not forget that not only the resources for the preparation phase play a role. The estimated costs of implementation (3.5 to 4 billion €) and exploitation (1 to 2 billion € per year (Ministerie van Verkeer en Waterstaat, 2010b)) are also an important element influencing the acceptance of ABvM and its successful implementation. Among other reasons, the complexity of the scheme makes the Dutch system an extremely expensive system, whose costs will have to be paid by the taxpayers. The public has to be convinced that these measures are necessary, that the expected effects justify such an investment, and that it is worth to take the risk for such high costs, even if the promised effects have not yet been verified.

**Complexity of scheme**
The planned scheme is characterised by an extremely high complexity, due to the combination of objectives (basic principles). The RUC tariffs have to be differentiated by time, place and environmental characteristics, everywhere in the Netherlands, and applicable to all cars. The amount of revenues was set to the taxes levied in the current scheme and a limit for the operational costs was set as well (maximum 5% of revenues). The combination of all these factors led to a further complication, since the complex scheme had to be reasonably cheap and affordable.

The basic tariffs were understandable and calculation models (however available only after the publication of the bill) made clear, how much the user would have to pay. Today it is not yet clear, what the exact influence of the much more complex surcharge for rush hours will be on the complexity of the scheme, as this aspect is not yet elaborated enough. However, it is rather obvious, that the rush hour charging is one of the most complex elements of the scheme.

Another complex issue is related to the protection of the users' privacy. As the planned thick OBU gathers data constantly about the position of the driver, clear rules have to be established how to handle this gathered data. This resulted in the elaboration of a very complex concept whose operation principle is difficult to explain to the public.

The complexity of the scheme is one of the aspects which has (and will have in future) a negative impact on the implementation. To elaborate all the details of such a complex scheme, more resources (budget and time) are needed. Furthermore, it makes the scheme extremely vulnerable to criticism from opponents.

**Technology**
The technology is complex, since the user's privacy has to be guaranteed, which requires a thick OBU, and the thick OBU requires a complicated installation, which takes time.
The most important issue is that the technology is still under development and is depending on innovations. Moreover, the system integration will be a very difficult process due to the dimension and number of elements of the system. Until now, only small and isolated elements of this kind of systems have been demonstrated as functioning without problems. The technology for occasional users has not yet been elaborated, but foreigners will be exempted. The high complexity of the technology and its related issues do not raise the chances of a successful implementation in the near future.

An issue inherently related to the choice of technology is standardisation. The Netherlands are closely involved in running standardisation processes (e.g.

EETS). However, the progress in agreeing on a European standard is slow and the Netherlands were in a difficult position. They had to conceive and develop a system that should comply - in the future - with standards, which were not available at the time of the system design. The active involvement in the standardisation process will possibly ensure some influence on the development of the standards and pay off later.

Scaling issues are very likely going to play a role in a later phase of the implementation, as the system has to be upscaled massively. After early small-scale trials, the first big upscaling-test will be the GPT with 60.000 users. After this test the actual start of the system with the HGVs (200.000 vehicles) will show whether the implemented concept can handle this range of upscaling. The biggest challenge then is the subsequent stepwise upscaling to 8 million cars. During these implementation steps it has to be clear that time and resources have to be made available to handle any emerging issues.

**Fairness**
As fairness for the users is one of the main basic principles of the RUC scheme, fairness is seen as an important (maybe even the most important) selling point of the proposed scheme. The user-pays principle, which will be applicable for everyone, is supported by a large majority.

However, the rationale for the surcharge in rush hours is difficult to explain in the context of fairness. These surcharges have been a controversial issue already during the coalition and played a role in the election campaign. This controversial issue might be a reason for political parties to stop promoting and supporting the currently planned scheme.

Due to the desire for maximum fairness, however, the scheme and system design became exceptionally complex. On one hand fairness increases the acceptability dramatically; on the other hand the complexity (caused by the desire for fairness) will make a successful implementation difficult.

An important aspect in the context of fairness are the measures taken for enforcement and fraud prevention, since a user who pays correctly his fee must be assured that the system is highly fraud-tolerant and that penalties will be applied and enforced without exemptions. In the ABvM anti-fraud measures are for instance built into the OBU and the GPS signal quality will be ensured by the Radio Communications Agency (Agentschap Telecom).

**Severity of problem of congestion**
The congestion problem is severe, although the daily congestion is fairly accepted by the public, since they got used to it over many years. Moreover, a large part of the public considers the construction of new roads as the solution for the problem. Mainly due to the economical downturn of the last years the congestion problems did not increase, but rather decrease. Therefore, the public does not recognize the danger of a potential traffic collapse in the future. Until the problem is not perceived as severe enough, this will stay a factor hampering implementation.

**Public Consultation**
Before the actual start of the implementation, a commission elaborated the principles. Although this was not a factual public consultation, many stakeholders and representatives of motorists were involved from the beginning and therefore supported the implementation. The Ministry could hide behind these involved organisations, as they elaborated the principles and

recommendations. During the implementation process, there were many occasions of consultation. The involvement of the different stakeholders in the various phases had a positive effect on the public support and acceptability.

Although no real referendum was planned, the ANWB held a referendum, which was generally seen as very important. The referendum, however, was not a simple yes/no referendum. Therefore, the result of the referendum was an expression of the public opinion about the general issues of the RUC scheme and its implementation. In principle, the outcomes of the referendum could contribute to the implementation. Since shortly after the referendum the government fell and all RUC implementation plans were stopped, it is difficult to estimate what the effect of the referendum would have been.

**Benefits (Public transport)**
Although experience from small-scale projects in the Netherlands and projects abroad indicates that RUC can have a substantial positive effect on traffic, there is no real evidence that this will also be valid for ABvM, which is a large-scale nationwide project. Therefore the expected benefits are a controversial issue and vulnerable to criticism. Opponents of ABvM effectively called the new scheme a "congestion tax", as in their opinion users will have to pay for being stuck in traffic jams.

**Legislation**
The legislation process of ABvM (although not even finished) showed that this is one of the trickiest parts of the implementation process. As there has to be a firm basis for the scheme, many aspects have to be integrated in the new law. As the draft bill has already shown, the new law will become quite extensive. Furthermore, the legislation process shows the importance of timing. Sticking to the original plan to finish the legislation process within the period of the government would have contributed to the successful implementation. However, with or without the fall of the government, in the end this tight schedule turned out to be unfeasible, and therefore the legislation process depends on the new coalition agreement. Technological and organisational issues have not yet been fully elaborated and are therefore only partially implemented in the law.

**Efficiency**
The basic principle that the revenues shall not exceed the total amount of currently levied taxes restricts the freedom of choosing an effective scheme. The base tariffs will be generally based on two principles: These tariffs firstly will have to be compliant with the maximum level set for the revenues and secondly, to increase the level of acceptability, they will be set to a level that the majority of users will pay less than in the current tax scheme. The introduction of the rush-hour surcharge, however, will be more aimed at efficiency, as this is the most effective instrument to reduce congestion. Since these surcharges seem to be one of the most controversial elements of the scheme, a careful trade-off between efficiency and acceptability will be unavoidable. Before the RUC plans were put on hold due to the fall of the government, the acceptability of these surcharges became a hot topic of discussions, but the exact results of these discussions and of the related trade-off are not yet known.

**Timing (stable political environment)**
As traffic problems and mobility are topical issues for many years, there is a strong will to tackle these issues. However, new governments have their own

priorities and solutions. Until now, no real continuation of the previous plans has taken place after new elections.
However, the plan for ABvM (not yet called ABvM), which started in 2004, has survived 6 years. Although a broad majority (as already mentioned) supported the plans in the House of Representatives and there is a consensus that measures are necessary, it cannot be predicted how plans will develop after the elections. It is however most likely that current plans and implementations will not be continued as planned.

**General transferability**
Successful projects abroad did not have the level of complexity of ABvM and therefore were not really applicable for the Dutch case. This also applies to the cases of small-scale projects. As the Dutch project is actually a pioneering work and will serve as a reference project, many other countries will rely on the experiences gained in the Netherlands.

**Acceptability**
Acceptability and public support were for Minister Eurlings the key criteria from the beginning of the ABvM project. High acceptability therefore was very important during the preparation and implementation. Many elements of the implementation process contributed positively to the acceptability. The fairness incorporated as a key element in its basic principles was the main contributor. The support of the societal parties was also assured, in particular through regular and intensive consultation campaigns. The use of revenues (earmarking for infrastructure-related investments and maintenance) and the logical consistency of the proposed plan play as well a role for the acceptability.

On the negative side, one has to mention that the limited transparency was eagerly used by the opponents of the RUC scheme to demonstrate that the proposed scheme and system was faulty and would never work as promised. This negative opinion was further aggravated by the limited trust of the public in the capability of the government to manage competently the implementation and operation of such a complex system. The missing convincing evidence for the promised benefits was also a reason for a reduced acceptability.

The complexity of the system contributed to the fact that resistance was so strong. Many issues were not that clear from the start. The more hidden issues became apparent during the implementation process, the more the specific criticism increased. As already said, the basic principles of the scheme were not the problem. These acceptable principles, however, were undermined by issues, which were not yet solved, or not solved adequately. An example is the chosen process of a stepwise introduction of the system, which was not seen as fair, since it could not be excluded that some people would pay more in the transition period (current vehicle tax, BPM for a purchased car).

## 6.1.2. External validation of framework

Interviews were held with senior officials of the Ministry of Transport, Public Works and Water Management (Mr. Heijboer, Projectmanager ABvM and Mr. Arnoldussen, Chief Information Officer (CIO) of ABvM) in order to get an independent assessment of the applicability and usability of the framework for the targeted users, who are the authorities responsible for the planning and implementation of large-scale RUC projects of the size and complexity of ABvM, and to achieve thereby an external validation of the framework.

According to both experts, the elements of the framework coincide to a large extent with the factors which have played up to now a role during the implementation of ABvM. Some of the factors (as discussed below) were emphasized as very important, but above all acceptance was confirmed as being of major importance. A political champion was also confirmed as being very essential for this kind of transition projects (the experts referred to the health insurance reform in the Netherlands, which was pushed through all political hurdles by minister Hoogervorst (Minister of Health, Welfare and Sport 2003-2007)).

However, in the interviews the experts mentioned a few factors which are in their opinion not (fully) incorporated in the framework. Most of the factors, which were mentioned by the experts, are however already (sub)elements of factors already incorporated in the framework and can thereby be considered to be actually integrated into the framework. Nevertheless, the following factors will be shortly discussed to reflect the opinions of the experts.

**Privacy**
Privacy has been extremely important from the beginning of ABvM, especially since in the Netherlands all cars will be subject to the new road charge and have to be equipped with onboard units. As the project team was alerted by experiences abroad, privacy played a very crucial role in the design phase. Only by considering this factor from the beginning, it was possible to integrate privacy into the design in such a way that privacy can be completely guaranteed (e.g. "by separating the technology not only logically, but also physically"), which is essential for the acceptance. The fact that in the Netherlands the general public is not yet fully convinced by these arguments is mainly due to insufficient communication (In the analysis of ABvM the issue of privacy has already been identified as important in the context of the factors "technology" and "complexity of scheme", but not explicitly within the factor "acceptability".

**Costs**
The cost of the actual system (investment and exploitation) does have a great influence on the acceptability of a proposed scheme, since it is eventually the taxpayer who has to pay for the project (This factor has already been addressed in the analysis of ABvM. To add the factor "cost" as a separate factor in the framework could be taken as a recommendation for improvement).

**Interoperability**
Interoperability is a big issue in the ABvM project team. The Netherlands are actively involved in the different interoperability and standardisation processes, as future interoperability obligations can have far-reaching consequences (Interoperability is already included in the factor technology).

**Fraud prevention**
Fraud prevention, but even more the perception of the user of fraud prevention, is very important for the acceptance (The fraud prevention element is already incorporated in the factor fairness).

**"3 B's" i.e. strategy of building new infrastructure, improving the use of existing infrastructure and pricing**
It is important to emphasise that there is a broader strategy including more measures than only introducing pricing to improve acceptability (the factor "logical consistency" covers this aspect of the implementation).

**Social Cost-Benefit analysis**
First of all the results of the Social Cost-Benefit analysis should be positive to make the designed RUC project acceptable for the public. As the individual benefit is in most cases less noticeable than the individual costs, it has to be emphasised that the society as a whole will be better off. By communicating this idea extensively the acceptance can be improved. (This can be understood as an extra amendment of the factor "benefits", which is already mentioned in the framework as a factor of great influence on the acceptability).

**Ease-of-use**
This factor is not included in the framework. It is stated that ease-of-use will be crucial for the acceptability in a later stadium of the implementation and therefore important for the success of the implementation. The system and its equipment have to be comprehensible for all users and should be "user friendly". In the reviewed literature ease-of-use has not been identified as a separate factor, since it is often treated in the context of "simple technology". As in the opinion of the experts ease-of-use will play an important role in the later phase of the system implementation, it could be justified to include "ease-of-use" as a separate factor in an extended version of the framework.

**Usability of framework**
Both experts confirmed in the interviews that the framework provides a good overall view of the critical factors determining the implementation of Road User Charging projects and, moreover, indicates correctly the actual key role of acceptability. They further commented that as a matter of fact the configuration of the framework is clear and helpful to see and grasp al key factors at a glance.

On international level there are many developments and a lot of countries are interested in RUC projects and its implementation processes. The Netherlands have been trendsetters until now, and there is a lot of interest from abroad. For example Belgium, Denmark and also France are watching carefully the developments in the Netherlands. Also requests for information from many other countries as for example the US and Singapore are often received in the ministry. These countries are not only interested in the technology (e.g. the chosen technology and standardisation), but moreover in the handling and management of the acceptability issue (as the Dutch system will be a large-scale system obligatory for all users, where the privacy issue is very important) and the other relevant factors.

Therefore, in the opinion of the experts, the framework and the thesis can be very interesting for foreign Ministries of Transport, which are considering the implementation of Road User Charging systems, and also for other interested organisations and companies like new stakeholders and new project members in a running RUC. A publication of this framework in an Intelligent Transportation System (ITS) related journal/magazine was recommended. According to the experts the framework could be further expanded by adapting it to the different phases of an RUC project (Definition phase, actual implementation phase and also exploitation phase), since some of the factors (like e.g. acceptability) might play a different role in the different phases.

## 6.1.3. Applicability and usability of framework

Summarising above discussions of the factors involved in the ABvM and assessing the applicability of the framework, taking also into account the results of the interviews with the experts one can state that the developed

framework turned out to be a useful tool for the analysis of the implementation of a large-scale RUC project like the ABvM, since it highlights correctly the crucial factors and their general interrelations and dependencies. In any case, all the factors which are elements of the inner circle of the framework, since they have a determining influence on the acceptability, can also be found being present in the ABvM. The framework covers the important factors and aspects of the implementation of ABvM and fully confirms the importance of acceptability. The general applicability and usability of the framework was also confirmed in the interviews by the experts (A few comments were made regarding the emphasis on certain factors and aspects. In addition some suggestions were made for an expansion of the framework).

One should however keep in mind the original objective and purpose of this framework, namely to be a tool for the analysis of the implementation of RUC projects. One should not be disappointed that this framework will not be the all-singing all-dancing miracle tool guaranteeing a successful implementation of RUC projects and providing solutions for conflicts and dilemmas. As intended, it is an analysis tool, which correctly identifies the crucial factors and highlights areas of potential conflicts and dilemmas. It can be used with benefit for the analysis of implementations in progress, for the post-implementation evaluation, but also in the planning phase to make sure that important factors and their interdependencies will not be overlooked (Mr. Heijboer, personal communication, August 3, 2010), (Mr. Arnoldussen, personal communication, August 3, 2010).

Whereas the developed framework shows those factors, which are found relevant for RUC projects in general, it is not surprising that the significance and importance of the factors will vary from project to project. This is also the case for the ABvM, where the course of the developments and the status of today emphasise even more the importance of factors like

- Acceptability
- Fairness
- Legislation
- Technology and system design (Innovation)
- Complexity
- Timing/stability
- Resources (Costs)
- Privacy

Globally speaking, there are no obvious shortcomings or deficiencies in the developed framework with respect to its applicability for a large-scale RUC project like the ABvM. A minor weakness of the framework can be found in the fact that it does not properly address the complexity of the procurement and tendering process of large-scale RUC projects. This weakness, however, is understandable and acceptable, since for most of the projects used for the construction of the framework this issue was not of great importance. In contrast to these projects, the ABvM will make use of new technology, which cannot be procured off the shelf. In addition to the challenge and risk to use new technology, the system design and system requirements are an issue, which needs to be agreed in consultation with the market parties.

## *6.2. Dilemmas of ABvM and related reflections*

In the cross-correlation table, which was conceived in Chapter 4 to support the developed framework, we have indicated potential areas of conflicting trade-offs and dilemmas, which are often linked with those factors, which show a

strong interrelation and interdependence. Indicating these potential areas of conflict does of course not mean that in each project one will find the same sort of conflicts and dilemmas, and with the same level of significance.

Therefore it is worthwhile to take a critical look at the implementation process of the ABvM in order to identify areas of conflicts and dilemmas in the ABvM and to check whether they are in agreement with the conflict-critical factors identified in the cross-correlation table.

## 6.2.1. Areas of conflicting trade-offs and dilemmas in the ABvM

**Communication ⇔ Complexity of scheme**
An obvious dilemma is that a more complex scheme makes efficient communication difficult. This means, that the complexity of the scheme should be kept low in order to make a clear and efficient communication possible. A clear communication is definitely needed during the complex implementation process of a RUC project. However, if a high complexity of the scheme cannot be avoided, then one has to accept as consequence that clear communication will be extremely difficult and therefore the impact of communication on the success of implementation will be marginal.

For ABvM the communication of its difficult scheme turns out to be very challenging. The fact, that many issues have not yet been solved, makes the communication even more difficult. As soon as elements of the scheme were made public, opponents found immediately new elements for criticism. This shows also that it is difficult to determine, how much details should be communicated and at which point in time. By communicating in an early phase one can prevent some problems and can increase the acceptability. This early communication is however complicated and often not really possible, when the scheme is complex and still under development. The ABvM case shows that the emphasis on the basic principles was important for the acceptability of the project, but the many elements of the complex scheme and the unsolved issues were difficult to explain and to communicate to the public, which undermined the efforts for clear communication. This confirms that, when a complex scheme is required, which already makes the success of the implementation less likely, good communication can hardly compensate the negative effect of complexity on the success probability.

**Complexity of scheme ⇔ Fairness**
One of the important factors regarding RUC in the Netherlands is fairness, which is considered as extremely crucial for the acceptability of ABvM and for the success of its implementation as well. The aim for "complete" fairness led to requirements that made the scheme very complex. The high complexity, on the other hand, is a factor, which reduces the chances for a successful implementation of ABvM. As a consequence one has to recognise that by striving for maximum fairness (and therefore for high acceptability) in the end the opposite effect might be attained.

**Complexity of scheme ⇔ Acceptability**
Since Minister Eurlings emphasised from the beginning that the implementation of ABvM will only succeed, if there is a broad majority supporting this implementation, efforts to ensure high acceptability have been extremely important from the beginning. This was tried by involving many stakeholders and societal parties in the implementation process as already demonstrated with the Commission Nouwen at the start of ABvM in 2004. However, this

resulted in a scheme and system design, where many aspects were incorporated to guarantee the acceptability of the proposed RUC project. As already mentioned repeatedly, this complexity is extremely harmful for the success of the implementation. Moreover, the complex scheme requires a complex system design with complex technology. This is clearly demonstrated by the fact that the scheme has to be applicable on all roads in the Netherlands. Combining this with the required differentiation by time and place, the only technological solution is the very complex GPS technology. This GPS technology, however, has become one of the main points of criticism. Despite of extreme efforts (technological and legislative) to guarantee the users' privacy, this technology remains vulnerable to criticism due to its privacy issues. The acceptability of the RUC project suffers severely from these issues, especially since the opponents seized this opportunity of weakness and started an effective campaign against the "big brother unit". The lack of trust in this technological solution is confirmed by the referendum held by the ANWB in 2010, where the privacy and complexity issues of the technology were judged as undesirable. The fact that the privacy issue plays an important role is in contradiction with findings about other projects found in the literature (Ison & Rye, 2005), (PRoGRESS Project, 2004). Again, striving for high acceptability resulted in the end in a decrease of acceptability, which makes the success of implementation less likely. The real dilemma is that a comprehensive and therefore complex scheme is often unavoidable to fulfil the expectations of all involved parties in order to gain the desired broad support, but in the end it can have a negative effect on the acceptability.

**Simple technology ⇔ Fairness**
A simple technology is good for a fast and low-risk implementation. All fairness requirements can however not be fulfilled with simple technology. This dilemma is a sub-element of the complexity⇔acceptability dilemma as discussed in the previous paragraph.

**Summarising** the discussions about the areas of conflicts and dilemmas in the implementation of ABvM, one can clearly identify - fully in line with the conflict areas shown in the cross-correlation table in Fig.4.2 - the conflict triangle "complexity of the scheme ⇔ fairness of the scheme ⇔ acceptability" as the core of the problems in the implementation of ABvM up to now.

## 6.2.2. External validation of dilemmas of ABvM

The main dilemmas in the implementation of ABvM (Complexity of scheme ⇔ Fairness, Complexity of scheme ⇔ Acceptability) as identified above were fully confirmed by the experts.

As already mentioned, in their opinion acceptability is very important, however, it is unavoidable to make choices. It is simply not possible to fulfil all demands and expectations in order to obtain and maintain full acceptability for everyone. Therefore one has to strive to find an optimum relation between high acceptability and low complexity. This trade-off, however, is often determined by a political choice. For the ABvM this means that one has to accept the high level of complexity, as the political choice was to focus on high acceptability.

The complexity, which both experts confirmed as being very high for this specific project, is highest during the definition phase of the implementation, for following reasons: major change of taxation scheme, many stakeholders with vested interests, new and unknown concept, new law not yet passed, procurement contracts not yet placed with industry.

According to the experts the strategy to deal with high complexity has to be to follow a stepwise approach. The complexity has to be resolved bit by bit and all these individual steps have to be taken. This stepwise approach has a given lead-time, which is unavoidable and has therefore to be accepted. On the other hand a certain progress has to be achieved in a reasonable timeframe. Therefore it was decided in the ministry to run during the implementation of ABvM many processes in parallel, which resulted in an even more complex process and in higher risks.

However, also in an approach with processes running in parallel, it is mandatory to integrate milestones and go/no-go decisions into the implementation process and to maintain full clarity about the running costs. Most important is to demonstrate to the public that the chosen approach is feasible as well as credible, and the progress made will lead eventually to the realisation of the plans. An important step to achieve this goal is to demonstrate the functioning of the concept in a real-life proof-of-concept test.

### 6.2.3. Reflections on the ABvM

Very characteristic for ABvM is the fact that there are many (still) unsolved dilemmas, some of minor importance, but some of major importance, as indicated above.

Focussing on and aiming for highest acceptability (in principle desirable) allowed to progress up to today. Aiming for highest acceptability led to stringent (rather unfeasible on short-term, e.g. 5% limit on operational costs) and sometimes conflicting requirements making the system very complex. The complex set of requirements made the implementation process vulnerable for public and media criticism, which makes all transitions of tax and law etc. very difficult and time-consuming, as they need full acceptance.

Concluding it can be stated that the reasons for the obvious and well-known delays and difficulties in the implementation of ABvM can most likely be linked to those factors, which are prone to cause conflicts and dilemmas as elaborated in Chapter 4. In the case of the ABvM they are even more pronounced due to its complexity. The knowledge and early identification of potential conflict and dilemma areas is a classical risk mitigation measure helping to reduce the risk for delays or total failure of the implementation. However, it has also to be stated that these main issues are not yet solved and therefore are still a serious problem for the successful implementation, even in the case that the new coalition will proceed with the implementation.

Small-scale projects and projects for specific target groups (e.g. HGV) have been successfully implemented, as shown by a number of projects. There were quite a number of barriers and difficulties, but thanks to the limited size or scope of these projects, solutions for the dilemmas could be found and the decision and implementation process could be accomplished within a government period.

For the ABvM the situation is different: due to the complexity of this large-scale project, finding acceptable solutions for the dilemmas will be a time-consuming process and most likely cannot be accomplished within the four years of a government period. It is noticeable that even after 20 years of research and preparatory work and six years of specific project implementation preparation this project could be quickly put on hold by a political decision, and the continuation of the project is now uncertain (this is in contrast with

infrastructure projects, where significant investments are already made in the preparatory phase making it "expensive" and therefore difficult to stop such projects).

On the long run an RUC scheme will be unavoidable in the Netherlands. Therefore it is worthwhile to mention a **few points which deserve special attention** to make a successful implementation more likely:

**Dilemmas need to be solved (or, if unsolvable, clear political choices and decisions are needed)**
The extreme complexity of the scheme requires extensive elaboration efforts. Until now, these different but highly interrelated processes (legislative/technological/organisational) run mostly in parallel. These interdependences make the elaboration of the concept very challenging, and as ABvM shows, the detailed elaboration is a very time-consuming process. However, it is important to elaborate these plans thoroughly, as this is crucial for clear communication and therefore for a high acceptability of the project. Although these matters are urgent, no hasty decisions and rash steps should be taken, which would only lead (again) to a cancellation of the implementation process. Therefore it should be made clear to everybody and communicated openly that thorough preparation is needed and this process will take time.

**Legislation**
The attempt to take irreversible steps for the implementation of an RUC system and secure these steps by proper legislation within a government period (four years) was definitely an excellent effort. However, good preparation is essential, and the elaboration of elements of a new law is very time consuming, as shown by the ABvM case, where not all issues could be solved completely. The trade-off between timing versus completeness will play a role. However, the focus should be on a thorough preparation. The plan to introduce new legislation within a period of four years was already very ambitious, even in a stable political environment, but became unachievable due to the fall of the government.

**Stable political climate**
A stable political climate is an absolute requirement, as shown by ABvM.

**Demonstrator projects**
Continue and expand the implementation of successful demonstration (pilot) projects and communicate with proper Public Relations campaigns the results of these demonstrator projects. As the benefits (effects) of the RUC are questioned constantly in the Netherlands, it is essential that these benefits can be demonstrated by providing credible evidence.

**Complexity**
Keep for the introduction the complexity of the scheme as low as possible, but ensure that sufficient flexibility is built in to allow the addition of options and new features later on, when new technology becomes available. This is definitely an area of conflicting trade-offs: simplicity versus flexibility, and growth potential versus fairness and acceptability. If complexity is not low, keep expectations about schedule realistic. High scheme complexity results in system requirements, which only can be met by complex technology, which is not yet available on large scale.

**Communication and consultation**
Continue and even strengthen communication and consultation; ensure absolute support from societal parties (dilemma with acceptability). Communicate the severity of the problem, make clear that other measures will not be sufficient to solve the problems of the future, and communicate realistic costs and negative economic effects of congestion.

**Speculation for the future**
As the Netherlands are pioneering in the field of nationwide large-scale RUC projects, there is no hope to find help by looking at other successfully implemented RUC projects: these dilemmas have to be solved by the Dutch authorities and implementation agencies, which will take time. The Netherlands have made real progress in the past six years and by continuing their efforts and stimulating innovative solutions, they will become a global leader in the field of RUC. This potentially will have great benefits for the future.

As stated recently in a Dutch newspaper (Vermeer, 2010), many political parties support the implementation of a form of RUC. The implementation of RUC is also supported by experts who say that the approach with the highest chance to solve the congestion issues is a RUC system.

ABvM (or a sort of RUC) will come in the Netherlands, when the congestion problem will become so severe that it is unacceptable for the majority of the public, and other issues, now still being a major concern for acceptability, will probably play a less decisive role (e.g. costs, taxation law, privacy etc.). The increased public support will make a political decision for implementation easier than nowadays. RUC continues to be a hot issue: it was an issue for the recent elections, now it will become an issue for the coalition negotiations. The actual developments in the near future will depend on the next coalition and its agreements.

# 7. Conclusions

Mobility, which is an essential need of human beings, and other traffic and transport related issues are playing an important role in our daily life. Most likely many of these issues will become serious problems in the (near) future. The main concern is of course the growing traffic congestion, but other traffic-related problems as the pollution of the environment or the cost of the road infrastructure must not be forgotten. One of the measures frequently identified as a possible contribution to the solution of these issues is Road User Charging (RUC), which explains why for many years attempts are being made in many countries to introduce RUC. However, despite decades of research the number of operational RUC systems all over the world is rather limited. After a number of failed attempts to implement RUC in the Netherlands, the Dutch government has been trying since 2004 to introduce a nationwide RUC system. This system, called ABvM, whose characteristics and implementation status are described in detail in Chapter 5, is characterized by a very high complexity, which is one of the reasons for the difficult implementation process and the well-known delays.

In order to succeed with the implementation of such a complex system a good knowledge of the factors, which are critical for the success or failure of the implementation, is essential. Therefore the motivation for this thesis was to derive these factors from the positive and negative experiences gained in RUC projects abroad and in small-scale projects in the Netherlands and to translate them into a theoretical framework to be used as a tool for the analysis of the implementation of large RUC projects like the Dutch nationwide ABvM project.

Based on the analysis of the implementation processes of several RUC projects abroad and taking into account the experiences gained in small-scale projects in the Netherlands, the factors playing an important role during the implementation of RUC systems and therefore mainly determining the success of the implementation have been identified:

- Political champion
- Strong management, planning and rapidity
- Communication
- Clarity
- Logical consistency, openness and trust
- Use of revenues
- Resources
- Complexity of scheme
- Technology
- Fairness
- Severity of problem of congestion
- Public consultation
- Benefits
- Legislation
- Efficiency
- Timing (political environment)
- General transferability
- Acceptability

From a critical discussion and analysis of these factors it can be concluded - in agreement with other authors - that acceptability is the most important factor for a successful implementation.

These factors have then been incorporated into a framework, which gives an overview of these crucial factors and emphasizes the important role of acceptability. It shows the various factors influencing directly the acceptability, but also other factors determining the success of the implementation of RUC systems. It also shows that most of these factors are heavily interrelated. Good knowledge and correct understanding of these interrelations are important for a solid analysis of the implementation of such complex projects. Moreover the

analysis of these interrelations reveals areas of potential conflicts, which can lead to dilemmas in the implementation of RUC systems.

In order to validate the developed framework, the developed framework was then used for the analysis of the implementation process of the Dutch RUC project ABvM. As discussed in chapter 6, the identified factors play indeed an essential role in the current implementation of ABvM. Although the implementation of ABvM is by far not yet completed (even currently put on hold), it can be stated - in agreement with the assessment of experts from the Ministry of Transport, Public Works and Water Management - that the framework correctly identifies the crucial factors of the implementation process and how these factors support or hamper the (potential) successful implementation. Furthermore, the framework shows also the conflicting interrelations, which can lead to serious dilemmas and which partly explain the difficulties and delays actually occurring in the implementation of ABvM.

The main dilemma of keeping on one hand the system complexity low and on the other hand ensuring maximum fairness and acceptability represents an almost unsolvable issue. In order to reach the desired high level of acceptance, a high complexity of the scheme and system is unavoidable, if as many as possible fairness requirements have to be met. The high system complexity, however, hampers the acceptability, since the broad public does not like complex systems. It has to be said that in case the implementation of the Dutch RUC system shall continue as planned, these crucial dilemmas will have to be solved with priority. This will require much more time than originally anticipated.

As the application of the framework to the ABvM case demonstrates that the crucial elements of the implementation are correctly identified in the framework, it is fair to state that the developed framework is applicable to large-scale RUC systems of the size and complexity of ABvM. The developed framework forms a useful tool for the targeted users, who are the authorities responsible for the planning and implementation of large-scale RUC projects or new stakeholders and organisations joining an RUC project during the implementation phase.

# 8. Reflections

**Scope**

It is striking to notice that Road User Charging, which has been discussed for so long all over the world (and especially in the Netherlands) and which seems to be a solution for many of our traffic problems, is so difficult to be successfully implemented. Road User Charging is a very broad topic, which encompasses many issues, and it is therefore difficult to pinpoint the exact reasons for these implementation difficulties. Many stakeholders and experts have diverse views on these issues. These views are often contradicting and often emphasising different elements of being important and critical. Therefore it was interesting and challenging to engage in a research project to investigate what are the real reasons for these difficulties and to try to pinpoint specific factors, which can be seen to be the cause for the implementation problems.

Finding the right scope for the research of such a complex and topic under constant development was a difficult task. The initial assignment of the internship at Berenschot/ Ministry of Transport, Public Works and Water Management provided some guidance, putting the focus on the actual implementation process of the Dutch nationwide RUC system. Unfortunately the scope of the research had to be redirected due to the cancellation of the contract between Berenschot and the ministry. Although the thesis research could be continued, the scope had to be widened and many other topics had to be taken into account. Whereas usually the scope is being narrowed down during the research project, in this case the scope was broadened: the basic idea of the research project was not to focus on a specific element as technology or legislation, but to give a comprehensive view of the implementation of RUC projects. A further difficulty for defining the scope was due to the fact that the RUC projects (mobility projects and ABvM) in the Netherlands are in constant development generating constantly a flow of new information.

**Methodology**

Originally it was intended to hold also interviews with key representatives from the various mobility projects in the Netherlands in order to gather the most up-to-date status information about the projects as a complement to the information from literature. However, already the first interview held with a representative of the most important mobility project revealed that large uncertainties exist due to the slow and delayed implementation of the mobility projects. Since it could not be expected that much useful information would be obtained in additional interviews, the added value of interviews was judged marginal and the interviews were not continued. As a compensating measure, the ABvM project status meetings, which have been organised by Connekt on behalf of the Ministry of Transport, Public Works and Water Management, were regularly attended. These meetings and the contacts with the participants provided up-to-date information about the ABvM which turned out to be very useful for this thesis. Furthermore, public documents were the basis for the analysis of the case studies.

In the final phase of the completion of this thesis interviews with two representatives of the Ministry of Transport, Public Works and Water Management were held, in order to get an external validation of the applicability and usability of the developed framework. These interviews turned out to be of great value, and, if there would not have been the holiday season, more interviews with other stakeholders would have been possible, even in this short period, providing additional validation of the framework.

# References

Bendixson, T. (2008). Road pricing in Britain and its relevance to the United States: findings from two scenarios of national road charging in Great Britain and some reflections on governance. In H. W. Richardson (Ed.), *Road Congestion Pricing in Europe. Implications for the United States* (pp. 39-56). Northampton: Edward Elgar Publishers.

Bergh, J.C.J.M. van den., Leeuwen, E.S. van., Oosterhuis, F.H., Rietveld, P., & Verhoef, E.T. (2007). Social learning by doing in sustainable transport innovations: ex-post analysis of common factors behind successes and failures. *Research Policy*, 36, 247-259.

Bondavalli, A., Brancati, F., Ceccarelli, A., & Falai, L. (2009). *An experimental framework for the analysis and validation of software clocks*. In LNCS Software Technologies for Embedded and Ubiquitous Systems (pp. 69-81).

CESARE III Project. (2006). Interoperability of electronic fee collection systems in Europe, D1.2 Revised CESARE Model. Brussels.

Chiaradonna, S., Lollini, P., Di Giandomenico, F. (2007). *On a Modeling Framework for the Analysis of Interdependencies in Electric Power Systems*. Proceedings from 37th Annual IEEE/IFIP International Conference on Dependable Systems and Networks (pp. 185-195). Edinburgh.

City of Stockholm. (2006). Facts and results from the Stockholm Trials. Stockholm.

Connekt. (2007, April 13). Minutes Kick-Off meeting Special Knowledge Group ABvM. Delft.

Connekt. (2008, April). Report round table discussion Special Knowledge Group ABvM. Delft.

Connekt. http://www.connekt.nl.

Consortium Spitsmijden. (2007). Experimental design and modelling – Spitsmijden.

CURACAO. (2009). *Final Report.* Coordination of Urban Road User Charging Organisational Issues Sponsored by European Commission under the FP6 Framework. Transport & Travel Research United Kingdom.

De Palma, A., Lindsey, R., & Proost, S. (2007). Synthesis of case study results and future prospects. *Research in Transportation Economics*, 19, 269–297.

European Commission. (2009). Commissions Decision on the definition of the European Electronic Toll Service and its technical elements. 2009/750/EC, OJ L 268/11 of 6.10.2009. Brussel.

Furch, A. (2008). *Global view on Business Cases for Road Pricing depending on the choice of charge schemes*. Unpublished paper. Delft University of Technology, Delft, Nederland.

Ison, S., & Rye, T. (2005). Implementing Road User Charging: The Lessons Learnt from Hong Kong, Cambridge and Central London. *Transport Reviews,* 25, 451-465.

KiM (Kennisinstituut voor Mobiliteitsbeleid). (2009). *Mobiliteitsbalans 2009*. Den Haag.

KTA (K.T. Analytics, Inc.). (2008). Lessons Learned From International Experience in Congestion Pricing*. Final Report prepared for U.S. Department of Transportation, Federal Highway Administration.*

Lee, S. (2008). Transferring London congestion charging to US cities: how might the likelihood of successful transfer be increased? In H. W. Richardson (Ed.), *Road Congestion Pricing in Europe. Implications for the United States* (pp. 212-227). Northampton: Edward Elgar Publishers.

LogicaCMG (2005). *Bijlagenrapport Het KAN! Techniek, organisatie, handhaving en kosten van varianten van Anders Betalen voor Mobiliteit*, LogicaCMG, Capgemini, GetID.

Meyer, M.D. (1999). Demand management as an element of transportation policy: using carrots and sticks to influence travel behavior. *Transportation Research Part A: Policy and Practice*, 33, 575-599.

Miller, C.S. (2009). *Transformation paradox: A framework for the analysis of politics in enterprise transformations*, Ph.D. Thesis, Old Dominion University, Norfolk

Ministerie van Verkeer en Waterstaat. (2004, September). *Nota Mobiliteit 2004*. Den Haag.

Ministerie van Verkeer en Waterstaat. (2005). *Different Payment for Mobility Platform*. Den Haag.

Ministerie van Verkeer en Waterstaat. (2007a). *Starten met de Kilometerprijs*. Den Haag.

Ministerie van Verkeer en Waterstaat, (2007b, March). *Notitie Implementatiepaden, werkgroep implementatie*. Den Haag.

Ministerie van Verkeer en Waterstaat, (2007c, October). *Public Private Comparator - onderzoek naar de optimale organisatievorm voor de kilometerprijs*. Den Haag.

Ministerie van Verkeer en Waterstaat. (2008a, June). *Letter Partial implementation decision based on Implementation Plan for Road Pricing System*. Den Haag.

Ministerie van Verkeer en Waterstaat. (2008b). *Letter Voortgangsrapportage 1 ABvM*. Den Haag.

Ministerie van Verkeer en Waterstaat. (2009a, June 30). *Presentation*. Den Haag.

Ministerie van Verkeer en Waterstaat. (2009b, November 30). *Presentation Connekt ABvM*. Den Haag.

Ministerie van Verkeer en Waterstaat, (2009c, March). *Voortgangsrapportage 2 ABvM*. Den Haag.

Ministerie van Verkeer en Waterstaat. (2009d, June). *Voortgangsrapportage 3 ABvM*. Den Haag.

Ministerie van Verkeer en Waterstaat. (2009e, June 30). *Presentation Connekt ABvM*. Delft.

Ministerie van Verkeer en Waterstaat. (2009f, November). *Memorie van toelichting*, *Wet kilometerprijs*. Den Haag.

Ministerie van Verkeer en Waterstaat. (2009g, November). *Letter Wet kilometerprijs*. Den Haag.

Ministerie van Verkeer en Waterstaat. (2009h, November). *Organisatie en werking in vogelvlucht, Wet kilometerprijs*. Den Haag.

Ministerie van Verkeer en Waterstaat. (2010a). *Letter, controversieel verklaring*. Den Haag.

Ministerie van Verkeer en Waterstaat. (2010b, April). *Voortgangsrapportage 4 ABvM*. Den Haag

Naaktgeboren, D. (2010, February 8). VVD woest, maar kan niets zeggen. *De Telegraaf*.

Nash, C., Menaz, B., & Matthews, B. (2008). Inter-urban road goods vehicle pricing in Europe. In H. W. Richardson (Ed.), *Road Congestion Pricing in Europe. Implications for the United States* (pp. 233-251). Northampton: Edward Elgar Publishers.

Nimwegen, N. van., & Heering, L. (2009). Van groei naar krimp: een demografische omslag. Samenvatting en discussie. In: N. van Nimwegen & L. Heering (Ed.), *Bevolkingsvraagstukken in Nederland anno 2009. Van groei naar krimp; een demografische omslag in beleid* (pp. 1-25). Werkverband Periodieke Rapportage Bevolkingsvraagstukken (WPRB), NIDI report nr. 80. Amsterdam: KNAW Press.

Niskanen, E., & Nash, C. (2008). Road Pricing in Europe – A Review of Research and Practice. In C. Jensen-Butler, B. Sloth, M.M. Larsen, B. Madsen and O. A. Nielsen (Eds.), *Road Pricing, the Economy and the Environment* (pp. 5-27). Berlin: Springer.

Praag, C. van., & Nimwegen, N. van. (2006). De grote stad in demografisch perspectief: samenvatting en discussie. In: N. van Nimwegen & L. Esveldt (Ed.), *Bevolkingsvraagstukken in Nederland anno 2006. Grote steden in demografisch perspectief* (pp. 13-46). Werkverband Periodieke Rapportage Bevolkingsvraagstukken (WPRB), NIDI report nr. 71. Den Haag.

PRoGR€SS (2004). *Final Report*. EU-Project PRoGR€SS funded by the European Commission DG TREN under the 5th Framework Programme. Bristol.

Richards, M. G. (2008). Road user charging in the UK: the policy prospects. In H. W. Richardson (Ed.), *Road Congestion Pricing in Europe. Implications for the United States* (pp. 118-135). Northampton: Edward Elgar Publishers.

Road Charging Interoperability. (2008, November). *Final Brochure*. Produced by the RCI project consortium. RCI is co-financed by the European Commission DG TREN.

Royal Academy of Engineering. (2006). Road User Charging – A statement by the Royal Academy of Engineering. London.

Rye, T., & Ison, S. (2008). The European and Asian experience of implementing congestion charging: its applicability to the United States. In H. W. Richardson (Ed.), *Road Congestion Pricing in Europe. Implications for the United States* (pp. 273-292). Northampton: Edward Elgar Publishers.

Rye, T., Gaunt, M., & Ison, S. (2008). Edinburgh's Congestion Charging Plans: An Analysis of Reasons for Non-Implementation. *Transportation Planning and Technology*, 31, 641-661.

Schelin, E. (2008). *Road user charging for heavy goods vehicles Implementation aspects.* Thesis. Linköpings Universitet, Norrköping, Sweden.

Silva, E.I. (2009). *A Unified Framework for the Analysis and Design of Networked Control Systems*. PhD Thesis. Department of Electrical Engineering and Computer Science, The University of Newcastle, Australia.

Stoop, J.A.A.M., Baggen, J.H., Vleugel, J.M., Kroes, J.L. de, & Vrancken, J.L.M. (2007). *HSL-beveiligingssysteem ERTMS, Een onafhankelijk onderzoek naar nut en noodzaak van de aanpassing van het HSL-beveiligingssysteem ERTMS*. Tweede Kamer der Staten-Generaal; Onderzoeks- en Verificatiebureau. Den Haag.

Transport for London. (2007).

Tweede Kamer. (2009, April 21). ABvM Debate with Government dated 8 April 2009.

Vermeer, O. (2010, May 22). Ook met nieuw kabinet staat Nederland stil. *NRC Handelsblad*.

Weinstock, C.B., & Goodenough, J.B. (2006). *On System Scalability*. Software Engineering Institute, Carnegie Mellon University, Pittsburgh.

# Appendix

## *Expert interviews*

| Name | Function | Date |
|---|---|---|
| Mr. Troost-Oppelaar | Senior Consultant Traffic, Transport & Infrastructure at AT Osborne | July 2, 2009 |
| Mr. Heijboer | Projectmanager ABvM (Anders Betalen voor Mobiliteit) | August 3, 2010 |
| Mr. Arnoldussen | Chief Information Officer (CIO) ABvM | August 3, 2010 |

## *Abbreviations*

| | |
|---|---|
| ABvM | Anders Betalen voor Mobiliteit (Different Payment for Mobility) |
| ANPR | Automatic number plate recognition |
| ANWB | Koninklijke Nederlandse Toeristenbond (Dutch Automobile Association) |
| CESARE | Common Electronic Fee Collection System for an ASECAP Road Tolling European Service |
| DSRC | Dedicated short-range communications |
| DUB | Definitief uitvoeringsbesluit (Definitive Implementation Decree) |
| EC | European Commission |
| EETS | European Electronic Toll Service |
| ERP | Electronic Road Pricing |
| ERTMS | European Rail Traffic Management System |
| ETC | Electronic Toll Charging |
| GPS | Global Positioning System |
| GPT | Grote Praktijktest (Large practivcal test/Proof of Concept) |
| HGV | Heavy Goods Vehicles |
| ICT | Information and Communication Technology |
| ITS | Intelligent Transportation System |
| MP | Mobility Project |
| OBE | Onboard Equipment |
| OBU | Onboard Unit |
| PPP | Public-private partnership |
| RCI | Road Charging Interoperability |
| RUC | Road User Charging |
| SIM | Subscriber Identity Module |
| SVV2 | Structuur Schema Verkeer en Vervoer 2 (Second Structural Plan) |
| VAS | Value-added service |