The Road to
Personal Intelligent Travel Assistance

How to Bundle Public Interests to Private Opportunities?

Colophon

Title of the thesis: The Road to Personal Intelligent Travel Assistance; *How to Bundle Public Interests to Private Opportunities?*

Place and Date: Baarn/Delft, 07/12/'09

Author: E.J. (Ewoud) Spruijtenburg (1176110)
Msc. Program: Systems Engineering, Policy Analysis and Management (SEPAM)
Faculty of Technology, Policy and Management
Delft, University of Technology
T (06)51364536
E espruijtenburg@live.nl

Graduation Section: TLO

Graduation Committee:
Prof. dr. G.P. van Wee (TLO)
Dr. ir. C.G. Chorus (TLO)
Dr. W.W. Veeneman (POLG)
Ir. J.F. Troost-Oppelaar (AT Osborne)

Delft, University of Technology
Faculty of Technology, Policy and Management
Postbus 5015
2600 GA Delft
Tel. 015-2787100
www.tbm.tudelft.nl

Delft University of Technology

AT Osborne B.V.
Postbus 168
3740 AD Baarn
Tel. 035-5434343
www.atosborne.nl

AT OSBORNE

Preface

This Master Thesis can be seen as the final part of six years of studying Systems Engineering, Policy Analysis and Management on Delft University of Technology. Six years I have very much enjoyed! This thesis is the result of seven months of research to the development and implementation of Personal Intelligent Travel Assistants (PITA-services) which has been accomplished within AT Osborne. During my study, I have always had a large interest in transport and mobility and travel information is currently becoming an important subject in this field of research. During my Master study, I also developed great interest in both the project- and process management of large engineering projects. Therefore, AT Osborne, as a management- and consultancy company having great expertise on this subject and operating in the field of mobility, was the perfect environment for me to carry out this master thesis project. With the results of this research, above all, I hope to give AT Osborne better insights in their business opportunities at the travel information market. Furthermore, I hope to accelerate the Dutch policy-making process regarding the real development and implementation of PITA-services.

Different persons have contributed to this research and I would really like to thank all of them for their continuous support. Firstly, Caspar Chorus, my first supervisor, has been a great source of motivation. His large expertise and interest in the field of research combined with his positive mentality made the research project more fun then I could expect beforehand. Secondly, Jan-Floor Troost-Oppelaar, my daily supervisor, has created a research environment for me within AT Osborne which was ideal to carry out the research project and to show my personal creativity. Furthermore, his practical experience, his personal interest in my work and his feeling for structure and process strongly helped me in keeping sufficient focus and speed during the research. Thirdly, Wijnand Veeneman, my second supervisor, has especially been important by emphasizing the multi-actor context of the research. Fourthly, Bert van Wee, my graduation professor, has also played a crucial role as the guarantor of the scientific quality of the thesis.

Furthermore, I would like to thank all my colleagues from AT Osborne, especially those from the business unit infrastructure and mobility, for giving me such a nice seven months. Their practical knowledge on many divergent subjects and their great interest in my research project has resulted in a very inspiring period. In addition, I would like to thank all my family and friends for giving me such a fantastic six years of study. Especially my girlfriend Tessa, who will fortunately also be with me discovering Asia the coming six months! Finally, my parents have always been of great importance because of their unconditional trust and support and all the opportunities they have given me during my life. The past six years have been a fantastic experience with many beautiful moments. Thank you!

Ewoud Spruijtenburg

Leiden, December 2009

Summary

Research Context

During the last years the development of travel information services has been going very rapidly. A category of travel information services that may be expected to become available during the coming five to ten years is the category of *Personal Intelligent Travel Assistants* or PITA-services. Such services are envisaged to provide at any time a traveller with all the travel information that is relevant given his time and place in the multimodal transport network and his or her personal characteristics.

The research in this thesis is carried out on behalf of *AT Osborne*. *AT Osborne* sees, as an independent consultancy- and management company, business opportunities in being involved in the development- and implementation process of future travel information services like PITA-services. To optimally accomplish the desires of *AT Osborne* and to deliver a scientifically sound thesis, the research is divided into three parts. This results in a main research question which is threefold:

1. What is the state-of-the-art in travel information services including the services that may be expected to become available till 2015?

2. What are, as perceived by the involved public and private parties, the expected effects of future PITA-services?

3. What is, among the involved public and private parties, the preferred actor constellation for the development and implementation of PITA-services?

To answer the first two research questions, both extensive *literature/desk research* and *explorative interviews* with potentially involved public and private actors have been carried out. To find the answer to the third research question, these two methods have also been used but additionally a *stated choice experiment* has been carried out to identify the preferences of the potentially involved actors regarding the fulfilment of the different roles.

The state-of-the-art in travel information services

Before starting to give the state-of-the-art in travel information services, first the concept of PITA-services is further defined. PITA-services will have four characteristics: they will be *mobile* (receivable on a mobile device), *dynamic* (based on a real-time monitoring of the transport systems), *multimodal* (providing information about multiple modalities) and *personalized* (based on the traveller's personal characteristics). In the current situation, such a service is not available but already some services are available that have one or at most three of these four characteristics (pre-PITA services).

It is concluded that the three travel information services that are currently available and tend most to future PITA-services are 'TomTom HD Traffic' (provided by TomTom), the iPhone application 'Trein' (provided by Apple) and 'Haaglanden Mobile' (provided by the VID). How fast future developments of these and other pre-PITA services will be and whether real PITA-services will become available before 2015 or not is very uncertain. Related to this, the development of other (information) services (VAS: *Value Added Services*) that might be bundled to future PITA-services will also be important. Regarding this bundling, *software developers* will play a major role (e.g. companies like Hyves, Google, Microsoft, Apple, etc.).

They are able to strongly enrich the value of data by bundling different services and developing advanced applications which will increase the value of each of the services individually.

The expected effects of future PITA-services

The interview results show that the involved public and private parties have many different expectations of future PITA-services. First, the expected effects of future PITA-services on the total utilization of the transport systems are very uncertain. Furthermore, the public parties especially expect that travellers will make more conscious travel choices due to the implementation of PITA-services and the private parties expect that they will not be able to make a sound business case for PITA-services. A reason for this is formed by the high investment costs of such services which also cause a lot of *free rider* behaviour among these private parties. An important development related to this is the commitment of the Ministry of Transport; Public works and Water Management, together with the other involved governmental bodies, to take the responsibility to build up the two databases consisting of public transit- and car data (respectively the NDOV and the NDW). A large proportion of the investment costs of PITA-services will be attributable to the acquisition and integration of these data, so this will probably make it easier for the private parties to make a sound business case. Although this is still very uncertain, the ministry has made the policy choice that the development of the future services will be a task for the market. But, in the context of *adaptive policy-making*, this thesis initially presumes that the market will fail to successfully develop and implement PITA-services themselves and that any governmental involvement will be needed.

The preferred actor constellation for the development and implementation of PITA-services

Another part of the research resulted in a definition of the process of delivering information to travellers. This definition has been used to determine which different actor roles must be fulfilled for a successful development and implementation of future PITA-services and to identify which public and private actors may be involved in the development- and implementation process of these services. Ten different roles have been distinguished: *Policy-makers; Traffic managers; Road data providers; Public transit data providers; Road data integrator (NDW); Public transit data integrator (NDOV); Service providers; Hardware providers; Software developers* and *Consultancy companies*. The research results showed that for only five of these ten roles more then one promising alternative is available for its fulfilment: *Traffic managers; Road data providers; Road data integrator (NDW); Public transit data integrator (NDOV);* and *Service providers*.

These five roles are included in the stated choice experiment. The observations gathered in this experiment have finally led to estimated model parameters which were significant for four of the five roles (only not for the *Public transit data integrator (NDOV)*) and form a solid basis to establish future policy on. Finally, based on these estimated model parameters, it is concluded that the preferred actor constellation for the development and implementation of PITA-services looks like the actor constellation as presented below.

The Preferred Actor Constellation for the Development and Implementation of PITA-services

Role	Fulfilment by
Policy-makers	Governmental bodies
Traffic managers	Governmental bodies
Road data providers	Private market parties
Public transit data providers	Public transit companies
Exploitation of the road data integrator (NDW)	A Private market party under concession
Exploitation of the public transit data integrator (NDOV)	A Private market party under concession or a Governmental body
Service providers	Private market parties with the government as launching customer (Low level of cooperation)
Hardware providers	Private market parties
Software developers	Private market parties
Consultancy companies	Private market parties

Recommendations

The future fulfilment of many of the defined actor roles will definitely lead to business opportunities for *AT Osborne* (e.g. the management of any tendering- and/or concession procedures; the project- and/or process management of experiments/pilots with new services or technologies; or the management of cooperation models like subsidy schemes or Public-Private Partnerships to enable the development of future services or technologies). *AT Osborne* is recommended to stay alert and grab these opportunities as soon as they arise. Complementary, *AT Osborne* is recommended to clearly distinguish its market position and to broaden its technological (IT) knowledge.

Furthermore, the central government is recommended to implement an adaptive PITA-policy and to integrate the preferred actor constellation (as presented above) in this policy. This adaptive approach to policy-making allows the central government to cope with the uncertainties and dynamics that confront them by creating policies that respond to changes over time and that make explicit provision for learning. To implement such an adaptive PITA-policy, the three steps of the adaptive policy-making process should be accomplished (*stage setting*; *assembling a basic policy*; and *specifying the rest of the policy*). During the stage setting phase, the different (PITA-) policy objectives, -constraints and -options should be specified and this phase results in a definition of success. Next, during the assembly of the basic policy, the central government is recommended to include (basic) policy actions in accordance with the preferred actor constellation. Thirdly, while specifying the rest of the adaptive PITA-policy, several vulnerabilities of these (basic) policy actions must be defined and related actions (hedging- and corrective actions) should be integrated.

To conclude, three scientifically challenging directions for further research are identified: the real effects of PITA-services; the role and wishes of the end user; and the design of the organisational structure for the development and implementation of PITA-services.

Thesis Contents

1 Context of the Research

1.1 Introduction

This first chapter of the thesis outlines the context of this research project. First, paragraph 1.2 describes the current situation within the field of research. Next, paragraph 1.3 defines the scope of the research project and paragraph 1.4 states the related research problem. Finally, paragraph 1.5 explains which methodologies will be used during the research project and paragraph 1.6 defines the structure of this thesis.

1.2 Current situation

During the last years the development of travel information services has been going very rapidly (Chorus and Timmermans 2009 p.1). For instance, a recent occurrence in this field in the Netherlands is the introduction of a new travel information service by the Dutch Railways. This service provides up-to-date travel information on mobile phones including delays and failures in the train schedule and also provides alternative routes and/or departure times (Romanillos 2009). Next to this example of the Dutch Railways, lots of other travel information services are available or will be available in the near future. One specific category of travel information services that may be expected to become available within the coming five to ten years is the category of *Personal Intelligent Travel Assistants* or PITA-services (Chorus and Timmermans 2009 p.5). "PITA-services are envisaged to be able to provide at any time a traveller with all the travel information, asked for and unasked for, that is relevant given his time and place in the multimodal transport network and his or her personal characteristics" (Chorus, Molin et al. 2006b p.127). The four key characteristics of such services are that they will be mobile, dynamic, multimodal and personalized. These characteristics will be explored in more detail in chapter two (Chorus and Timmermans 2009 p.5). The precursors of PITA-services are defined here as pre-PITA services and most of the latest introduced travel information services belong to this category. They are the precursors of real PITA-services because they already have one or a combination of at most three of the four PITA-characteristics as described above. The concepts pre-PITA and PITA will be more sharply defined in chapter two of this thesis.

The development and implementation of future PITA-services might have many different effects. For example, PITA-services might help to alleviate the negative externalities of reaching the capacity limits of our transport networks (e.g. increasing congestion levels, high environmental damage, low traffic safety levels, etc.). To realize this, such future PITA-services should aim at an optimal utilization of the total transport networks. But, to successfully develop and implement such services, the different involved public parties will need to cooperate with the involved private parties which are usually the developers and providers of travel information services. Though, these private parties look at travel information services as a business case and strive for more productive individual travellers instead of more productive total transport networks. These kinds of contradictions and interdependencies illustrate the organizational complexity around the development and implementation of future PITA-services which will be further explored in this thesis, especially in chapters three and five.

For *AT Osborne*, as the problem-owner of this research project, the travel information market is a high-potential new market. This explains why it is very interesting for them to get acquainted with the actual and future developments in this market. As an independent consultancy- and management company, *AT Osborne* sees business opportunities in being

involved in the development- and implementation process of future travel information services. Thus, it is interesting for them to get an overview of the currently available travel information services and of those services that may be expected to become available within the coming five to ten years. Furthermore, it might be very useful for *AT Osborne* to get more insights in the different public and private parties (and their interests) that might be involved in the development- and implementation process of future PITA-services together with the expected effects of such services as perceived by them. Finally, it will be useful for *AT Osborne* to get an overview of the most promising alternatives for the fulfilment of the different roles within the future actor constellation for the development and implementation of PITA-services and of the preferences among the potentially involved actors regarding these alternatives.

1.3 Scope of the research

Due to given budget- and time constraints, the scope of the research project must clearly be defined. To optimally accomplish the desires of the problem-owner and to deliver a scientifically sound report, this research project is divided into three parts. The first part gives an overview of the current and next-generation travel information services in the Netherlands which belong to the category of pre-PITA services. Travel information services which do not have any of the four PITA-characteristics as illustrated above, are not taken into account in this research project. As seen in the description of the current situation, the development of travel information services is going very rapidly. Because most of the latest introduced travel information services belong to the category of pre-PITA services and this category also has a very high potential for the near future, the first part of the research project will focus only on this specific category. Next, the second part of the research project further specifies the actor arena and identifies the expected effects of future PITA-services as perceived by the potentially involved actors (both public and private). Finally, the third part of the research project defines the preferred actor constellation for the development and implementation of PITA-services among the potentially involved actors.

After providing an overview of the available pre-PITA services (including the services that may be expected to become available till 2015), for the following parts of the research project the scope will be even further limited to real PITA-services which have all the four PITA-characteristics as illustrated above. The research will be further limited to this specific category because PITA-services are seen as the highest achievable services for the next ten years and it seems really plausible that within five or at most ten years from now, PITA-services will have been successfully developed and implemented. Combined, this makes a focus on this type of services very realistic and interesting for *AT Osborne* as the problem-owner.

Finally, one last other demarcation is made: the focus of the research project will be on the road to personal intelligent travel assistance in the Netherlands. The international context of travel information services will be out of the scope.

1.4 Problem statement

This paragraph defines, based on the current situation and the demarcation of the research project as described above, the main research questions and the related sub-questions.

1.4.1 Main research questions

Because, as indicated above, this research project is divided into three parts, the main research question is also divided into three separate questions:

1. What is the state-of-the-art in travel information services including the services that may be expected to become available till 2015?

2. What are, as perceived by the involved public and private parties, the expected effects of future PITA-services?

3. What is, among the involved public and private parties, the preferred actor constellation for the development and implementation of PITA-services?

1.4.2 Sub-questions

The three main research questions as defined above are further divided into six different sub-questions as follows:

Sub-questions related to the first main research question:

1. Which travel information services are currently available (*literature/desk research; interviews*)?

2. Which travel information services may be expected to become available till 2015 (*literature/desk research; interviews*)?

Sub-questions related to the second main research question:

3. Which public and private parties may be involved in the development and implementation of PITA-services (*literature/desk research; interviews*)?

4. What are, as perceived by these public and private parties, the expected effects of future PITA-services (*interviews*)?

Sub-questions related to the third main research question:

5. Which promising alternatives are available for the fulfilment of each of the different roles within the future actor constellation for the development and implementation of PITA-services (*literature/desk research; interviews*)?

6. What are the preferences of the potentially involved public and private parties regarding these promising alternatives for the fulfilment of the roles within this future actor constellation (*stated choice experiment*)?

1.5 Methodological approach

This paragraph explores the research methods that will be used to answer the different sub-questions as defined above. Furthermore, it will be explained why these specific methods are useful within this research project and there will be elaborated on the requirements as set to the needed data and to the sources that will be used to acquire these data.

1.5.1 Literature/Desk research

Literature/Desk research plays an important role within this research project. Especially to find answers on sub-questions one, two, three and five, a lot of desk research has to be carried out (in combination with explorative interviews). Firstly, to provide a complete state-of-the-art in travel information services, a lot of different data sources have to be used. For instance, scientific literature within the field; policy documents; and websites related to for example the involved service providers (TomTom, 9292OV, Eileen, etc.) or the involved governmental bodies, to find out which pre-PITA services are currently available and which services may be expected to become available within the coming five years. Furthermore, in order to identify which different public and private actors may be involved in the future development and implementation of PITA-services, desk research will also play a major role. Finally, literature/desk research will be carried out to define some highly promising alternatives for the fulfilment of each of the different roles within the future actor constellation for the development and implementation of PITA-services. Theories that should be considered are for example theories regarding public interests, the theory of adaptive policy-making and market- and micro-economic theories. Furthermore, theories regarding the available cooperation models for a future cooperation between the involved public and private parties might be of interest (e.g. Public-Private Partnership (PPP), traditional tendering, subsidy schemes, etc.).

1.5.2 Explorative interviews

An important part of the research will be performed by doing explorative interviews. The (potentially) involved actors (both public and private) are a central factor within this research project to provide answers to sub-questions one to five. To identify which travel information services are currently available and may be expected to become available, but also to investigate which actors may be involved in the development and implementation of future PITA-services, it will be useful to do explorative interviews. Though, it will actually be most useful to do explorative interviews with potentially involved actors in the context of sub-question four, to define the expected effects of future PITA-services as perceived by them. It is much better in this research project to do explorative interviews instead of quantitative interviews because the opinions of the potentially involved actors regarding these expected effects may strongly diverge. Finally, in relation to sub-question five, the interview findings might be useful to identify some promising alternatives for the fulfilment of the different roles within the future actor constellation for the development and implementation of PITA-services. The interview findings may for example contribute to the investigation of opportunities and resistances for cooperation between the potentially involved public and private parties for the fulfilment of the roles.

To provide a complete investigation of the expected effects of future PITA-services as perceived by the involved public and private parties, the aim of the selection of interviewees is to interview at least one actor out of each different actor role. Due to budget- and time constraints, it will probably not be feasible to interview much more actors. Ideally, the interviewees act on a high (strategic) organizational level (e.g. directors, business unit managers, section managers, etc.) and participate to the interview from the viewpoint of their specific organisation (instead of their individual viewpoint). For most of the different actor roles, potential interviewees are accessible through the external relationships of the problem-owner *AT Osborne*. The final list of interviewees will be presented in appendix B.

1.5.3 Stated choice experiment

To find an answer to sub-question six, a *stated choice experiment* will be accomplished. A utility function will be derived from choices of individuals between hypothetical alternatives (in this research: actor constellations). Every alternative will be defined by a number of attributes which are varying on a few different levels. These attribute levels are presumed to influence the respondent's choices. Respondents derive a utility from each attribute level and combine these into a total utility for each alternative. In the choice experiment, the respondents will be shown a number of choice-sets, for which is presumed that the respondents will always choose the alternative with the, for him, highest utility. Within every choice-set, the respondents need to choose between different alternatives. Based on all these made choices (observations), finally a *Multinomial Logit Model* will be estimated. Based on this estimated model will be concluded which fulfilment alternatives for the different roles within the future actor constellation are *preferred* by the respondents and what will be seen as the most important criteria for this future actor constellation to realize a successful development and implementation of PITA-services. The respondents in the experiment will be public and private actors from the categories that will be involved within this future actor constellation themselves. A more detailed description of this methodology will be presented in chapter six.

1.6 Structure of the thesis

The remainder of this thesis consists of six chapters (chapters two to seven). Chapter two gives the answers to sub-questions one and two. It has a descriptive character, providing an overview of the currently available travel information services including the services that may be expected to become available till 2015. Then, chapter three further specifies the actor arena. It investigates which roles are distinguished in the development- and implementation process of future PITA-services and which public and private actors may be involved in these processes. Thus, it answers sub-question three. Chapter four focuses on sub-question four by identifying the expected effects of future PITA-services as perceived by the potentially involved public and private actors. Next, chapter five defines some promising alternatives for the fulfilment of each of the different roles within the future actor constellation for the development and implementation of PITA-services (sub-question five). Subsequently, chapter six investigates the preferences of the potentially involved public and private parties themselves regarding these promising alternatives for the fulfilment of the roles (sub-question six). Based on this, the preferred actor constellation for the development and implementation of PITA-services will be defined. Finally, Chapter seven describes the most important conclusions that can be drawn from the research carried out in this thesis and gives some important recommendations, both for the problem-owner *AT Osborne* and for the central government.

2 Current and Next-Generation Travel Information Services

2.1 Introduction

This chapter gives an overview of the currently available travel information services and next-generation travel information services in the Netherlands. First, some important definitions will be given as they will be used in the following chapters of this thesis. Next, the state-of-the-art in travel information services will be given including the services that may be expected to become available till 2015.

2.2 Definitions

This paragraph defines some important concepts as they will be used in the rest of this thesis. First, paragraph 2.2.1 clearly defines what is meant in this thesis with travel information services in general and which classifications can be made within travel information services. Next, paragraph 2.2.2 defines the difference between "pre-PITA"- and future real "PITA"-services and finally paragraph 2.2.3 explains the process of delivering information to travellers.

2.2.1 Travel information services and different classifications

Since people are travelling, they make use of all kinds of travel information. Thousands of years ago, travel information was no more then verbal communications between individuals. Later on, other forms of travel information became available like maps or time tables. During the 1980's, technological developments in the fields of data gathering, -integration and -processing and the distribution of information to travellers led to the introduction of ATIS (Advanced Traveller Information Services). "ATIS are an integral component of Intelligent Transport Systems (ITS)" (Adler and Blue 1998 p.157). It are systems that, based on observations in the current transport network combined with historic data, provide car-drivers with for example travel time estimates or route guidance and provide transit-riders with for example up-to-date messages on delays of trains or buses. The information is provided to travellers through radio, variable message signs (VMS), telephone services and, starting in the mid-1990's, also internet-sites (Chorus 2007a p.1).

"Travel information plays a significant role in the travel decisions of individuals" (Abdel-Aty 1999 p.195). In general, to a certain extent, information reduces uncertainty in decision-taking. More specifically, travel information is expected to help travellers making better travel choices by increasing their knowledge levels. Furthermore, it is desired (especially by governmental bodies) that providing information to travellers will lead to a more efficient use of the available transport infrastructure networks. According to the Commission of the European Communities (2007 p.12), information is even one of the critical success factors for mobility in urban networks. Many different types of travel information can be distinguished. To illustrate, a few examples are: route guidance for cars, public transit information, information about travel costs, information about travel times, information about incidents (accidents, road works, traffic control, events, etc.), information about congestion and delays, parking information, yellow pages information (restaurants, hotels, theatres, tank stations, etc.) and information about the environmental damage of travel alternatives (emissions and noise) (Transportation research board 2004 p.6; Chorus, Arentze et al. 2006a p.5; Chorus, Arentze et al. 2007b p.626; Regio Brabant, Zuidvleugel Randstad et al. 2008; Chorus and Timmermans 2009 p.2).

To present all these different sorts of travel information to travellers, there are many different kinds of travel information services available which can help travellers making well-informed decisions regarding their individual mobility patterns. These different types of travel information services can be classified according to some important characteristics. First, the services can be *personalized* (in-car navigation systems) or *collective* (public transit departure time tables at stations). Secondly, they can be *mobile* (handheld systems) or *immobile* (road signs). Thirdly, they can be *static* (information from bus or train time tables) or *dynamic* (the real-time actual journey time to work). Fourthly, they can be *uni-modal* (car route guidance), *multi-modal* (a single point of access to multiple uni-modal services) or *integrated multi-modal* (compares and/or combines travel alternatives of different modes, like (9292OV 2009a)). Fifth, the services can be *national* (9292OV), *regional* (warning for dangerous traffic situation due to weather circumstances in a certain region), or *local* (information about a local traffic jam). Furthermore, a classification can be made in *pre-trip* (route guidance from the ANWB route planner), *on-trip* (in-car radio traffic information) and *post-trip* services (when a navigation system informs you after the trip about the total fuel consumption of the trip) where pre-tip information services can be further divided in *short-term* (looking at a time table to see when the next train is leaving) and *long-term* (using road maps when planning a holiday journey) services. Seventh, the services can be *prescriptive* (navigation systems prescribing to take the next exit) or *descriptive* (time tables). Eighth, they can be *visual* (time tables) or *audible* (spoken navigation system). Ninth, they can be *infrastructure-bounded-* (VMS), *vehicle-bounded-* (in-car navigation systems) or *cooperative infrastructure-vehicle* systems (in-car dynamic information provision about changing speed limits) and lastly the services can be *quantitative* (there is 15 km congestion on the A4) or *qualitative* (providing information that there is just any congestion on the A4) (Adler and Blue 1998; Lyons and Kenyon 2003; Lyons 2006; Bruntsch, Mentz et al. 2007; van Koningsbruggen and Westerman 2007; Regio Brabant, Zuidvleugel Randstad et al. 2008; Chorus and Timmermans 2009). To give some more clarity, these different classifications are also depicted in figure 2.1 below.

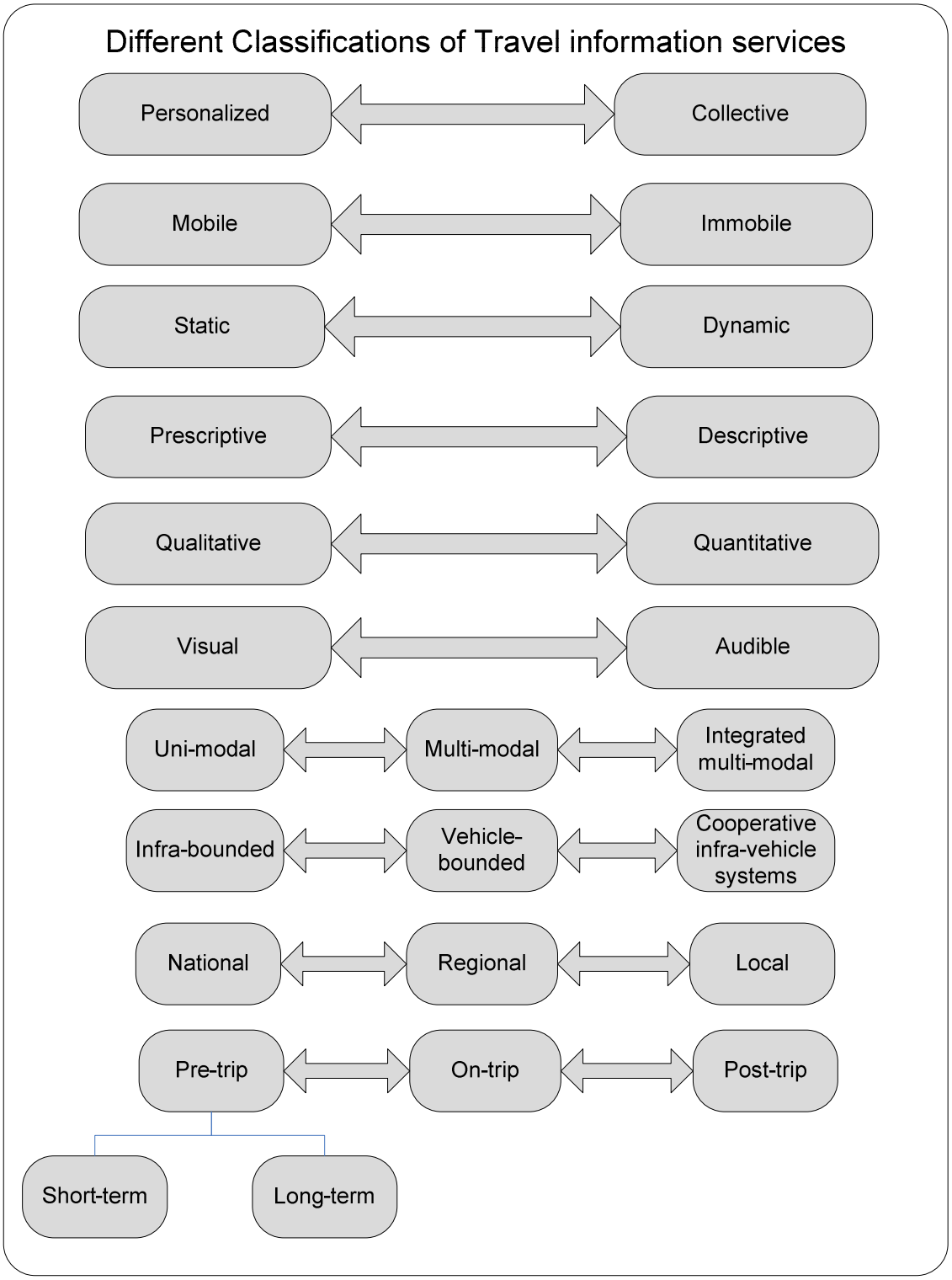

Figure 2.1 *Different classifications of travel information services*

2.2.2 "Pre-PITA"- and "PITA"-services

This sub-paragraph explains the difference between "pre-PITA" services and future real "PITA" services. Both definitions are given as they will be used in the rest of this thesis.

"Pre-PITA" services

"The development of travel information services, as described above, has advanced substantially during the last ten years, boosted notably by advances in ICT and specifically the mainstreaming of internet and mobile telephony" (telematics) (Lyons 2006 p.210). Especially the rapid development in mobile communications has provided a vision among the involved actors of a technological revolution in ATIS, as described above, towards what are called next-generation ATIS. "Next-generation ATIS are envisaged to be able to provide at any time a traveller with all the travel information, asked for and unasked for, that is relevant given his time and place in the multimodal transport network and his or her personal characteristics" (Chorus, Molin et al. 2006b p.127). Important features of such services are that they must be *mobile, dynamic, multimodal and personalized*.

A *mobile* service is a service which can be received on any kind of mobile device. An example of mobile travel information services are services that could be received on mobile devices like for example handheld navigation systems, mobile phones, PDA's, iPhones, laptops, etcetera (Chorus and Timmermans 2009 p.1). An underlying characteristic of a mobile device is that "it is always near the person, i.e. it can be carried in the palm or elsewhere on the body" (Bruntsch, Mentz et al. 2007 p.33).

A *dynamic* service is defined as a service that provides information based on a real-time monitoring of the transportation systems. An example of such services are Dynamic Route Information Systems (DRIS) at bus stations (Chorus and Timmermans 2009 p.1).

A *multimodal* service is defined as a service that provides information about multiple modalities (car, bus, train, bicycle, etcetera.) and which is based on an integrative view of all separate parts of the transport networks (Chorus and Timmermans 2009 p.1). An advanced sub-category of multimodal services is called *integrated multimodal* travel information services. This category differs slightly from other multimodal services by the fact that they automatically present the user with information concerning different mode choice options in response to a particular journey specified by the user (Lyons and Kenyon 2003 p.6). An example in the Netherlands is the multimodal planner of 9292OV.

A *personalized* service is defined as a service that provides information which is based on an accurate assessment of the traveller's preferences, his or her location in the transport network and the constraints he or she faces (in terms of his or her schedule for the day, but also in terms of, for example, transit season ticket-ownership or car availability) (Chorus and Timmermans 2009 p.1).

The precursors of future PITA-services are defined in this thesis as pre-PITA services. Pre-PITA services distinguish themselves from other travel information services by the fact that they have one, or a combination of at most three of the four characteristics which are defined above: *mobile, dynamic, multimodal, personalized* (Chorus and Timmermans 2009 p.1).

Technological developments in the field of pre-PITA services are going very fast. A few examples of these actual developments are dynamic route guidance services (TomTom 2009); 'iMetro', which is a mobile application showing the public transit networks of many hundreds of large cities in the world (SenterNovem 2009a) and lastly 'the Bikeplanner', a

mobile application developed for the iPhone providing route guidance services for bikers (Chorus, Arentze et al. 2006a p.4; Regio Brabant, Zuidvleugel Randstad et al. 2008 p.5; SenterNovem 2009b).

"PITA"-services

Those pre-PITA services as defined above are called pre-PITA services because of the fact that 'real' PITA-services, which will have all four of the described characteristics together (*mobile, dynamic, multimodal* and *personalized*), are not yet available.

Although it is still uncertain, "it is generally expected that information provided through such future PITA-services may trigger travellers to adapt their departure time-, route- and/or mode-choices in ways that lead to a more efficient distribution of mobility across time and space" (Chorus and Timmermans 2009 p.2). Whether potentially involved actors share this expectation is further researched in this thesis and will be described in chapter four.

2.2.3 The process of delivering information to travellers

For each of all the different travel information services that are described in this chapter, the process as presented below in figure 2.2 plays a crucial role. To accomplish this process many different technologies are used and at the moment also many new technologies related to this process are still under development (Ministry of Transport; Public Works and Water Management 2006 slide 2; Regio Brabant, Zuidvleugel Randstad et al. 2008 p.18).

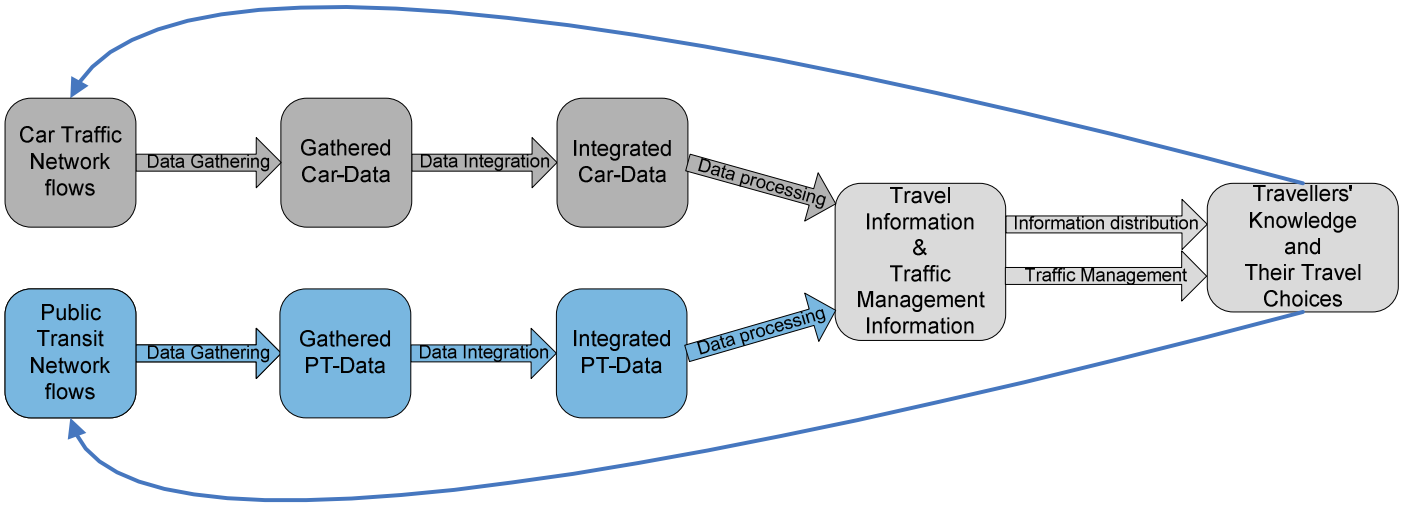

Figure 2.2 *The process of delivering information to travellers*

Data gathering means for example the measurement of traffic speeds or congestion levels at highroads, or investigating delays within public transit networks. *Data integration* is defined as the bundling and standardisation of different kinds of data into a central database. The *processing* of data means that data are processed and translated into meaningful information. *Information distribution* means the presentation of information to travellers by the appearance of travel information services. Finally, *traffic management* is an activity carried out by traffic managers, presenting information to travellers with the objective to realise more efficient use of the available transport infrastructure networks (for example by use of traffic signs or Dynamic Route Information Panels (DRIP)).

Furthermore, within this process of delivering information to travellers, lots of different actors are involved having different roles and responsibilities. In the next chapter the actor arena will be further specified but the most important actor roles that are distinguished within the process are shortly described here. First, data are gathered and provided by *data providers* and further bundled and integrated by *data integrators*. Secondly, the data will be translated into information and this information will be distributed to travellers by *service providers*. Thirdly, *hardware providers* and *software developers* are involved to provide respectively the needed hard- and software to support this processes. Fourthly, different *road-* and *traffic managers* are involved as managers of the different roads of which data is needed and as managers of the traffic flows on these roads. Fifth, different governmental bodies are involved as the related *policy-makers*, both on a national- and on a regional level. Finally, *consultancy companies* might be indirectly involved in the process by providing consulting services to one of the directly involved actors.

2.3 The current availability of travel information services including the services that may be expected to become available till 2015

This paragraph gives a state-of-the-art in travel information services in the Netherlands including those services that may be expected to become available till 2015. This is done according to the four characteristics of (pre-) PITA-services as defined in paragraph 2.2.2 above, which are: *mobile*, *dynamic*, *multimodal* and *personalized*. In the rest of this paragraph, both the most advanced services having just one of these characteristics and the services having a combination of two or even three of these characteristics will be described by category. First, this is done for the services that are already available (2.3.1) and next an outlook will be sketched regarding the services that may be expected to become available till 2015 (2.3.2).

2.3.1 Currently available travel information services

This sub-paragraph gives an overview of the current availability of travel information services. These travel information services will be categorized by the four PITA-characteristics as defined in paragraph 2.2.2. To conclude this subparagraph and to provide some more clarity, all services that are mentioned will be presented together in one table (table 2.1).

Mobile travel information services

As defined in paragraph 2.2.2, mobile services are services that can be received on any kind of mobile device. To this category, only those mobile travel information services belong that have none of the other three PITA-characteristics. In the Netherlands, the following two sorts of mobile travel information services are available: First, *internet services* which can be received on mobile phones providing all sorts of static, unimodal and collective information. Examples are websites with static travel information or route planners that can be received on mobile phones (Connexxion 2009; Haalmeeruitdeweg 2009; ANWB 2009a; The Dutch Railways 2009a). Secondly, all sorts of *sms-services* providing static, unimodal and collective information of different kinds on mobile phones. Examples are the 'sms-travel planner' of the Dutch Railways (The Dutch Railways 2009b) and the 'warning-service' from Haalmeeruitdeweg (Haalmeeruitdeweg 2009), providing information about events and road works in the region of Brabant. Actually, most of these sms-services also have a dynamic character and those services will be described further on in this paragraph.

Dynamic travel information services

As defined in paragraph 2.2.2, dynamic travel information services provide travel information which is based on a real-time monitoring of the specific transportation system. Dynamic travel information services in the Netherlands which do not have any of the three other PITA-characteristics are: DRIP- (Dynamic Route Information Panels) or DRIS-systems (Dynamic Route Information Systems) for any mode of transport; Dynamic travel information services provided via the internet by public transit companies like the web-based 'travel planner Xtra' of the Dutch Railways (The Dutch Railways 2009c); and dynamic traffic information services through the conventional channels like radio, internet and television (provided by service providers like the VID, Traphic, Eileen, the ANWB and the NOS (Ministry of Transport; Public Works and Water Management 2009c)).

Multimodal travel information services

As defined in paragraph 2.2.2, multimodal travel information services are services that offer one source of travel information covering multiple modalities. In the Netherlands, currently there are only two different services which provide multimodal information and do not have any of the three other PITA-characteristics. These (web-based) services are: The 'Car & OV' Travel planner by 9292OV (9292OV 2009b) and the multimodal web-based planner provided by the ANWB (ANWB 2009a). However, this last service makes use of the same public transit information as provided by 9292OV.

Personalized travel information services

Personalized travel information services, as seen in paragraph 2.2.2, are services that provide information which is based on an accurate assessment of the traveller's preferences, his or her location in the transport network and the constraints he or she faces (in terms of his or her schedule for the day, but also in terms of, for example, transit season ticket-ownership or car availability). Currently there are not many services available that belong to this category and have none of the other PITA-characteristics. The only services that belong to this category are conventional in-car and built-in navigation systems because these services are based on the specific location of the user in the transport network (based on GPS).

Mobile and Dynamic travel information services

This category of services consists of those services that have both a mobile and a dynamic character and none of the other two PITA-characteristics. A lot of services which belong to this category are currently becoming available. These are mostly services that can be received on mobile phones via SMS or mobile internet. Good and recent examples are the 'travel planner Xtra' as provided by the Dutch Railways via mobile internet; 'file-sms' from Eileen (or one of the other many service providers) providing dynamic traffic information on mobile phones (Eileen 2009); and lastly mobile internet services providing dynamic traffic information as provided by service providers like the ANWB (ANWB 2009b).

Mobile and Personalized travel information services

This category of services consists of those services that have both a mobile and a personalized character, as defined in paragraph 2.2.2, and none of the other two PITA-characteristics. Important services that belong to this category are conventional navigation services that can be received on mobile phones with GPS ('KPN op weg', Falk mobile, Garmin, TomTom and lots of other providers). Services that also belong to this category are conventional navigation services that can be received on other handheld systems like for example conventional TomTom- or Garmin Systems. A last important service within this category is '9292OV Mobile' (9292OV 2009c). This is the same service providing public transit

information as the conventional 9292OV travel planner on the website, but this service can be received on mobile phones and is also linked to GPS.

Mobile, Dynamic and Personalized travel information services

This category consists of services that have already three of the four PITA-characteristics so they are approaching real PITA-services. The first services in this category are conventional navigation systems that make use of RDS-TMC information and adjust their route-advice according to this information which makes them dynamic. A more advanced service in this category is 'TomTom HD Traffic' which is a cooperation between TomTom and Vodafone that determines real-time traffic speeds, congestion levels and delays on the basis of 'floating car data'. These data are available and gathered via mobile phones and via the users of the service itself. A third service in this category is 'VIDsms' (VID 2009). This service of the VID automatically warns users when there are problems on one of his or her personal routes on points in time of his or her interest. Fourthly, all kinds of new developments regarding applications for the iPhone also belong to this category. A good example of such applications is 'Trein', which is an application that makes the Travel Planner Xtra of the Dutch railways available on the iPhone and which is also linked to GPS. Another example is 'I-nap'. This is an application which wakes you up when you are travelling in a train and arrive at the station of your destination.

Mobile, Dynamic and Multimodal travel information services

Services in this category also combine three of the four PITA-characteristics. However, at the moment there is only one service available in the Netherlands that belongs to this category and this service is only available on a regional level. It is called 'Haaglanden Mobile' and it is actually, together with the services in the category above, the service which comes closest to future real PITA-services (Haaglanden Mobiel 2009). Haaglanden Mobile provides information on mobile phones regarding the actual situation on both the public transit- and the car network in the region of Haaglanden.

As seen above, there are six categories of pre-PITA services to which none of the currently available services belong. These categories are: *multimodal and personalized travel information services*; *dynamic and personalized travel information services*; *dynamic and multimodal travel information services*; *mobile and multimodal travel information services*; *mobile, multimodal and personalized travel information services* and *dynamic, multimodal and personalized travel information services*. The next subparagraph explores whether such services, or even more advanced travel information services, may be expected to become available within the Netherlands till 2015. To conclude this subparagraph, table 2.1 below presents an overview of the state-of-the-art in travel information services which are already available at the moment as described above.

Category	Available Services
Mobile travel information services	▪ *sms-services* providing static, unimodal and collective information of different kinds on mobile phones (the sms-travel planner from the Dutch railways; the sms-service from haalmeeruitdeweg; etc.) ▪ *internet services* which are received on mobile phones providing all sorts of static, unimodal and collective information (the website of the ns; the route planner of the ANWB; haalmeeruitdeweg; etc.)

Dynamic travel information services	▪ DRIP- or DRIS-Systems ▪ Dynamic travel information services provided via the 'conventional' internet by public transit companies like for example the web-based 'travel planner Xtra' of the Dutch Railways ▪ Dynamic traffic information services through the conventional channels like for examples radio, internet and television (provided by service providers like the VID, Traphic, Eileen, the ANWB, the NOS, etc.)
Multimodal travel information services	▪ The 9292OV 'Car & OV' Travel Planner ▪ The ANWB Multimodal Planner
Personalized travel information services	▪ Conventional in-car and built-in navigation services/systems
Mobile & Dynamic travel information services	▪ The Travel planner Xtra as provided by the Dutch Railways via mobile internet ▪ File-sms from Eileen ▪ Mobile internet services providing dynamic traffic information (e.g. the service from the ANWB)
Mobile & Personalized travel information services	▪ Conventional Navigation services that are received on mobile phones ('Kpn op weg', Falk mobile, etc.) ▪ Conventional navigation services that are received on other handheld systems like TomTom systems ▪ 9292OV Mobile
Mobile & Dynamic & Personalized travel information services	▪ Traffic information integrated in mobile navigation systems (using RDS/TMC) ▪ TomTom HD Traffic (using 'floating car data') ▪ VIDsms ▪ All sorts of iPhone applications (e.g. 'Trein')
Mobile & Dynamic & Multimodal travel information services	▪ Haaglanden Mobile

Table 2.1 *The State-of-the-Art in available travel information services*

2.3.2 Travel information services that may be expected to become available till 2015

Until 2015 probably many new travel information services will become available. These will be very close to PITA-services or even have all the four PITA-characteristics present but, for instance, only provide information on a regional level.

An interesting development in this field is the PTA-project (Personal Travel Assistant) in the municipality of Amsterdam. Within this research project the municipality cooperates with organisations as Vialis, 9292OV, the GOVI-project and Waag Society. The final version of the PTA is desired to be a multimodal mobile navigation system providing personal and actual

travel information, meaning it will have all the four PITA-characteristics as defined in paragraph 2.2.2 (Happel and Vaes 2009 p.1). The municipality of Amsterdam stimulates the development of the PTA till the end of 2010 (also the end of the first pilot) after which the developed knowledge, standards and business models will be available to be used free of charge by interested market parties to develop and implement 'PTA-like' services. This PTA-project might also be helpful for the development of PITA-services but whether real PITA-services on a national level will really become available before 2015 or even 2020 is really questionable. "While it seems to be plausible that PITA-services will have been successfully implemented within five or at most ten years from now" (Chorus and Timmermans 2009 p.5), the opinions regarding the speed of this developments strongly diverge among the involved organisations, as can be seen below.

> "Before a real PITA-service will be successfully developed as a complete, nationwide and high-quality service we will be at least twenty years further. On a shorter term I do not think it will be feasible to have a PITA-service of the quality as we would like to see it. To achieve that, there are way to little data available in the coming years!" (Quote J. M. van den Berg (Municipality of Amsterdam) in Spruijtenburg 2009k).

> "At the moment developments are going very fast and I think that within two to three years there will be at least a few successful initiatives that has the four characteristics of a real PITA-service" (Quote M. van Heumen (the Dutch Railways) in Spruijtenburg 2009j).

However, according to the Ministry of Transport; Public Works and Water Management, the development of PITA-services could go very fast. Their objective is that in 2015 every individual traveller must have continuous access to *individual*, *dynamic* and *multimodal* travel information (Ministry of Transport; Public Works and Water Management 2008a p.42). In practice they even think that developments might go faster.

> "In my opinion PITA-services might become available on a pretty short term. In fact, the only character that is currently missing is multimodality but when the NDOV will really be operational in 2011, market parties at that time can start developing real PITA-services. So, actually within four years from now the first PITA-service could be implemented!" (Quote M. van Gelderen (Ministry of Transport; Public Works and Water Management) in Spruijtenburg 2009d).

However, to realize this, the following steps must be taken in line with a critical time-line as set by the Ministry itself (Ministry of Transport; Public Works and Water Management 2009a p.10):

1) In 2010 Nationwide standards for public transit data (BISON (Connekt 2009)) must be available.
2) In 2011 the NDOV must be operational.
3) In 2012 the NDW must cover 5.500 km of the Dutch road network.
4) In 2015 the NDW must cover around 10.000 km of the road network which equals 80-90% of the total Dutch road traffic.

Simultaneously to this developments, existing pre-PITA services (as described in the overview of the available travel information services in paragraph 2.3.1) will improve during the coming five years and probably also other pre-PITA services will become available which

will be of an increased quality compared to the services in this category that are already available at the moment.

> "The coming years the travel information market will be strongly moving and some parties might really introduce successful innovations. I hope that the PTA will be one of them and furthermore I think you must keep an eye on parties like Vodafone, Hyves, Logica, 9292OV, etc. Different parties will come with fantastic idea's that will really give the market some new impulses" (Quote J. M. van den Berg (Municipality of Amsterdam) in Spruijtenburg 2009k).

For example, a service like 'TomTom HD Traffic' will be further improved and become a more reliable service. "From the year 2010, floating car data will provide complete and reliable information, also for provincial and lower level roads" (Connekt 2007 p.36). Another possible development of pre-PITA services might be the introduction of a multimodal navigation system (e.g. by TomTom) making use of *static* public transit information (like the available information from 9292OV). Generally, on a term till 2015 it is very difficult to determine how fast the development of services provided by companies like TomTom will go because such companies usually determine their strategies on a very short term.

> "Strategically we look forward around three years at maximum and for our real investments even only around one and a half year. In this context there is still very much possible before the year 2015 and maybe even a service like PITA. However, this also strongly depends on other developments like for example the European standardisation of public transit data" (Quote B. Rutten (TomTom) in Spruijtenburg 2009g).

Another example of a service that might be improved in the coming years is '9292OV Mobile'. When the availability of dynamic public transit data increases, it is a good possibility that 9292OV will introduce a dynamic public transit travel planner and that such a service will also become available in a mobile configuration like 9292OV Mobile.

Furthermore, as will also be described in the next chapter which further specifies the actor arena, software developers (e.g. Hyves, Google, Microsoft) will play a very important role regarding the development of pre-PITA- and PITA-services. They are able to strongly enrich the value of data by bundling different services and developing beautiful applications. This might accelerate the introduction of services like PITA. Related to this, the development of other information services that might be bundled to future PITA-services also plays an important role. Such a bundling of services could increase the value of each of the individual services. Think for example about other in-car services, social networks or developments in the field of ABvM (Dutch: Anders Betalen voor Mobiliteit).

Finally, it is important to note that the current financial situation might negatively influence the development- and implementation process of travel information services like PITA on a short term.

> "Savings related to the actual credit crunch will make innovative developments like PITA-services more difficult and can delay their development process on a short term" (Quote M. van Heumen (the Dutch Railways) in Spruijtenburg 2009j).

"As TomTom we are also in terrible times at the moment so we have to focus and this is not a very good moment to introduce completely new services. The coming period we will probably stay close to our core business but we do not totally exclude developments like this for the future" (Quote B. Rutten (TomTom) in Spruijtenburg 2009g).

3 The Actor Arena further specified

3.1 Introduction

"The information chain from the collection of raw data through its conversion into meaningful information to its delivery to end users (as described in paragraph 2.2.3 and specifically in figure 2.2) will usually involve a number of organisations spanning the public and private sectors" (Austin, Duff et al. 2001 p.18; Lyons 2006 p.208). The mutual relationships between these different involved public and private parties and the related complexity of the actor arena can be illustrated by the model as presented in figure 3.1 below (Connekt, ARS T&TT et al. 2003).

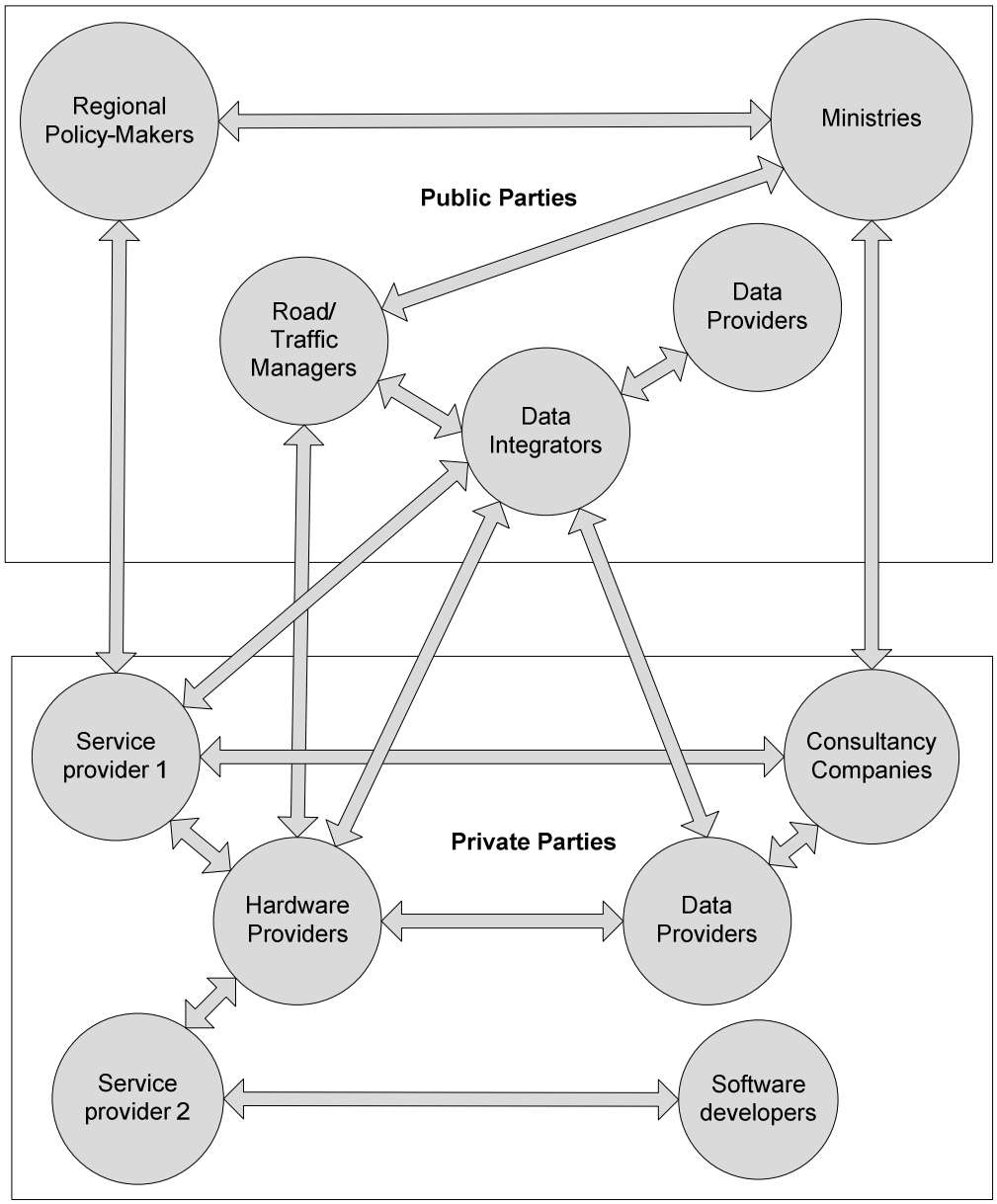

Figure 3.1 *The Complexity of the Actor Arena*

The involved public and private parties could have different roles within the process of delivering information to travellers. Though, currently there are also some travel information services that are developed and offered just by individual public or private parties which fulfil all the different roles themselves. Think for example about the Ministry of Transport, Public Works and Water Management and its DRIP-systems next to the highroad network, TomTom and its dynamic route guidance systems ("HD Traffic") or the Dutch Railways and its 'Travel planner Xtra' providing actual travel information on mobile phones regarding delays and failures in the train schedule and also providing alternative routes and/or departure times (Connekt, ARS T&TT et al. 2003 p.3; Romanillos 2009; TomTom 2009).

However, within most of the available pre-PITA services and probably also within future PITA-services, many different actors in different roles are or will be involved having different goals and interests. Sometimes these different goals may be in conflict (Lyons 2006 p.208).

> "The organizational challenge especially is that there are lots of different actors involved with different interests which strongly delays the process and emphasises the importance of detailed arrangements. Parties like the Dutch Railways that 'sit on their data' or bus companies that don't want to provide data because they don't want to be controlled on their punctuality throw up large barriers" (Quote R. Roding (District of Noord-Brabant) in Spruijtenburg 2009a).

Regarding the process of delivering information to travellers, as explained in paragraph 2.2.3, eight different roles are identified. This chapter further specifies the actor arena according to these roles, which are: *Policy-makers* on a National or Regional level (paragraph 3.2); *Road/Traffic Managers* (paragraph 3.3); *Data Providers* and *Data Integrators* (paragraph 3.4); *Service Providers* (paragraph 3.5); *Hardware Providers* (paragraph 3.6); *Software Developers* (paragraph 3.7) and *Consultancy Companies* (paragraph 3.8). The relationships between these different roles and the process of delivering information to travellers are presented below in figure 3.2. This chapter describes all these categories of actors together with their most important goals and interests whereby must be kept in mind that some actors could fulfil multiple roles within one process. At the end of paragraph 3.8, table 3.1 gives an overview of all the involved actors together with their general interest and their specific objectives related to travel information (PITA-) services. Finally, paragraph 3.9 describes the mutual relationships between the identified actor roles and the general components within future PITA-services.

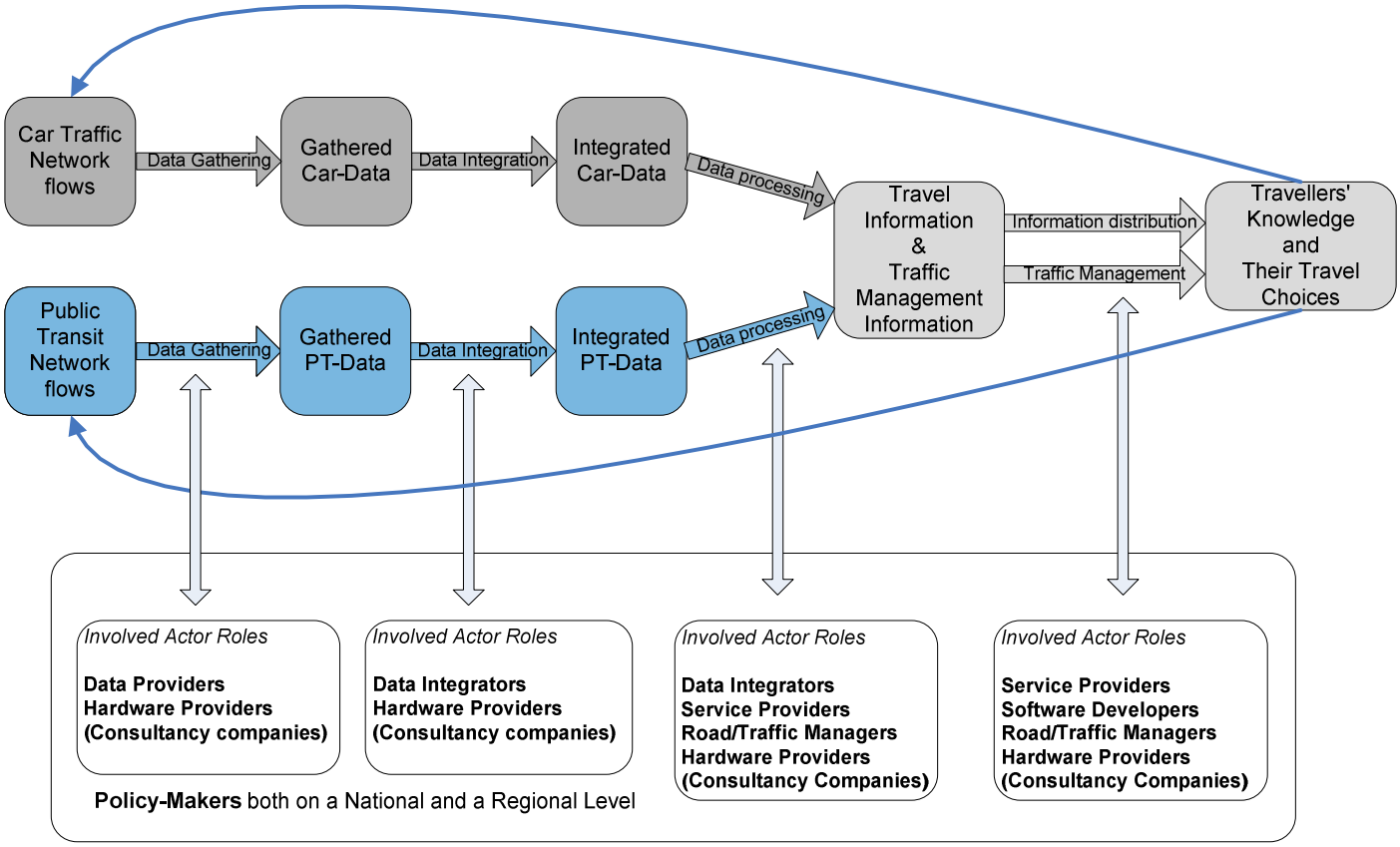

Figure 3.2 *The different roles within the process of delivering information to travellers*

3.2 Policy-Makers

This paragraph describes the involved policy-makers both on a national- (3.2.1) and on a regional level (3.2.2).

3.2.1 Policy-Makers on a national level

On a national level, the most important policy-makers that are involved in this process are the *Ministry of Transport, Public Works and Water Management* as the policy-making body and *Rijkswaterstaat* as the executing body of the ministry. As one of the thirteen Dutch Ministries, their general interest is to ensure a solid physical base in the Netherlands to efficiently guide mobility and to realize that the Dutch citizens can work and live in a safe environment. Their most important goals are to create and keep up good accessibility, safety and liveability. The ministry is, together with the policy-making bodies on a regional level which are described in the next subparagraph, responsible for a proper functioning of the Dutch mobility system (Ministry of Transport; Public Works and Water Management 2009a p.2). One of the objectives of the ministry related to this responsibility is to improve the utilization of the total Dutch transport networks. To realize that, easy access to high-quality travel information is required.

> "For the ministry, the general interest regarding travel information services is to provide travellers with as much comfort and quality as possible. We all know how frustrating it is to be in a traffic jam without knowing your actual

> travel time and the travel alternatives which are available to you" (Quote M. van Gelderen (Ministry of Transport; Public Works and Water Management) in Spruijtenburg 2009d).

This is the reason why the ministry also has the objective that "in 2015 every individual traveller must have continuous access to *individual*, *dynamic* and *multimodal* travel information" (Ministry of Transport; Public Works and Water Management 2008a p.42). The category of travel information services that may provide these specific kinds of information indeed is the category of *Personal Intelligent Travel Assistants* (PITA-services) as defined in paragraph 2.2.2.

Other ministries that are involved, although on a more general level, are *the Ministry of Housing, Spatial Planning and the Environment* and the *Ministry of Economic affairs*.

3.2.2 Policy-Makers on a regional level

On a regional level, many different policy-makers are involved. Three different levels of regional policy-making bodies are distinguished: *districts*, *city-regions* and *municipalities*. Specifically there are twelve different *districts*, eight *city-regions* and four hundred and forty-one *municipalities*. The general interest of these regional policy-making bodies is to realize a high liveability in their region of responsibility. The expectation is that high-quality travel information services can be an instrument contributing to this.

> "In cities like Amsterdam the road network cannot be further expanded and it will also not be easy to further expand public transit networks. This together makes other instruments to improve the utilization of transport networks, like improving the quality of travel information services, extra important. Therefore we are working so hard on it at the moment, for example by the PTA-project!" (Quote J.M. van den Berg (Municipality of Amsterdam) in Spruijtenburg 2009k).

Eighteen of these regional policy-makers have an additional role as the *Dutch public transit authorities.* In this role they have the right to grant concessions to public transit companies for city- and regional transit. Agreements around the provision of travel information are part of these concessions, so this way these public transit authorities also play a very important role.

The regional policy-makers that are most strongly involved in the development of travel information services are those who are the *front runners* of the National Data Warehouse (see paragraph 3.4.1): The municipalities, of Amsterdam, Rotterdam, The Hague and Utrecht; the districts of Utrecht, Zuid-Holland, Noord-Holland and Noord-Brabant; and the city-regions of Utrecht, Amsterdam, Arnhem/Nijmegen, Eindhoven, Rotterdam and Haaglanden (Nationale Databank Wegverkeersgegevens 2008 p.24).

3.3 Road/Traffic Managers

In the Netherlands, *Rijkswaterstaat* is the road manager of the highroad network and the different *districts*, *municipalities* (note that these are also involved as policy-makers) and a few *Water Authorities* are the road managers of the lower level road networks.

In their role of road manager these actors are juridical owners of the different roads and responsible for the management of these roads. Road management is defined by the

Ministry of Transport; Public Works and Water Management as: "all activities carried out to develop, maintain and manage the functions of the Dutch road network to serve the users of the roads" (Ministry of Transport; Public Works and Water Management 2007). The three core tasks of the road managers that can be distinguished are: *infrastructure management*, *strategic capacity planning* and *traffic management* (Advisory body of the Ministry of Transport; Public Works and Water Management 2007 p.41-43).

Traffic management is an important activity in the process as described above in figure 3.2. As traffic managers, road managers want to realize efficient traffic flows through the different road networks by matching the total demand for transport to the capacity of the transport networks. They do this for example by using traffic signs or Dynamic Route Information Panels (DRIP's). Traffic managers see traffic management activities as an important instrument to mitigate the negative externalities of the increasing road capacity problems in the Netherlands (Advisory body of the Ministry of Transport; Public Works and Water Management 2007 p.41-42). It is very important to distinguish traffic management activities as carried out by traffic managers from travel information services as delivered to travellers by service providers (see paragraph 3.5). Sometimes this distinction is very difficult to make and this is called the *'grey area'* between travel information and traffic management information.

> "In the Netherlands there is a large grey area between traffic management information and travel information. Sometimes it is very difficult to define what can be seen as traffic management information and what can be seen as travel information. In the current situation traffic management is seen as a public activity and travel information services as a task for the service providers" (Quote M. de Vreeze (Connekt) in Spruijtenburg 2009f).

In relation to their policy goals and in their public responsibility, road/traffic managers sometimes want to influence travel information as it is finally delivered to travellers by service providers. That is the reason why they see it as their responsibility to make the connection between traffic management activities and travel information services. How this connection could be realized will be further explored in chapter five (Regio Brabant, Zuidvleugel Randstad et al. 2008 p.16).

3.4 Data Providers and Data Integrators

This category of actors is very differentiated and consists of both public and private parties. The data are also very diverse and can consist of traffic flow data, traffic management data, data regarding available parking places, road characteristics, public transit delays, etc. (Regio Brabant, Zuidvleugel Randstad et al. 2008 p.15). A general distinction can be made between data providers and -integrators regarding the road network (paragraph 3.4.1) and data providers and -integrators regarding public transit networks (paragraph 3.4.2).

3.4.1 Road data

First, a very actual and important development in this field is the development and introduction of the National Data Warehouse Wegverkeersgegevens (NDW) in July 2009. This data warehouse is initiated by the involved policy-making bodies which are also described in paragraph 3.2 above and it will function as data integrator for the available road data (Ministry of Transport; Public Works and Water Management 2009a p.4). The NDW will consist of complete, reliable and actual data regarding the availability of the Dutch road network and it has the specific objective till 2012 "to provide a reliable and efficient national

data warehouse; to acquire, record, manage and deliver relevant data about 5.500 kilometres of the total Dutch road network; and to stimulate the use of these data" (Nationale Databank Wegverkeersgegevens 2008 p.3). Furthermore, an increase to 10.000 kilometres (covering 80-90% of the total road traffic) in 2015 is desired and another ambition of the NDW is to collect data about road works, events, road barriers and temporary detours due to special circumstances. Finally, the NDW also wants to realize, by providing high-quality road traffic data to both service providers and road/traffic managers, a decrease in vehicle-hours of delay of 10 to 20 % in the coming four years (Nationale Databank Wegverkeersgegevens 2008 p.9). That these objectives are very ambitious can be concluded from the large technological problems the database already faces. Due to these problems the database is shut down again two weeks after its operational start for at least one more month (ANP 2009). Figure 3.3 below presents a clear description of the position and the role of the NDW.

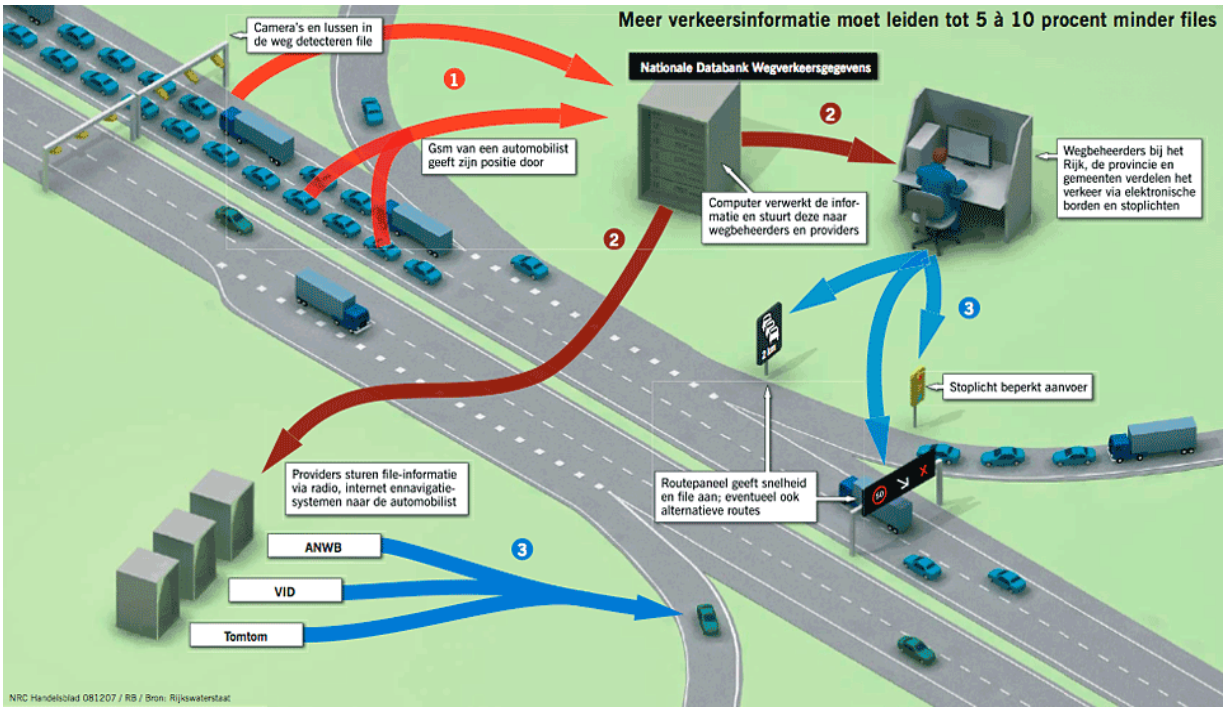

Figure 3.3 *The position of the National Data Warehouse (Only available in Dutch)*

Many different forms of road data can be distinguished but the two most important categories are *traffic management data,* as currently provided by the road/traffic managers (see paragraph 3.3), and *traffic flow data*. Before the development of the National Data Warehouse was initiated, but probably also when this data warehouse is completely developed and operational, Rijkswaterstaat (Verkeerscentrum Nederland: VCNL) for the highroad network and the different regional road/traffic managers for the lower level road networks, are the most important data providers regarding these traffic flow data. An important problem of the situation before the introduction of the NDW was that every data provider had his own information system and for many regions there was even no data available at all (Nationale Databank Wegverkeersgegevens 2008 p.5).

> "An example of this kind of problems related to the lack of data on some regional road networks occurs when navigation systems give travellers the

> advice to take a provincial road in case of a traffic jam on the highroad, without taking the actual traffic status on that provincial road into account" (Quote M. van Strien (NDW) in Spruijtenburg 2009c).

In the current situation, with the NDW in place, the different road managers can still be very important because they can function as providers of traffic flow data to the NDW where the data are further bundled and integrated into a central database. To create a nationwide and complete database it is very important that all these different regional road managers are willing to deliver their data to the NDW.

Another important development is that private parties like service providers are more and more developing technologies to collect the traffic flow data they need for their services themselves, or in cooperation with other private parties. A clear example is TomTom that, with 'HD Traffic', makes use of 'floating car data' to determine actual traffic flows, congestion levels and travel times for their customers. To collect these floating car data they cooperate with telecom operator Vodafone and this way they are actually becoming their own data provider (at least for *traffic flow data*) (Bakker and Maartens 2007 p.1). It is imaginable that in the future these kinds of data acquired by private parties will also be used by the NDW to improve their database.

> "We are talking about the possibilities to deliver our data to the NDW but currently I do not know what the results of these negotiations will be. Anyway, it is a very serious possibility that private actors like us will function as data provider in the future. Our database of historical data is the largest and most qualitative database in the Netherlands at the moment" (Quote B. Rutten (TomTom) in Spruijtenburg 2009g).

Lastly, it must be taken into account that numbers of other road data providers could be in place in the future as well, especially when new technologies and services arise. Examples can be telecom providers like Vodafone as already seen above, providers of data regarding parking availability (parking operators) or even operators of GPS (Global Positioning Systems) – tracking systems (Ministry of Transport; Public Works and Water Management 2006 slide 6; Regio Brabant, Zuidvleugel Randstad et al. 2008 p.15).

3.4.2 Public transit data

Currently, regarding public transit data, different data providers can be identified. However, these are especially the public transit companies themselves. Examples are bus operators like Connexxion or Arriva, train operators like the Dutch Railways or Veolia but also railway manager ProRail. The data that must be provided by these public transit companies are specified as part of the concessions which are permitted by the Dutch public transit authorities.

> "We, just as all other public transit companies, are required by the public transit authorities to provide some data. The specifications of these data are part of the concession. An important requirement is that, at one moment, we must deliver real-time and dynamic data to a data integrator like the NDOV which is not yet introduced at the moment" (Quote from a Public Transit company in Spruijtenburg 2009i).

Because the current situation of data provision is actually very differentiated and inefficient, there are, next to the introduction of the NDW, also strong developments in place towards

the introduction of a National Data warehouse regarding public transit data (NDOV). This NDOV will take over the role of data integrator which is at the moment fulfilled by 9292OV. The difference will be that 9292OV integrates static data while in the 'new' NDOV dynamic data must be integrated. A development in the direction of this future NDOV is the GOVI-project (GOVI 2009). The objective of this project, which is initiated by fourteen of the nineteen public transit authorities, is to integrate dynamic data of all PT-modalities and –companies within these fourteen regions in one database and to present this information to travellers by means of DRIS.

> "The GOVI-project can be called an 'NDOV-light' " (Quote R. Roding (District of Noord-Brabant) in Spruijtenburg 2009a).

9292OV will probably stay involved but will split up in two parts: a 'database-part' and 'another part' which will further function in the role of service provider.

> "In my expectation the NDOV will be a combination of the GOVI-project and the 'database-part' of 9292OV" (Quote J.M. van den Berg (Municipality of Amsterdam) in Spruijtenburg 2009k).

The NDOV must be operational in the year 2011 and it is planned to be developed by the Ministry of transport, public works and water management in combination with the public transit companies and the Dutch public transit authorities. The objective of this NDOV is comparable to that of the NDW: Providing one national and central database which integrates all available data and gives market parties, public transit companies and regional governments the possibility to develop and implement all kinds of new travel information services (like PITA-services) (Ministry of Transport; Public Works and Water Management 2009a p.3).

Lastly, regarding the provision of public transit data, it might be possible that new technologies will be developed and become available and that other parties will act in the role of data provider. However, currently there are no tangible indications into this direction.

3.5 Service Providers

The category of service providers regarding travel information services is very diverse. Service providers in the current situation usually are private parties that deliver services to travellers consisting of all kinds of travel information. Normally they translate data as provided by the different data providers and/or -integrators into useful travel information services for travellers (Regio Brabant, Zuidvleugel Randstad et al. 2008 p.16). The general interest of these service providers is, as they are mostly private parties, to maximize their profit. Future and advanced services like PITA-services might contribute to this what makes them very interesting for service providers.

> "For us as a company, Travel information services are purely business" (Quote B. Rutten (TomTom) in Spruijtenburg 2009g).

Within the category of service providers, currently a number of sub-categories are distinguished. First, a group of service providers can be seen as *"pure" service providers*. For instance 9292OV, the VID, Eileen, Traphic and Routenet belong to this category. A subgroup within this group is formed by the producers of navigation systems and road maps because these parties also act as hardware providers. This subgroup consists of actors like TomTom, Garmin and Falkplan Andes.

A second group of service providers is formed by the *public transit companies*. These public transit companies like the Dutch Railways; Connexxion; Arriva; Veolia; HTM and RET, act as service providers because they provide their customers with travel information services. They do this for two reasons. First, they want to achieve an optimal information provision for their customers because that might help to retain them or even to attract new ones (Chorus, Molin et al. 2006b p.128). Secondly, travel information is part of the concession.

> "In the concession is for example stated that we, as a public transit company, must provide static travel information at bus stops and at the internet. Furthermore, at the moment is not stated in concessions that we must provide real-time travel information services through for example an sms-service. However, we actually do provide such a service!" (Quote from a Public Transit company in Spruijtenburg 2009i).

Finally, a third group of service providers is formed by *telecommunication providers* like KPN, Vodafone and T-Mobile. For them, travel information services could be value added services (VAS) to distinguish themselves from their competitors. A very good example of such a service is 'KPN op weg'. Actually, this is a conventional navigation service provided on mobile phones. It might also be possible that telecommunication providers will play an important role in the provision of future PITA-services.

3.6 Hardware Providers

A category of important actors regarding travel information services is formed by the hardware providers. Hardware providers are usually private parties who develop technological systems which enable the service providers on her turn to deliver the final services. Four different subcategories are distinguished: producers of technological systems/servers/databases/etc.; producers of road maps and navigation systems; producers of mobile devices; and finally the automotive industry. The general interest of these hardware providers is, as they are private parties, to maximize their profit.

The first subcategory is formed by the producers of all sorts of supporting hardware like for example technological systems, servers, databases, etc. Parties within this subcategory are for example Cisco, Siemens, Logica CMG, Vialis and ARS T&TT. It seems plausible that such parties will be of great importance for the development and implementation of future PITA-services. The quality of the servers, data streams and databases related to such services will be crucial.

The second subcategory of hardware providers is formed by the producers of road maps and navigation systems. Actors involved within this subcategory are for example TomTom, Falkplan-Andes, Garmin, Navigon and Becker. TomTom, as the market leader, is by far the most important party within this subcategory.

The third subcategory is formed by the producers of mobile devices. For future PITA-services, the quality of the mobile devices on which the PITA-services can be received will be of great importance. Mobile devices are for example mobile phones, smart phones, iPhones, PDA's and laptops. Important parties that belong to this subcategory are Nokia, Apple, HTC, Samsung, Siemens and even maybe also TomTom.

The fourth and last subcategory is formed by the automotive industry. Companies that belong to this subcategory are for example BMW, Volkswagen, Volvo, etc. Because built-in

information services are becoming increasingly more common in this industry, the development of future PITA-services might be a very interesting opportunity for them to attract new customers (Chorus, Molin et al. 2006b p.128). Also a combination with the development of other built-in services like "Anders Betalen voor Mobiliteit (ABvM) could cause new opportunities.

> "A good opportunity to develop and implement PITA-services might be to link such a service to other services like for example services related to 'Anders Betalen voor Mobiliteit' (ABvM)" (Quote M. van Strien (NDW) in Spruijtenburg 2009c).

3.7 Software Developers

Software developers are becoming more and more important for the development process of travel information services. These software developers are usually private parties that develop advanced (mobile) software applications which can strongly enrich all kinds of available data.

> "The developments in this field are going so rapidly that, when the integrated data really becomes available, there will certainly be some 'smart guys' that can develop a beautiful and advanced application for it" (Quote G. Klijn (District of Noord-Brabant) in Spruijtenburg 2009a).

Because these software developers are private parties, their general interest is to maximize their profit. Important companies within this category are Google, Microsoft, Hyves, Apple and Waag society (developing the mobile application for the PTA-project in Amsterdam). New companies are emerging very rapidly at the moment. For future PITA-services, the quality of the application and the possibility to bundle the PITA-service to other useful services (VAS) will be very important.

3.8 Consultancy Companies

The last category of actors is formed by the consultancy companies, consisting of all sorts of companies which deliver consulting services to actors in any of the other seven involved actor roles (see figure 3.2). They have different kinds of expertise which might create additive value to the development process of future PITA-services. Their core interest is to maximize their profit. Consultancy companies that might be involved in the development- and implementation process of PITA-services are probably those companies that are already active in the field of mobility. Examples of such companies are Peek Traffic, Mobycon, Goudappel/Coffeng, Inno-V and AT Osborne.

To summarize this actor analysis, table 3.1 below presents an overview of all the involved actors together with their general interest and their objectives regarding travel information services (and future PITA-services).

Actor	Interest	Objectives regarding Travel Information Services
Ministry of Transport, Public works and Water management	High accessibility, safety and liveability in the Netherlands	Easy access for travellers to high-quality travel information and an optimal utilization of the total transport networks
Regional Policy-Makers	High liveability in their region of responsibility	Easy access for travellers to high quality travel information and an optimal utilization of the transport networks in their particular region
Road/Traffic Managers	High quality road network	• Efficient traffic flows through the road network • No conflicts between traffic management activities and travel information services
Road Data Providers	A complete and accurate data gathering and provision	High-quality travel information services based on their data
Road Data Integrator (NDW)	An integrated and nationwide database consisting of complete and standardized road traffic data about 5500 km road in 2012 and consisting of data covering about 80-90% of the total road traffic in 2015	High-quality travel information services provided by concurrent service providers making use of the data as provided by the NDW
Public Transit Data Providers	A complete and accurate data gathering and provision to accomplish the concession-requirements	High-quality travel information services for their customers
Public Transit Data Integrator (NDOV)	One national, central database that integrates all different kinds of available Dynamic Public Transit data	A situation in which market parties, public transit companies and regional governments have the possibility to develop and introduce all kinds of new travel information services by help of the integrated data within their database
Service Providers	Profitable business development	To provide advanced and competitive travel information services
Hardware Providers	Profitable business development	To provide hardware products that are widely used within the process of travel information services
Software Developers	Profitable business development	To provide advanced and competitive software products/applications related to travel information services
Consultancy Companies	Profitable business development	A competitive position within the consultancy sector in the field of travel information and mobility

Table 3.1 *Actor Analysis*

3.9 The mutual relationships between the involved actor roles and the components of future PITA-services

This last paragraph describes the mutual relationships among the involved actor roles as defined above and between these actor roles and the general components within the system of future PITA-services. It can actually be seen as a product-service description of such future services. To go straight to the point, figure 3.4 below shows this system description.

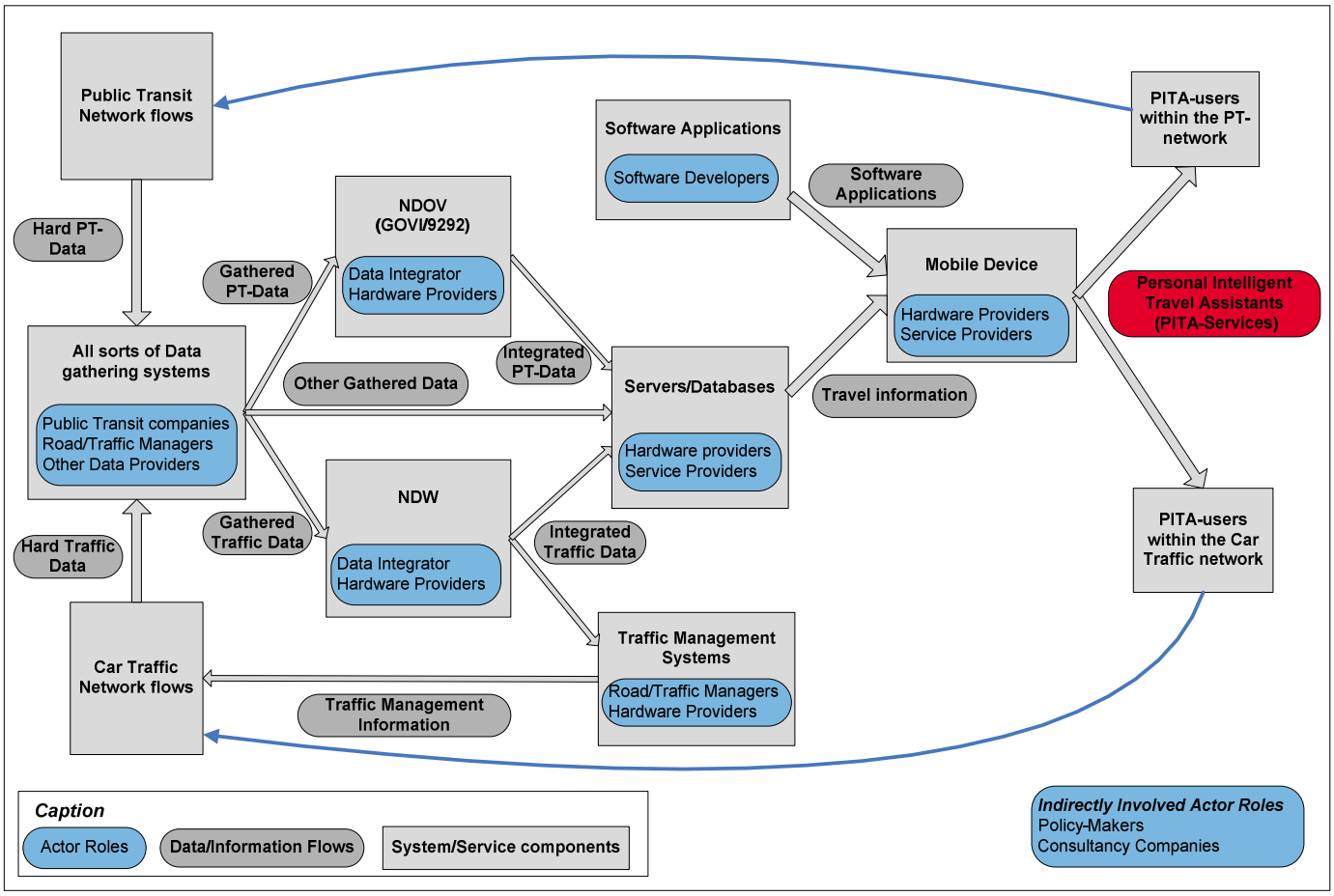

Figure 3.4 *The mutual relationships between the involved actor roles and the components of future PITA-services.*

As can be seen in this figure and as earlier described, within the process of delivering information to travelers, eight different actor roles are distinguished. Regarding the development and functioning of PITA-services as illustrated above, the mutual relationships between the different actors that fulfill these eight roles and the interoperability between the different subsystems of the services play a crucial role. "Interoperability is one of the most important problems in the domain of multimodal travel information" (Bruntsch, Mentz et al. 2007 p.34). During the development of multimodal travel information services like PITA-services, these issues must have continuous attention. Every involved actor should recognize and efficiently manage the interfaces and relationships in which it is involved out of its own role.

In respect to this, it is very important that the eight actor roles will be fulfilled in an effective way and that cooperation between the involved actors will be well-organized. However, many different alternatives are available to fulfill this actor constellation. In chapter five and six of this thesis the most promising alternatives to fulfill the different actor roles will be identified and the preferences of the potentially involved actors regarding the fulfillment of this future actor constellation will be investigated.

4 The Expected Effects of Future "PITA" – Services

4.1 Introduction

This chapter defines the expected effects of future PITA-services as perceived by the potentially involved public and private parties. The increase in the availability of different pre-PITA services, as described in chapter two, and a future development of real PITA-services might have many different effects. For example, it might strongly help to alleviate the negative externalities of reaching the capacity limits of our transport networks or it might have very profitable effects for any of the involved private parties. To determine these expected effects, first the concept of mobility has to be defined as it is used in this thesis. This will be done in paragraph 4.2. Furthermore, paragraph 4.2 explains the importance of the role of the potential users of PITA-services regarding the effects such services might have. Finally, paragraph 4.3 investigates the expected effects of future PITA-services as perceived by the involved public and private parties.

4.2 Definitions

To provide some more clarity, this paragraph gives two important definitions. Firstly, the concept of mobility will be defined as it will be used in the rest of this thesis. Secondly, the importance of the role of the potential users of future PITA-services will be explained regarding the effects such services might have.

4.2.1 The concept of mobility

The concept of mobility is defined in this thesis as the product of the number of person-trips per time-unit and the distance of those trips. This results in mobility as a total amount of travelled kilometres for a chosen time-unit (Ministry of Transport; Public Works and Water Management 1997 par. 1.1).

Mobility is part of a modern community, a condition for a healthy and strong economy and it gives citizens possibilities for personal development and recreation (Ministry of Transport; Public Works and Water Management and Ministry of Housing; Spatial Planning and the Environment 2004 p.5). "Mobility is one of the most important needs of society today and this need is likely to grow further in the future" (Bruntsch, Mentz et al. 2007 p.31).

In the Netherlands, a strong growth of mobility is perceived. The Dutch citizens are travelling more and more, both in regard to their jobs and in regard to recreational motives. This ongoing increase in mobility is expected to result in a growth of passenger transport of up to 20% between 2005 and 2020 and in a growth of freight transport of 40-80% between 2005 and 2020 (Ministry of Transport; Public Works and Water Management and Ministry of Housing; Spatial Planning and the Environment 2004 p.5). Through this growth, the traffic networks for both cars and public transit are threatened to reach the limits of their capacity which will bring some negative externalities (Programmabureau M&ICT). It will cause more congestion, an increase in vehicle-hours of delay and environmental pollution, but it will also have negative impacts on traffic safety, accessibility and on the national economy. Finally, another negative consequence is that externalities like noise and emissions will be caused at undesired places (Ministry of Transport; Public Works and Water Management and Ministry of Housing; Spatial Planning and the Environment 2004 p.119-125; Commission of the European communities 2007 p.3; Ministry of Transport; Public Works and Water Management 2008a p.18; Ministry of Transport; Public Works and Water Management 2008b p.18-19; Chorus and Timmermans 2009 p.4).

4.2.2 The role of the potential users of future PITA-services

An important notion that should be made at this point in the thesis is that the travellers as the potential users of future PITA-services play a very important role regarding the effects these services will cause. Though, if the travellers are not willing to make use of the services, which is not unthinkable because the extent to which usefulness for the individual equates to behavioural change by the individual is still not clear (Lyons 2006 p.210), they will also not make better and more conscious travel choices. Then, the alleviating effects on the negative externalities of reaching the capacity limits of our transport networks will also be none. Next to the usefulness of future PITA-services, many other factors influence whether travellers will really use such a service or not and in which way they will use it. Such factors are for example the reliability of the service, the price of the service, the bundling to other useful services and the quality of the public transit system in the Netherlands.

> "You can develop and implement a technologically perfect working PITA-service but if you do not take into account the 'human factor' and the wishes and requirements of the potential users, a service like PITA will never be successful!" (Quote M. van Strien (NDW) in Spruijtenburg 2009c).

Despite the fact that the importance of the role of the end-user and its behaviour is definitely recognised here, it will further be out of the scope of this research project.

4.3 The expected effects

This paragraph describes the expected effects of future PITA-services as perceived by both the potentially involved public parties (paragraph 4.3.1) and the potentially involved private parties (paragraph 4.3.2).

4.3.1 The expectations of the involved public parties

The involved public parties, both on a national and on a regional level, have a lot of different expectations regarding the effects of future PITA-services. As already mentioned in this thesis (paragraph 3.2), it is desired by these public parties that providing information to travellers will lead to a more efficient use of the available transport infrastructure networks and, according to the Commission of the European Communities (2007 p.12), information is one of the critical success factors for mobility in urban networks (Transportation research board 2004 p.6; Chorus and Timmermans 2009 p.2). Also in literature, many times is stated that: "With ATIS (e.g. pre-PITA- and/or PITA-services) each traveller individually, and the transport networks as a whole, could be made more productive" (Levinson 2003 p.75). This implicates that it is expected that more productive individual travel choices will indirectly lead to a more efficient distribution of travellers to available routes and modes (Adler and Blue 1998 p.157).

Whether the public parties indeed have the expectation that future PITA-services will lead to a more efficient use of the available transport infrastructure networks is researched in this part of the thesis by means of explorative interviews with governmental bodies from all the different levels (Ministries, Districts, City-regions and municipalities). The results of this research are described below. Other expectations of the public parties regarding future PITA-services are also taken into account and actually the total group of their expectations is divided in two categories: *transport network effects* and *social effects*.

Transport network effects

Future PITA-services might have many different effects on the total transport networks in the Netherlands. First, it is a general thought among the involved public parties that the implementation of PITA-services will cause the effect that travellers will make more conscious travel decisions. Whether this will also cause a better utilization of the total transport systems is very uncertain. The opinions regarding these effects differ and it is clear that it is very difficult to forecast or estimate such effects of future services.

> "Advanced travel information services like PITA-services are a prerequisite for travellers to make more conscious choices, although it is not guaranteed that the total transport systems will be better utilized by this" (Quote R. Roding (District of Noord-Brabant) in Spruijtenburg 2009a).

> "We really think that dynamic and personalized information will have the effect that travellers will make more conscious choices and the transport networks will get a higher self-organizing character. We also believe that the effectivity of the utilization of the total transport networks will increase. This effect will certainly be positive, although we do not specifically know how large the total effect will be. For instance, recently the Minister stated: 'Maybe we can win 10% in the effectivity of our road transport network when every traveller is perfectly informed'. This might be possible but it is so difficult to estimate that I do not dare to set statements of this kind. Anyway, the increase in comfort for travellers that will be achieved by PITA-services is reason enough to go for it!" (Quote M. van Gelderen (Ministry of Transport; Public Works and Water Management) in Spruijtenburg 2009d).

Secondly, regarding the potential effects on the modal shift in the direction of public transit that might be caused by PITA-services, the expectations also diverge and are very uncertain.

> "We have no discrete or high expectations whether a modal shift in the direction of public transit could be achieved by means of future PITA-services. Pilots from the past do also not give any clarity related to this" (Quote M. van Gelderen (Ministry of Transport; Public works and Water Management) in Spruijtenburg 2009d).

> "I really think that PITA-services could have positive effects on the modal shift although I do not know how large this effect will be" (Quote J.M. van den Berg (Municipality of Amsterdam) in Spruijtenburg 2009k).

A third important effect that is expected by the public parties is that the total amount of road traffic might be better distributed over the different levels of the total road network by future PITA-services.

> "It is remarkable that within the Netherlands we make very little use of the available underlying road transport networks. Thus, lots of regional traffic makes use of the highroad network while this highroad network is in first instance meant for national or even international traffic. In other countries can be seen that much more use is made of these underlying road networks and I think that better travel information services (like PITA-services) and

better traffic management can strongly contribute to this" (Quote W. Benschop (City-Region of Haaglanden) in Spruijtenburg 2009e).

Social effects

Next to these transport network effects, PITA-services are expected by the public parties to have some social effects. First, the vulnerability is expected that users might become too dependent on future PITA-services which can cause problems in cases of failure.

> "A vulnerability of a service like PITA might be that the users of it will completely trust on the service and don't think by themselves anymore about the travel alternatives they have. This can cause undesired and dangerous situations when the service fails at one moment or becomes defective" (Quote G. Klijn (District of Noord-Brabant) in Spruijtenburg 2009a).

Another social effect that is expected by the public parties is a potential shift in responsibility from the different involved public and private parties to the travellers.

> "I think that an important effect might be that, in a situation with an NDW and NDOV in place and some private parties that really deliver high-quality PITA-services, a lot of responsibility can be given back to the travellers. When the involved public and private parties together take care off the availability of such PITA-services, it is the responsibility of the travellers themselves to use them and make more conscious travel choices" (Quote J.J. van Dijke (District of Utrecht) in Spruijtenburg 2009b).

4.3.2 The expectations of the involved private parties

The involved private parties have a lot of different expectations regarding the effects of future PITA-services. As described in chapter three of this thesis, the general interest of these private parties is to realize a profitable conduct of business. In this part of the thesis is researched whether they really do expect that future PITA-services can contribute to this or not. This is researched by means of explorative interviews in which also the other effects that they expect of future PITA-services are taken into account. The total group of expectations is divided in two categories: *business effects* and *other expected effects*.

Business effects

The first effect that the involved private parties expect that PITA-services will have on their conduct of business is that they generally think that they will not be able to make a sound business case for PITA-services. Three different reasons are underlying this expectation.

> "In my opinion there is generally a very small margin on travel information services. Because travellers, as the users of the services, are still not really willing to pay for it, the distribution of travel information services usually generates very little income which is also seen in other countries!" (Quote B. Munnik (9292OV) in Spruijtenburg 2009h).

> "We as TomTom are still not convinced that we can make a substantial business case for a multimodal PITA-service. This feeling is especially caused by underlying technical reasons. In Europe, almost none standards are in place regarding public transit data. Despite this, we can still introduce a PITA-service only in the Netherlands but actually you can only make money with it when you implement such a service on a larger scale and in many

different countries. However, the introduction of something like the NDOV could make it easier. That is also the reason why we are sharply following developments like those and I will not exclude the possibility that at one moment we will do introduce something like a PITA-service" (Quote B. Rutten (TomTom) in Spruijtenburg 2009g).

"Considering the relative high investments costs of PITA-services, I really doubt whether such services can result in a positive return on investments. The yield of travel information services is usually very low" (Quote M. van Heumen (the Dutch Railways) in Spruijtenburg 2009j).

A second effect that is expected by the subcategory of private parties, which is formed by the public transit companies, is the positive effect that PITA-services might have on customer satisfaction and through this also on their sales numbers.

"For public transit companies like the Dutch Railways, a good travel information service like PITA could have positive effects on customer satisfaction and related to this also a positive effect on the sales numbers might be expected" (Quote M. van Heumen (the Dutch Railways) in Spruijtenburg 2009j).

Other expected effects

One other expected effect that private parties link to future PITA-services is related to the potential change in modal shift which might be caused by such services. However, the opinions regarding these effects diverge.

"PITA-services will definitely have positive effects on the modal shift. Travellers will really start doubting when they are provided with good (PITA-like) travel information. We have researched the effectivity of our static multimodal planner. One conclusion of this research was that 25% of the travellers who had planned to travel by car decided to change the set-up of their journey based on the information from our multimodal travel planner. This effect can be translated into a social value of about € 100 million. I was really surprised that this effect was so large because our multimodal planner is still a very primitive service compared to future PITA-services!" (Quote B. Munnik (9292OV) in Spruijtenburg 2009h).

"If the quality of the public transit increases next to the introduction of PITA-services, some positive effects on the modal shift may be achieved. Though, I do not have the illusion that PITA-services only will have substantial effects on our current mobility problems" (Quote from a Public Transit company in Spruijtenburg 2009i).

This paragraph has described many different expectations regarding future PITA-services. The most important expectation among the involved public parties is that they collectively expect that travellers using PITA-services will make more conscious travel choices. Regarding the indirect effects which are related to this (effects on the utilization of the transport networks or on the modal shift in the direction of public transit), the opinions of the public parties diverge. Also among the private parties the opinions regarding the effects of PITA-services on the modal shift diverge and are uncertain. Another interesting expectation in this context is the expectation of the public parties that through PITA-services more use will be made of the underlying road networks. Furthermore, among these public parties two social

effects are expected: First, the future users of PITA-services might become too dependent on the services which can cause problematic situations and secondly a shift in responsibility is expected from the involved public and private organizations to the travellers themselves.

Among the involved private parties, the most important expectation is the general thought that they will not be able to make a sound business case for PITA-services. Three different reasons are given to ground this expectation. Though, a related expectation among the subcategory of public transit companies is that PITA-services can positively influence the satisfaction of their customers and on her turn a higher customer satisfaction might positively influence their sales numbers.

5 Promising Alternatives for the Fulfilment of the Roles

5.1 Introduction

As extensively described in chapter three, "the information chain from the collection of raw data through its conversion into meaningful information to its delivery to end users will usually involve a number of organisations spanning the public and private sectors" (Austin, Duff et al. 2001 p.18; Lyons 2006 p.208). Usually, these different parties have different goals and interests and sometimes these may be in conflict (Lyons 2006 p.208; Veeneman and van der Elst 2006 p.6). As such, the process of delivering future PITA-services will necessitate any form of cooperation between the involved organisations for the service to be developed, to function and to achieve success (Austin, Duff et al. 2001 p.18; Lyons 2006 p.208).

In chapter three, eight different roles have been identified that must be fulfilled for a successful development and implementation of PITA-services in the Netherlands. Based on recently publicized policy documents (e.g. The approach multimodal travel information (Ministry of Transport; Public Works and Water Management 2009a) and the conclusions of the advisory commission traffic information (Adviescommissie Verkeersinformatie (commissie Laan) 2009)) is stated that, regarding the fulfilment of these eight roles, very few 'hard' policy-related choices are already made. At the moment, most policy strategies are only formulated as: "Regarding the process of delivering information to travellers, cooperation between the involved public and private parties is needed in a way that every involved party can contribute to the improvement of this process from its own role and responsibility"(Ministry of Transport; Public Works and Water Management 2009a p.9); or: "Further arrangements must be made between the involved public and private parties regarding ownership of data, liability and other issues" (Adviescommissie Verkeersinformatie (commissie Laan) 2009 p.26). This chapter of the thesis goes one step further by identifying some highly promising alternatives for the fulfilment of each of the eight roles within the actor constellation for the development and implementation of future PITA-services.

Most of these eight different roles could be fulfilled in many different ways, by public and/or private parties. This also results in many different alternative actor constellations. This chapter defines some highly promising alternatives for the fulfilment of each of the individual roles. Based on examples of actor constellations within comparable information systems (paragraph 5.2), some relevant theoretical notions and perceptions of the potentially involved actors, paragraph 5.3.5 finally defines these promising alternatives. This last subparagraph (5.3.5) will also be used as input for the stated choice experiment which will be described in the next chapter of this thesis.

5.2 Examples of actor constellations within comparable information systems

Within the process of future PITA-services, the following roles have to be fulfilled (see figure 5.1 below): *Policy-Makers, Road/Traffic Managers, Data Providers, Data Integrators, Service Providers, Hardware Providers, Software Developers* and *Consultancy Companies*.

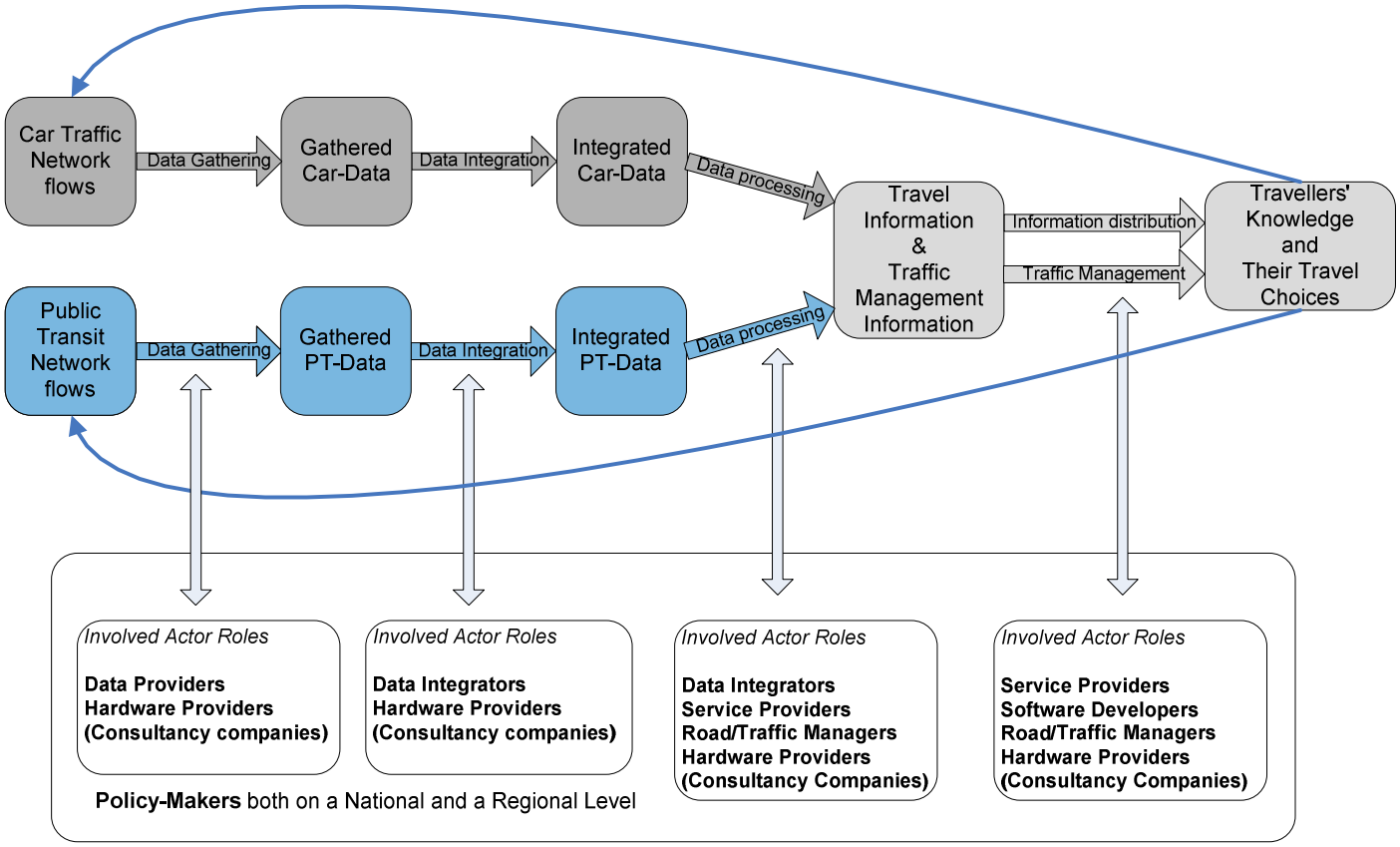

Figure 5.1 *The different roles within the process of delivering information to travellers*

This paragraph analyses four information systems which are comparable to the system of future PITA-services and in which comparable roles are distinguished. This analysis is made because from such comparable information systems that are already developed and implemented, some important lessons might be learned regarding the future development and implementation of systems like PITA. First, the *KNMI* (paragraph 5.3.1) and the *'land registry office'* (paragraph 5.3.2) will be analysed because many characteristics of these systems are comparable to those of future PITA-services. From these two systems a few interesting lessons can be learned. Next, the systems of two already existing travel information (pre-PITA) services will be analysed which are even more comparable to the system of future PITA-services: *TomTom 'HD Traffic'* (paragraph 5.3.3) and the *iPhone application 'Trein'* (paragraph 5.3.4). These are actually two of the most advanced travel information services that are currently available. Therefore, also from these two existing systems some important lessons can be learned regarding the development and implementation of future PITA-services.

5.2.1 KNMI

The Royal Dutch Meteorological office (KNMI) is an agency of the Ministry of Transport, Public Works and Water Management that fulfils many (public and private) tasks under command of this ministry. Within the 'weather information system', just as within the process of future PITA-services, the roles of data provider, data integrator and service provider play an important role. The KNMI is engaged in both the gathering of the data, the

integration of the data and the communication of the information. Furthermore, some volunteers and foreign meteorological offices also act as data providers. The KNMI delivers weather reports against fixed prices for general use, to the air traffic sector and to the maritime sector. Most of the other (service) providers of weather reports in the Netherlands also make use of the data as provided by the KNMI. Within the KNMI, during a long time, public and private activities have been carried out together but in the year 2000 the ministry has established a separate company in which the private activities of the KNMI are bundled: Weerbureau HWS. This company has been set up to enter into competition with the other (service) providers of weather information services to realize a market (Veeneman and van der Elst 2006 p.9). This way a system has been created in which the provision and integration of the data is a task for the government while the delivery of the information services is a task for the market (Ministry of Transport; Public Works and Water Management 2006 slide 5).

From this case is learned that it is very important for the ministry to clearly distinguish the public and private roles of their agencies. Here is chosen for a system in which the gathering and integration of the data is a public task while the delivery of the services is done by private market parties. This might also be a promising alternative for the fulfilment of the roles within the process of future PITA-services (Veeneman and van der Elst 2006 p.8-9).

5.2.2 Land registry office

The land registry office is another agency of the Dutch government which records data regarding real estate. These data are provided by the offices of notary that report all real estate-transactions to the land registry office. Subsequently, the information as provided by the land registry office is used by different governmental bodies, private parties, project developers but also by the offices of notary themselves. Furthermore, the land registry office also delivers some other commercial services.

An important lesson that is learned from this case is that the providers of the data to the land registry office are at the same time an important consumer of the information as delivered by this office. This causes that the providers of the data (the offices of notary) themselves have a very large interest in a complete and reliable reporting of transactions to the land registry office, which secures the quality of the information (Veeneman and van der Elst 2006 p.7-8). Within comparable information systems like PITA-services this might also be the case.

5.2.3 TomTom 'HD Traffic'

TomTom 'HD Traffic' is, as described in chapter two, one of the most advanced travel information services that are currently available. It is a mobile, dynamic and personalized travel information service and it is a good example of a service for which almost all the different roles are in one hand (Adviescommissie Verkeersinformatie (commissie Laan) 2009 p.5). TomTom gathers its own traffic flow data together with Vodafone but it makes also use of some traffic management data as provided by the different road/traffic managers and as integrated in the NDW. See table 5.1 below for an overview of the actor constellation as fulfilled within TomTom 'HD Traffic'.

Role	**Actor fulfilment**
Policy-Makers	(public)
Road/Traffic Managers	The ministry, districts and municipalities (public)

Data Providers	TomTom/Vodafone itself for traffic flow data (private) and the different road/traffic managers via the NDW for traffic management data (public)
Data Integrator	TomTom (private)
Hardware Provider	TomTom (private)
Software Developer	TomTom (private)
Service Provider	TomTom (private)

Table 5.1 *The Actor Constellation within TomTom 'HD Traffic'*

The most important lesson that is learned from the actor constellation within this travel information service is that TomTom with Vodafone as private parties prove that the role of provider of traffic flow data can also (and maybe even better) be fulfilled by private parties. Furthermore, an important conclusion is that it might be possible to keep (almost) all roles within the process in one hand. For instance, when private parties can more effectively gather road traffic flow data then public parties, it is also not unthinkable that they can more effectively manage traffic.

5.2.4 iPhone application 'Trein'

Another advanced travel information service which is currently available is the application 'Trein' for the iPhone. The actor constellation as fulfilled within this travel information service is presented below in table 5.2. Two issues regarding this service especially attract attention. The first is the increasing importance and impact of 'smart' software developers. It stays unknown what kind of beautiful applications they are able to produce until they have really done it. "Sander Stevense developed 'Trein' within only one working week" (Van Ringelestijn 2008). Actually, 'Trein' is exactly the same application for the iPhone as the 'travel planner Xtra' as provided on conventional mobile phones by the Dutch Railways. Such innovative applications can only be developed by private parties.

Role	**Actor fulfilment**
Policy-Makers	(Public)
Data Provider	The Dutch Railways (private)
Data Integrator	The Dutch Railways (private)
Hardware Provider	Apple (private)
Software Developer	Sander Stevense (private)
Service Provider	Apple (private)

Table 5.2 *The Actor Constellation within 'Trein'*

Secondly, this example illustrates the increasing importance of the private producers of mobile devices as earlier identified in chapter three. Apple produced the iPhone and proves that when an application (here: 'Trein') is developed especially for an already available very advanced mobile device, the probability that consumers will pay for the application also increases.

To conclude, the lesson learned from this information system is that the roles of the software developers and hardware providers will be very important for the success of future travel information services like PITA. Furthermore, both roles can optimally be fulfilled by private parties under the market mechanism because this will lead to innovative applications and mobile devices of the highest quality.

5.3 The fulfilment of the roles within the actor constellation for the development and implementation of future "PITA"-Services

At the end of this paragraph (5.3.5), some highly promising alternatives will be defined for the fulfilment of each of the different roles within the process of future PITA-services. This will be done based on the examples of actor constellations within comparable information systems as described above (5.2), combined with some important theoretical notions and perceptions of the potentially involved actors which will both be described in the rest of this paragraph. First, the most important public interests regarding PITA-services will be described (paragraph 5.3.1). Next, an economical view on PITA-services will be given (paragraph 5.3.2). Thirdly, the opportunities and resistances will be described that are identified among the potentially involved public and private actors regarding a future mutual cooperation (paragraph 5.3.3). Subsequently, paragraph 5.3.4 describes how an adaptive policy-making process fits to the development and implementation of PITA-services. Finally, paragraph 5.3.5 defines the high-potential alternatives for the fulfilment of each of the different roles within the process of future PITA-services. This last subparagraph also forms the basis for the stated choice experiment which will be described in the next chapter of this thesis.

5.3.1 Public interests regarding "PITA"-services

This subparagraph firstly describes the definition of public interests based on some theoretical notions. Next, the second section identifies which public interests are important regarding the development and implementation of future PITA-services.

The theory of public interests

It is the responsibility of the public parties in the Netherlands to look after the public interests (KPMG Bea 2004 p.11). The question is when an interest can be defined as public? "Most people are able to form an overall idea of the terms 'general interest' and 'public interest', but it becomes more difficult when they are asked to identify the fundamental difference between these two terms" (Lijesen, Kolkman et al. 2007 p.15). Lijesen et al. use a funnel to clarify that these terms indicate two different levels of interests (2007 p.15) (see figure 5.2 below).

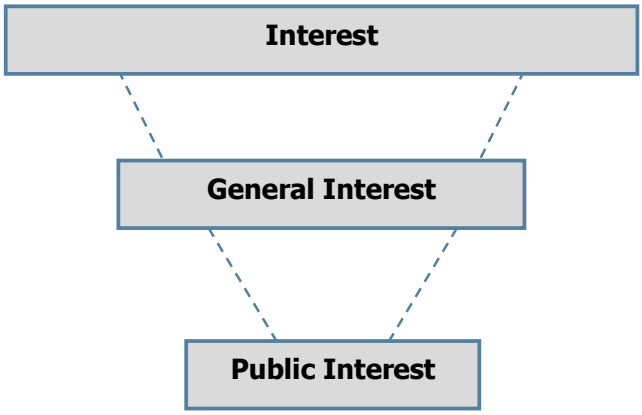

Figure 5.2 *The funnel of interests*

Related to this funnel, the following definitions will be used in this thesis (Lijesen, Kolkman et al. 2007 p.30):

- An *interest* is any matter to which people pay attention because it is advantageous for them to do so.
- A *general interest* is any matter that involves an advantage for the whole of society.
- A *public interest* is a general interest that requires governmental involvement. Several different opinions are distinguished as regards the question of which general interests are also public interests.

Lijesen et al. state that there are two different approaches to public interests (2007 p.35-39):

1) The *political approach* states that an interest is public when it is something that is expected by the broader public or society to be warranted by the government;
2) According to a more *economical approach*, an interest is public when it is a general interest and it can not be warranted for by the market. Governmental bodies must be involved here to warrant for the specific public interest.

Both approaches state that public interests are not universal because both the nature of the interest and the weight of the interest can change. In this thesis the following definition will be used to define public interests: "An interest is defined as public when the governmental bodies feel attracted to look after a general interest on the basis of the belief that this interest will otherwise not be secured" (Wetenschappelijke Raad voor het Regerinsbeleid 2000 p.20).

Public interests regarding PITA-services

As defined above, public interests are general interests of which the governmental bodies feel attracted to look after on the basis of the belief that these specific general interests will otherwise not be secured. As recently emphasized by the Ministry of Transport, Public Works and Water management, the most important public interests regarding the Dutch mobility system are *sustainability*, *liveability*, *accessibility* and *traffic safety* (Ministry of Transport; Public Works and Water Management 2009a p.2; 9292OV 2009d p.3).

To optimally secure these public interests, the involved public parties strive for an optimal utilization of the available transport networks (a *system optimum*), resulting in more productive total transport networks. Consequently, they look at travel information services (PITA) from a *policy* point of view and see them as a potential tool for travel demand management (TDM) (Chorus and Timmermans 2009 p.4). Their objectives regarding the development and implementation of future PITA-services are that such services should contribute to the realization of this system optimum and to the security of the public interests. However, when private firms will act as service providers being the future providers of PITA-services, the security of these public interests might become in danger. These private firms look at travel information services from a *marketing* point of view and only strive for more productive individual travellers (a *user optimum*) instead of more productive total transport networks (see 5.3.2 below). From this viewpoint it is possible that a private service provider gives truck drivers the advice to drive through a residential area while such an advice might be very undesired from a policy point of view. How cooperation between the public and private parties forms an opportunity to overcome such contradictions will be described in paragraph 5.3.3.

5.3.2 PITA-services – making the business case

This subparagraph gives, based on some theoretical notions and perceptions of potentially involved actors, an economical view on the development and implementation of PITA-services.

Traditional neo-classical theoretical notions

The traditional neo-classical theory forms the starting point for the study of markets and this neo-classical view on economical processes is based on three characteristic assumptions (van Gent and van Bergeijk 2000 p.167):

1) Consumers behave rationally and maximize their utility;
2) Firms behave rationally and maximize their profit;
3) The market is the most effective mechanism for coordination of the wishes of consumers and the activities of producers.

Furthermore, "a firm is defined as the economical-organisational completeness of activities which enables the supply of goods and services at markets" (van Gent and van Bergeijk 2000 p.54). Firms that strive to make profit should make this profit to survive and have to make three fundamental choices regarding their business (van Gent and van Bergeijk 2000 p.54):

1) Which goods and/or services should be supplied at which market and how should this market be approached?
2) Which combination of production factors like labour, capital, raw materials, etc. should be used?
3) Should the firm choose for competition with other suppliers, look for cooperation or even try to bind or take over other suppliers?

When firms make those three fundamental choices in such a way that they can achieve a profit-making situation, they actually have a sound *business case*. The neo-classical theory assumes that firms and individuals only undertake economical transactions when these are mutually valuable. So, firms will only be willing to sell products or services when the price is at least equal to the costs it will take to bring the product or service to the market.

An economical view on PITA-services

As described above, firms are constantly looking for a sound *business case* to continue their specific business in a profitable way. To realize this, they have to choose which goods and/or services to supply by making use of which combination of production factors. "Also at the heart of the development of travel information services which involve private organisations, who are under limited or no legal obligation to commit, is the need to have a clear business case" (Austin, Duff et al. 2001 p.20). Such a business case will involve setting out the design-, build- and operating costs and balancing them against the projected revenue from use of the service (Lyons 2006 p.208).

Keeping this in mind regarding future PITA-services, the involved private parties strive for more productive individual travellers (as being the potential consumers), a *user optimum*, and look at the service from a *marketing* point of view seeing it as a business case (Chorus and Timmermans 2009 p.4). The problem is that there is limited availability of robust and relevant empirical evidence that information services like PITA will generate sufficient demand and in turn a revenue stream to offset the costs (Austin, Duff et al. 2001 p.20). Furthermore, related to the neo-classical assumption that consumers behave rationally, firms and individuals will only undertake economical transactions when these are mutually

valuable. Though, according to Schumpeter's view on entrepreneurship, a firm's profit-making capacity is only determined by the advantage it achieves on its competitors by introducing an innovation like a future PITA-service would actually be.

Schumpeter's view on entrepreneurship
"According to Schumpeter's view on entrepreneurship, firms make the market by being innovative and successfully introducing 'neue kombinationen'. The temporary advantage a firm achieves on its competitors by introducing an innovation determines its profits" (van Gent and van Bergeijk 2000 p.93). Schumpeter distinguished five types of innovations of which the first two types (product- and process innovations) are by far the most important (van Gent and van Bergeijk 2000 p.98):

1) The introduction of a new product or service;
2) The introduction of a new production method;
3) The development of a new consumer market;
4) The exploitation of a new source of raw materials or semi-manufactured product;
5) The introduction of a new organisational form in the branch of industry.

During the last years, car travellers are 'discovered' by market parties as consumers of commercial (information) services. As described in chapter two, in-car services directed at real-time traffic information, navigation aid, safety and comfort are becoming available more and more. For market parties these services are apparently very interesting (Ministry of Transport; Public Works and Water Management 2008b p.23). But, although these developments are going very fast regarding car travel information services, for multimodal travel information services like PITA is still no sound *business case* available. For so far, the market mechanism has not led to efficient results (*market failure*). It seems that PITA-services currently cannot be supplied by market parties in a profitable way. This indicates that private parties will need to cooperate with the involved public parties to realize a successful development and implementation of PITA-services. Some promising alternatives for such a cooperation model between the public and private parties for the fulfilment of this role of the service providers will be defined in paragraph 5.3.5.

> "In my opinion there is generally a very small margin on travel information services. Because travelers, as the users of the services, are still not really willing to pay for it, the distribution of travel information services usually generates very little income which is also seen in other countries!" (Quote B. Munnik (9292OV) in Spruijtenburg 2009h).

Market- and governmental failure

In general, products and services can be brought forth under two different extreme economical coordination mechanisms: *The market mechanism* or *hierarchical governmental production*. However, usually an intermediate structure is in place (van Gent and van Bergeijk 2000 p.20-21). In a situation of a free market, the following three conditions must be fulfilled (van Gent and van Bergeijk 2000 p. 179-180):

1) Enough suppliers and consumers to evade that an individual can have a decisive influence on the price
2) Free entrance to, and retirement from, the market
3) Complete transparency

An important additional notion is that, under market forces, demand and supply will find expression in the price of a product or service. In some markets these conditions cannot be fulfilled. Then, the market mechanism does not lead to efficient results and some products or services will not be sufficiently produced, which results in *market failure* (Plug, van Twist et al. 2003 p.17). However, when a market failure occurs, it is not directly the ideal solution to switch to a structure of hierarchical governmental production. Namely, also *non-market failures* can be in place that are inefficiencies which occur when products or services are produced by governments (*governmental failure*) (Wolf 1993 p.35-37).

Related to public interests (as described in paragraph 5.3.1), a last important notion is that there are strong interdependencies between markets and governments. "It is a common thought that the utilization of market mechanisms positively influence the efficiency of the security of public interests" (Wetenschappelijke Raad voor het Regerinsbeleid 2000 p.31). In this context, governments need markets to realize their objectives and to more efficiently look after their public interests. At the contrary, markets do also need governments (KplusV organisatieadvies 2009). It can be concluded that the two coordination mechanisms can fill up and strengthen each other in a positive way.

In chapter four of this thesis, three reasons have been given for this market failure and the fact that market parties do still not have a sound business case to develop and implement services like PITA. First, generally there is a very small margin on multimodal travel information services. Secondly, there is a lack of European standards regarding public transit data and finally, the most important reason is that the investment costs for such services are still relatively high. This last problem of the high investment costs is a strong reason for firms that are active at this market to show *strategic-* or *free rider behaviour*.

Strategic- and free rider behaviour
Firms know that their economical and innovative activities will not be unnoticed at the market and reckon with potential reactions by their current and potential competitors. They show *strategic behaviour*. "Strategic behaviour means that an actor's behaviour is not determined by his opinions, but is aimed at consolidating his power position in the network. It is primarily aimed at self-interest, even if it might harm the *public interest*" (de Bruin, ten Heuvelhof et al. 2002 p.47-50). Strategic entrepreneurial behaviour is further distinguished in behaviour which directly affects the results of the firm and behaviour which is directed at the competitive environment and the position of the firm within it (van Gent and van Bergeijk 2000 p.244-245).

Another form of behaviour which is frequently seen at markets is called *free rider behaviour*. When a firm is behaving as a *free rider*, it is seizing economical assets to itself without sharing in the costs or it is minimizing its efforts or costs while knowing an already determined economical asset (van Gent and van Bergeijk 2000 p.275).

Indeed, this *free rider* behaviour is strongly in place regarding the development and implementation of PITA-services. Public and private parties look at, and wait for, each other to exclude themselves from doing the firstly needed investments for the development of PITA-services. A crucial development related to this is the commitment of the Ministry of Transport, Public Works and Water Management together with the other involved governmental bodies to take the responsibility to construct the two databases consisting of public transit- and car data, respectively the NDOV and the NDW. This will be realized according to the time-line as earlier described in paragraph 2.3.2 (Ministry of Transport; Public Works and Water Management 2009a). It is crucial because a very significant proportion of the investment costs of PITA-services will be attributable to the acquisition and integration of the data, so this will probably make it much more easy for market parties to develop profitable services (Lyons 2006 p.208).

> "The first parts of the development process, namely the gathering, standardisation and integration of the data in databases (NDW/NDOV) are essential for the progress of the development of services like PITA. The conversion of the data into information and then the delivery of the final services will not be a problem because that is relatively easy for the (private) market parties" (Quote G. Klijn (District of Noord-Brabant) in Spruijtenburg 2009a).

5.3.3 Opportunities and resistances for cooperation

Both to secure the public interests (as described in paragraph 5.3.1) and to create a sound business case for the involved private parties (5.3.2), any cooperation between the public and private parties will be required (AT Osborne 2009 p.2). Among the potentially involved public and private parties, both opportunities and resistances are seen regarding such a future cooperation for the development and implementation of PITA-services. This subparagraph describes these opportunities and resistances, partly based on perceptions of these potentially involved actors themselves.

Opportunities

As earlier mentioned in this thesis, public and private parties probably need to cooperate for a successful development and implementation of future PITA-services. As described in paragraph 5.3.1, sometimes there might be a contradiction between the objectives of more productive individual travellers (*user* optimum) which is desired from a *marketing* point of view and more productive total transport networks (*system* optimum) which is desired from a *policy* point of view. From a *marketing* point of view (as aimed at by the involved private parties) information should be provided that serves potential users the best in their individual travel patterns. Next to this, from a *policy* point of view (as strived for by the involved public parties) information provision is desired which can contribute to achieve an optimal productivity of the total transport networks (Chorus and Timmermans 2009 p.4). Sometimes, these two contradicting points of view ask for a different kind of information provision (see figure 5.3 below).

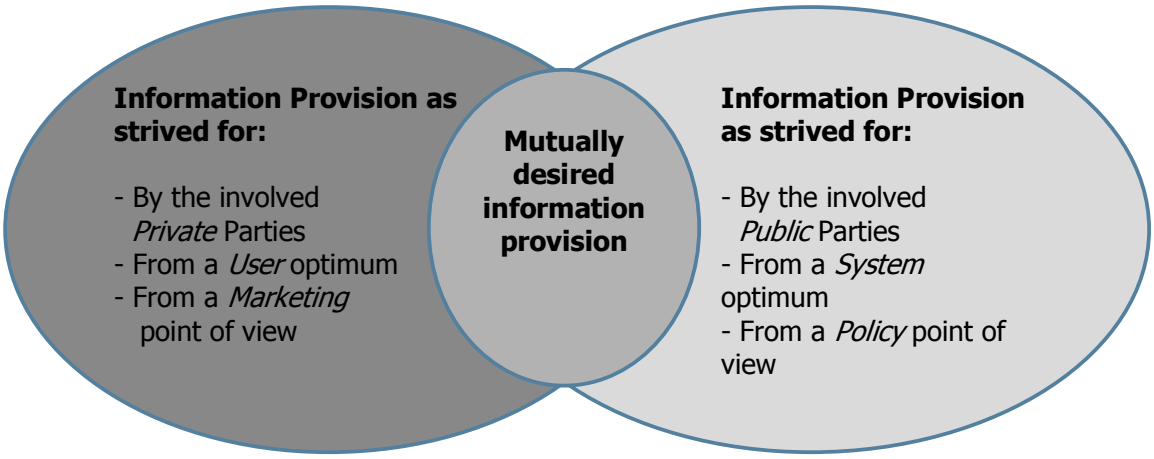

Figure 5.3 *Different kinds of information provision*

However, as presented in figure 5.3, also large parts of the information provision are mutually desired and actually this contradiction more and more seems to be a 'semblance of the truth'.

> "The contradiction that we as private service providers have another interest then the public parties because they would like, from a societal point of view, the traffic flows on some specific routes is mostly a semblance of the truth. Our information gives travellers the advice to take the route that causes optimal traffic flows. These are mostly the same routes as chosen by the road/traffic managers (at the moment public parties) as being the optimal flow routes" (Quote B. Rutten (TomTom) in Spruijtenburg 2009g).

Though, always extreme situations are thinkable in which the public parties want to provide travellers with other information then the private parties would do independently in such situations. Example situations might be situations of incident- or evacuation management when (national) safety becomes in danger. In such situations it is crucial that public parties can interrupt (as traffic managers) by providing traffic management information which must also be integrated in the travel information services to avoid that travellers get contradictory information.

As described in paragraph 5.3.1, PITA-services that strive for a system optimum might help to alleviate the negative externalities of reaching the capacity limits of our transport networks (e.g. higher congestion levels, increasing environmental damage and increasing accident numbers). The negative impact of these externalities on the public interests of *sustainability*, *liveability*, *accessibility* and *traffic safety* might also be decreased. If the public parties aim at a successful introduction of such PITA-services, cooperation with the involved private parties which are usually the providers of the services and have the needed technological experience, forms a good and interesting opportunity to create a win-win situation. Crucial in this context is the integration of traffic management information of the traffic managers within the future PITA-services to prevent that travellers get contradictory information. Among the involved private parties, not any resistance is foreseen against such cooperation (Lingham 2006 p.13; Groenhuijzen 2007; van Koningsbruggen and Westerman 2007 p.2; Ministry of Transport; Public Works and Water Management 2008a p.42; Ministry of Transport; Public Works and Water Management 2008b p.40).

> "When there are for example some roads in a municipality for which the public parties do not want heavy trucks to drive on, we are absolutely not unwilling to make appointments about that and its very easy for us to include such things in our system for the calculation of route advices. In the future, such boundary conditions can also be included by the road/traffic managers in the database of the NDW" (Quote B. Rutten (TomTom) in Spruijtenburg 2009g).

Resistances

Next to the opportunities for cooperation between the involved public and private parties to develop and implement future PITA-services, also at least one important resistance is in place regarding such a cooperation. It seems that firms can operate more efficiently when there is more freedom of the market and less governmental involvement. For the development and implementation of PITA-services this might also be the case (KPMG Bea 2004 p.8). However, a potential problem that must not be ignored is that when public parties leave a task to the market (like the supply of future PITA-services), they can not unthinkingly presume that the market will also, and free of charge, secure the public interests.

> "The automatism with which is expected by public parties that the market will secure a social justified task sometimes seems to be very under-appreciated. However, in my opinion it is just unfair to expect something like that from an independent private market party" (Quote B. Munnik (9292OV) in Spruijtenburg 2009h).

On the other side, the governmental bodies will also be careful by giving any financial support to the market parties for taking care of the public interests. Namely, they can not be completely sure that their money will indeed be used for sake of the security of these public interests.

5.3.4 An adaptive PITA-policy

This paragraph describes how an adaptive policy approach can be used by the involved policy-making bodies regarding the development and implementation of future PITA-services. First, some theoretical notions about this adaptive approach to policy-making will be given. Next, the second section outlines how this approach applies to the development and implementation of PITA-services.

Adaptive policy-making

"Policy-making is about the future" (Walker, Adnan Rahman et al. 2001 p. 282-283). "If we were able to predict the future accurately, preferred policies could be identified (at least in principle) by simply examining the future that would follow from the implementation of each possible policy and picking the one that produced the most favourable outcomes. However, for most systems of interest today such prediction is not a possibility and most policies must be devised in spite of profound *uncertainties* about the future" (Walker, Adnan Rahman et al. 2001 p. 282-283).

The *adaptive* approach to policy-making allows policy-makers to cope with the uncertainties and dynamics that confront them by creating policies that respond to changes over time and that make explicit provision for learning. Adaptive policies comprise sequential combinations of policy options. Some options are to be implemented right away; others are designed to be implemented at an unspecified time in the future, or not at all if conditions are inappropriate. An adaptive policy includes both contingency plans and a specification of conditions under which the entire policy should be reconsidered. The policies themselves are designed to be incremental, adaptive and conditional. The complete process of adaptive policy-making is presented in figure 5.4 below (Walker, Adnan Rahman et al. 2001 p.283-286).

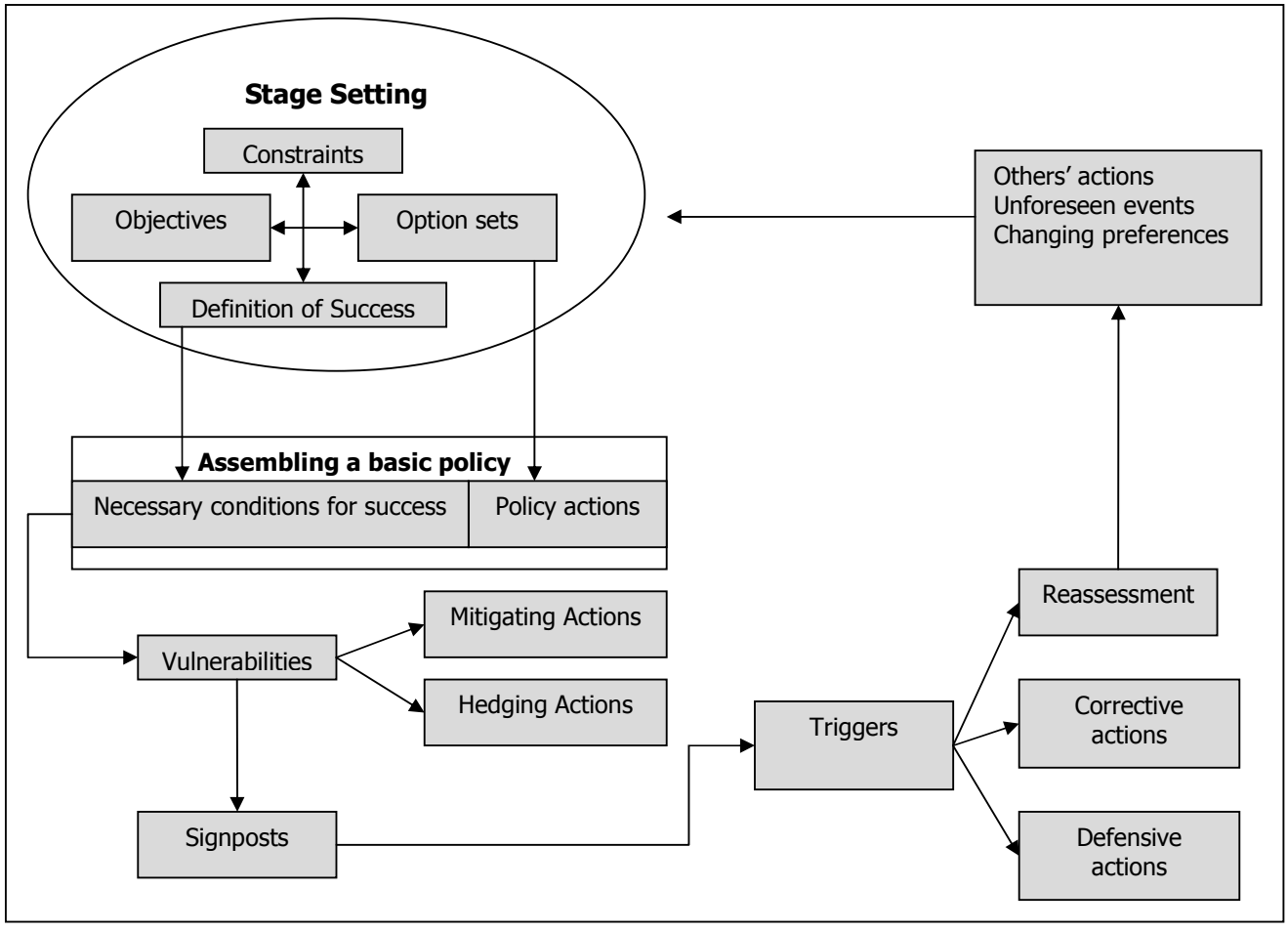

Figure 5.4 *The adaptive policy-making process*

The first phase of this adaptive policy-making process is the stage-setting phase. In this phase objectives, constraints, policy options and uncertainties are defined which results in a basic policy and some vulnerabilities (associated with key uncertainties regarding the assumptions of this basic policy). According to these vulnerabilities, some hedging- or mitigating actions might be taken in advance of the implementation of the policy but also some signposts and related triggers (critical values of these signpost variables) should be defined. When such a trigger value is reached during the implementation phase, defensive or corrective actions might be taken or even full reassessment of the basic policy could be required (Walker, Adnan Rahman et al. 2001 p.285-286).

An adaptive PITA-policy

"Usually the implementation of innovative solutions in urban transport systems, like PITA-services, really lacks progress. Reasons for this include the fact that the implementation of such innovations is surrounded by massive uncertainties regarding external developments relevant for urban transport systems (e.g. technological progress, economic developments, urban planning, demographic developments, etc.), the possible consequences of these developments for the performance of the urban transport system and the way crucial stakeholders will value these consequences" (Marchau, Walker et al. 2008 p.405).

As described above, the adaptive approach to policy-making allows policy-makers to cope with the uncertainties and dynamics that confront them by creating policies that respond to changes over time and that make explicit provision for learning. "This adaptive approach enables policy-makers to proceed with implementing innovative solutions like PITA-services despite the massive uncertainties surrounding them" (Marchau, Walker et al. 2008 p.406). Assumptions underlying the general expectation that PITA-services might become available within five to ten years, like the continuous availability of the necessary traffic information, a perfectly functioning technology and the willingness to pay for such services among the travellers, are uncertain and insufficient for policy-making on PITA implementation. Instead of additional research on reducing these uncertainties, implementation of PITA-services could be speeded up by developing an adaptive policy that enables learning about these uncertainties and modifies the basic policy based on what is learned (Marchau, Walker et al. 2008 p.406). Important other uncertainties regarding future PITA-services are for example what the effects of PITA-services will be on the utilization of the total transport systems; and what the impact will be of the development of other information services or instruments like ABvM (Dutch: *Anders Betalen voor Mobiliteit*) on the development of PITA-services.

The uncertainty regarding the development of PITA-services which is researched in this thesis is already mentioned in the introduction of this chapter. It is the uncertainty about the fulfilment of the roles within the actor constellation for the development and implementation of PITA-services. Regarding the fulfilment of these roles, very little 'hard' policy-related choices are already made. It is still unclear how the actor constellation for a future PITA-service should be fulfilled. The only hard policy choice, which is recently made by the Ministry (2009a), is that the governmental bodies take the responsibility of building the two databases NDW and NDOV, and that the delivery of the real PITA-services in first instance will be a task for the market. But, in the context of adaptive policy-making, it is also important to define beforehand which policy actions to undertake when the market fails to develop PITA-services themselves, for example because they can still not make a sound business case. Then, the government, if they still strive for an implementation of services like PITA, probably has to support the private market parties financially. Though, many alternative actions could be undertaken to give such financial support. Also regarding the (uncertain) fulfilment of the other roles within the actor constellation, implemented policies should be adaptive. To give strong recommendations regarding the implementation of such

an *adaptive PITA-policy*, it is useful to investigate the preferences of the involved public and private actors regarding the fulfilment of these different roles. This will be done in chapter six by carrying out a stated choice experiment.

5.3.5 Definition of the alternatives

This last subparagraph defines some high-potential alternatives for the fulfilment of each of the roles within the actor constellation for the development and implementation of future PITA-services. For each of the roles within the process as described in chapter three (*Policy-Makers, Road/Traffic Managers, Data Providers, Data Integrators, Service Providers, Hardware Providers, Software Developers* and *Consultancy Companies*), the most promising alternatives for their fulfilment will be defined. Hereby, for the roles of *data provider* and *data integrator*, a further distinction must be made between road data and public transit data and also within the future actor constellation these will be seen as different roles. This results in ten different roles instead of eight. Furthermore, an important question around the fulfilment of most of the distinguished roles is the consideration between public and private fulfilment, or possibly even the fulfilment of a role by use of any form of cooperation between public and private parties. "Public and private parties have their own specific boundary conditions and strengths which might be combined to fulfil some of the roles in an optimal way" (Veeneman and van der Elst 2006 p.6).

> "There are many possible alternatives for the fulfilment of the different roles within the future actor constellation. For instance, currently can be seen that private parties more and more want to interfere as road data providers, which was usually a task for road managers. For many other roles it is also still unclear how they could optimally be fulfilled. Even traffic management tasks might be fulfilled by private parties in the future. Though, I cannot directly imagine that this will really happen" (Quote M. van Gelderen (Ministry of Transport; Public Works and Water Management) in Spruijtenburg 2009d).

In this context, another important notion is that the fact that there are ten different roles within the process of future PITA-services does not immediately mean that these ten roles are fulfilled by ten different parties. It might be well possible that any party fulfils multiple (or even all) roles (Connekt, ARS T&TT et al. 2003 p.3-4). For instance, in the examples of travel information service TomTom 'HD Traffic' and the 'land registry office' is illustrated that providers of data to the database can simultaneously be users of the integrated data as provided by the database. Finally, the most promising alternatives for the fulfilment of each role, as defined in this subparagraph, will function as input for the choice-experiment that will be described in chapter six.

Policy-Makers

The first role that is distinguished within the process of future PITA-services is the role of the policy-makers. However, little attention has to be paid to the fulfilment of this role because it is by definition fulfilled publicly. In this thesis is presumed that it is currently not possible to privatise a policy-making body in the Netherlands.

Road/Traffic Managers

At the moment, as seen in chapter three, the role of the road/traffic manager is always a combined role fulfilled by different governmental bodies for the different levels of the road networks: The Ministry of Transport, Public Works and Water management for the highroad network and the different districts and municipalities for the lower level networks. This role is

publicly fulfilled in the current situation because the general thought is that so the public interests, as described in paragraph 5.3.1, can optimally be secured.

However, the example of travel information service TomTom 'HD Traffic' showed that private parties might become more effective in the gathering of road traffic flow data then public parties. Keeping this in mind, it might also be imaginable that private parties could more effectively gather and provide traffic management data then public parties and even that they could better manage the traffic.

> "The role of the traffic manager could easily be fulfilled by private parties. Many different thinkable consortia are able to do this. They say: 'Give us a clear assignment regarding the security of the public interests and a little bit freedom and we arrange it!' " (Quote J.J. van Dijke (District of Utrecht) in Spruijtenburg 2009b).

Because the emphasis within this role is pointed at traffic management activities and not at road management, in the rest of this thesis and in the choice experiment which is described in chapter six, this role is defined as *traffic managers*. If this role would be fulfilled by a private party (or by a few private parties together in a consortium), the cooperation model that seems as the most useful is to grant a concession, which is a specific form of traditional tendering.

Traditional tendering and concession

"For the execution of assignments in the fields of works, services or deliveries, traditional tendering is still seen as the traditional or classic model" (AT Osborne 2009 p.4). The point of departure within this model is that the principal clearly defines a description of the assignment he wants to be executed and that he proposes this assignment to the market by means of any kind of tendering procedure. In the next stage interested market parties can tender for the assignment where after the principal and one of these market parties come to an agreement for the execution of the assignment. Within this relationship there is a strict division between the principal and the contractor and the scope of the cooperation is clearly determined in the description of the assignment and the other contractual conditions. Important within this model is that the principal needs to have a clear picture of his problem and the related solution he has chosen to solve this problem, before he proposes the assignment to the market. A risk related to this is that the principal does not have enough knowledge about his problem to propose such an assignment that will lead to a product which fulfils his expectations. Many interesting solutions might be overlooked. So, traditional tendering forms no big incentive for innovation (AT Osborne 2009 p.4-5).

A specific form of tendering is to grant a concession. When a principal grants a concession to a market party, the market party gets the right for exploitation of a specific entity. The market party gets the economical ownership of the entity and receives its income from the exploitation, but also carries a substantial risk related to the execution of the exploitation. In this cooperation model the principal (governmental body) keeps the juridical ownership of the entity (Connekt, ARS T&TT et al. 2003 p.24-26).

So, for the fulfilment of the role of the traffic managers, two promising alternatives are available:

1) By governmental bodies (current situation)
2) By private market parties under concession

Road Data Providers

In the context of this role, road data providers are defined as providers of *traffic flow data*. At the moment, this role is mostly fulfilled by public parties (as being the road managers). Also within the comparable information system of the KNMI (paragraph 5.2.1), the policy-making bodies has determined the gathering and provision of the data to be a public task. However, as described in chapter three, new technologies are becoming available which also enable private market parties to gather traffic flow data and this way to become a road data provider (Ministry of Transport; Public Works and Water Management 2006 slide 6). Actually, TomTom with Vodafone (paragraph 5.2.3) already prove that this role of provider of traffic flow data could easily (and maybe even better) be fulfilled by private parties.

> "A situation that might be possible in the future is that there will be made use of private parties for the provision of traffic flow data. Think about *'floating car data'* as already gathered by TomTom and Vodafone. These data might have a higher quality and anyway be cheaper then the data as traditionally gathered by the ministry itself" (Quote M. van Gelderen (Ministry of Transport; Public Works and Water Management) in Spruijtenburg 2009d).

So, for the fulfilment of the role of the road data providers also two promising alternatives are available:

1) By governmental bodies (current situation)
2) By private market parties

Public Transit Data Providers

Public transit data providers in the Netherlands are the public transit companies as they are required by the concessions (paragraph 3.4.2). In the example of the actor constellation within iPhone application 'Trein' (paragraph 5.2.4) is also seen that the data which is used for this unimodal (train) travel information service is provided by the Dutch Railways. In this thesis is presumed that there are no other promising alternatives available for the fulfilment of this role.

> "I see us and the other public transit companies more and more in the role of data provider" (Quote from a Public Transit company in Spruijtenburg 2009i).

Road Data Integrator (NDW)

At the moment, the road data integrator (NDW) can be described as an agency of the different involved governmental bodies so this role is publicly fulfilled at the moment.

> "Up till now the position of the governmental bodies is as follows: We take the responsibility to built up the databases (NDW and NDOV) but to develop the real services based on the integrated data in these databases will be a task for the market" (Quote J.J. van Dijke (district of Utrecht) in Spruijtenburg 2009b).

This way a strong similarity is seen between the NDW and the information systems of the KNMI and the land registry office as described in paragraphs 5.2.1 and 5.2.2. Another

similarity between the land registry office and the NDW is that for both databases yield that some parties which provide them with data are at the same time consumers of the integrated data as delivered by them. This makes that those data providers themselves have a large interest in a complete and reliable reporting of the data and this way a large part of the quality is secured. Although the role of the NDW is publicly fulfilled at the moment, it might be thinkable that private parties could exploit this database more efficiently. Think in relation to this also about the early technological problems the NDW has been faced by. Due to these problems the database has been shut down again already two weeks after its operational start for at least one month (ANP 2009).

> "We are a governmental body as we are an agency financed by a number of governmental bodies: The Ministry of Transport, Public Works and Water Management in cooperation with some districts, municipalities and city-regions. Though, actually we feel more like a firm which is also the reason that we have a real business plan" (Quote M. van Strien (NDW) in Spruijtenburg 2009c).

So, for the fulfilment of the exploitation of the road data integrator (NDW), two promising alternatives are available:

1) By a governmental body (current situation)
2) By a private market party under concession

Public Transit Data Integrator (NDOV)

Next to the introduction of the NDW, at the moment also strong developments are in place towards the introduction of a national data warehouse regarding public transit data (NDOV). This NDOV must be operational in the year 2011 and it is planned to be developed by the Ministry of transport, public works and water management in combination with the public transit companies and the Dutch public transit authorities. The objective of this NDOV is comparable to that of the NDW: Providing a national, central database that integrates all the available data and giving other parties the possibility to develop and introduce all kinds of new and advanced travel information services (Ministry of Transport; Public Works and Water Management 2009a p.3).

For this NDOV, as for the NDW, probably yields that private parties might be able to exploit such a database more efficiently then the governmental bodies themselves. So, for the fulfilment of the exploitation of the public transit data integrator (NDOV) also two promising alternatives are available:

1) By a governmental body
2) By a private market party under concession

Service Providers

As seen in chapter three, service providers are usually private parties that deliver services to travellers/users consisting of all kinds of travel information. Normally they translate the data as provided by the different data providers and/or data integrators into useful travel information services for travellers (Regio Brabant, Zuidvleugel Randstad et al. 2008 p.16). Up till now, it is a policy-related choice of the involved policy-making bodies that the provision and integration of the data is a task for the governmental bodies and that the delivery of the final services will be a task for the market (Ministry of Transport; Public Works and Water Management 2006 slide 5; Ministry of Transport; Public Works and Water Management 2009a p.3). Also in a comparable information system like the KNMI (paragraph 5.2.1), the tasks of provision and integration of the data are fulfilled by public parties while the delivery of the final services is a task for the private market parties.

> "The development and supply of the final services is a task for the market parties. The question is whether this will really result in a profitable business case or not" (Quote M. van Gelderen (the Ministry of Transport, Public Works and Water Management) in Spruijtenburg 2009d).

However, as described in paragraph 5.3.2, market parties up till now can still not make a sound business case for the development and implementation of PITA-services. In chapter four of this thesis already some reasons are given for this market failure and the fact that market parties do still not expect that they can make a sound business case for PITA-services. Firstly, in general there is a very small margin on multimodal travel information services. Secondly, a lack of international standards regarding public transit data can be identified and finally, the investment costs for such services are still relatively high. Although the commitment of the Ministry, together with the other involved governmental bodies, to take the responsibility to construct the two databases consisting of public transit- and car data (NDW; NDOV) can substantially decrease those investment costs, a situation in which the private market parties are still not able to make a sound business case for PITA-services could really be expected.

From this starting point that the market fails to develop and implement PITA-services by themselves and in the context of an adaptive PITA-policy (paragraph 5.3.4), the public parties should probably also be involved and cooperate with the private parties to achieve a successful development and implementation of such services.

> "When the private parties can not make a sound business case for PITA-services, involvement of the public parties could work to put the market into motion. Possibilities to do this are for example by subsidy schemes or by traditional tendering (which worked perfectly for 'Haaglanden Mobile')" (Quote W. Benschop in Spruijtenburg 2009e).

To realize this involvement of the public parties for the fulfilment of the role of the service providers, the following cooperation models could be used: *Traditional tendering* as described above; *Public-Private Partnership (PPP)*, *Subsidy schemes* and *the government as 'launching customer'*.

Public-Private Partnership (PPP)

Public-Private Partnership (PPP) is a long time cooperation model in which governmental bodies and private parties, while keeping their own identity and responsibilities, realize a project together based on a clear and optimal distribution of tasks, costs, responsibilities and risks. Within a Public-Private Partnership, usually the by the principal (governmental body) desired result is the basis for the output of the project (Connekt, ARS T&TT et al. 2003 p. 20 ; Lingham 2006 p.2; Ministry of Transport; Public Works and Water Management 2009b). "Public-Private Partnership is frequently presented as a good vehicle to realize Public goals" (Klijn and Twist 2007 p.1). The added value of Public-Private Partnership is expressed in "a better product against the same costs" or in "the same quality for less costs" (AT Osborne 2009 p. 5-6). Furthermore, "a successful Public-Private Partnership strikes the delicate balance between public and private sector's interests" (Lingham 2006 p.4).

"A key component in most cases of PPP is that the public agency retains ownership of the project" (Lingham 2006 p.3). Every party that is involved in the PPP brings in its own knowledge and skills and its personal and financial resources, especially in those parts of the project that belong specifically to their own domain and where their share of knowledge and skills contributes most to the cooperation. From this viewpoint, the involved public parties will usually be responsible for the preparation of policy-related issues like plans and permits, while the involved private parties will usually be responsible for the factual realisation and financing of the project (AT Osborne 2009 p.5).

Public-Private Partnership is a model for cooperation with a large amount of juridical varieties that is used more and more during the last few years for a diversity of projects. First, PPP can be based on a *contractual agreement* between the involved parties in which the different cooperation modalities are described. A second commonly used form is to set up a separated entity that gives the cooperation the shape of a *joint-venture*, which will be managed and directed by the participating parties. Thirdly, a more innovative juridical form for a PPP is the *Alliance*. The most important characteristic of an alliance is that the interests of the involved parties are equalized and a win-win situation is realized by the initiation of a joint organization in which all the involved parties bring in human resources. Furthermore, risks are managed together, there is searched together for opportunities and tasks are also jointly executed. The used financial mechanism is an 'alliance fund' in which all the involved parties bring in an equal amount of financial resources (AT Osborne 2009 p.6; Hertogh 2009 sheet 1-8).

Subsidy schemes

A more market-directed cooperation model with less involvement of the governmental bodies is the subsidy scheme. Subsidies can be provided for various reasons. One reason might be to challenge and invite the market to develop systems and experiment with them in a way that can contribute specifically to the objectives of the public parties. "This is interesting when the market itself fails to motivate and reward firms for innovative performances and for investments in the production and development of technological knowledge that are desired from a societal viewpoint " (van Gent and van Bergeijk 2000 p.314).

Subsidies will be placed at the disposal of those market parties that fulfil the boundary conditions as set by the governmental bodies in the subsidy scheme. These boundary conditions monitor whether there will really be contributed to the objectives of the governmental bodies. In its request for a subsidy, the involved market party should make clear how its specific system development activities and/or the test situation for its developed system fulfil these boundary conditions and contribute to the objectives of the governmental bodies (AT Osborne 2009 p.6-7).

Related to this, it is very important to pay sufficient attention to the formulation of the boundary conditions. Furthermore, also conditions must be included regarding evaluation moments and a final test of the considered systems. When this is done well, a subsidy scheme allows the governmental bodies to spread the available budgets over a lot of different interested market parties which all have innovative and promising ideas. A last important notion is that this cooperation model is very intangible. The governmental bodies do not know which market parties will participate and whether those parties participate in which they are especially interested. A subsidy scheme enables the market to come with interesting developments but whether this will really be the case is uncertain (AT Osborne 2009 p.7).

The government as 'Launching Customer'

To stimulate the commercial development of products or services, the government can act as *'launching customer'*. By consuming directly and initially a large amount of the specific product or service, the government can enable a transition to a large scale production by the market parties (AT Osborne 2009 p.8).

As described above, the public parties probably need to be involved in the fulfilment of this role of the service providers because the private parties will not be able to develop PITA-services themselves. However, the possibility that the public parties will be able to develop and implement such innovative services like PITA without any help of the private parties, does also not seem to be very realistic.

> "As a governmental body you are not able to develop PITA-services totally individually but actually I do also not think that any private party will be able to do so" (Quote J.M. van den Berg (Municipality of Amsterdam) in Spruijtenburg 2009k).

So, for the fulfilment of the role of the service providers, four promising alternative cooperation models are available:

1) By private market parties under subsidy schemes
2) By private market parties under traditional tendering
3) By governmental bodies and private market parties completely together by means of a Public-Private Partnership
4) By private market parties with the government as 'launching customer'

Hardware Providers; Software Developers and Consultancy Companies

These three roles are mostly supporting roles within the process and in this thesis is presumed that they will by definition be fulfilled by private parties. Though, from the example of the actor constellation within the iPhone application 'Trein', as described in paragraph 5.2.4, has been learned that the roles of the private software developers and hardware providers are becoming increasingly more important regarding a successful development and implementation of future services like PITA. So, the importance of these two roles must definitely not be underestimated.

To summarize, for five of the ten roles within the future actor constellation for the development and implementation of PITA-services, more then one promising alternative for its fulfilment have been identified. It is very helpful to investigate the preferences of the potentially involved actors themselves regarding the fulfilment of these five roles. This way could be investigated how, and in which actor constellation, the involved public and private parties would be most willing to cooperate to realize a successful development and implementation of PITA-services. These preferences will be investigated in the next chapter (chapter six) by carrying out a stated choice experiment. Chapter six also defines how an adaptive PITA-policy (paragraph 5.3.4) could optimally take those actor preferences into account.

6 The Preferred Actor Constellation

6.1 Introduction

In chapter five, for each of the individual roles within the process of future PITA-services, the most promising alternatives for their fulfilment have been identified. Based on relevant theories, perceptions of the potentially involved actors and examples of actor constellations within comparable information systems, for each of the ten roles one or a few promising alternatives for its fulfilment are defined.

These different high-potential alternatives for the individual roles can be combined into many different promising total actor constellations. To be able to give any valuable and useful recommendations regarding the preferred fulfilment of this future actor constellation and the implementation of an adaptive PITA-policy, it is very useful to investigate the *preferences* of the potentially involved actors regarding the alternatives for the fulfilment of each of the roles. In this chapter, this will be accomplished by carrying out a stated choice experiment. Paragraph 6.2 further describes the used methodology and paragraph 6.3 describes the results of the experiment. Next, paragraph 6.4 describes the most important implications of a situation in which the future actor constellation would really be fulfilled in accordance with the preferred actor constellation as defined in paragraph 6.3. Finally, paragraph 6.5 states how this preferred actor constellation could optimally be taken into account in an adaptive PITA-policy.

6.2 Methodology

This paragraph describes the used methodology. The first subparagraph explains why there is chosen in this research to carry out a stated choice experiment and it describes the theory. Next, the second subparagraph defines the experimental design and finally the third subparagraph describes the population and states how the respondents are selected.

6.2.1 Stated choice theory

In this research project is chosen to carry out a stated choice experiment because by means of such an experiment more insights will be acquired in the preferences of the actors that might be involved in the development and implementation of PITA-services. This is required to give any recommendations regarding the preferred fulfilment of the future actor constellation for the development and implementation of such services and regarding the implementation of an adaptive PITA-policy. A choice based experiment has been carried out instead of a rating based experiment because in reality the potentially involved actors also have to choose whether they participate in a specific actor constellation for the development and implementation of PITA-services or not.

The general objective of the experiment is to predict which alternative actor constellation would be preferred among the potentially involved actors. In the experiment, the respondents are asked to choose the alternative actor constellation they prefer within eight different choice-sets which each consist of two alternative actor constellations. An alternative actor constellation exists of different attributes (roles) which all vary on different levels (fulfilment alternatives). This way a large number of observations (choices) is gathered. Based on the acquired data-set of observations, model parameters will be estimated for each individual attribute level. Then, based on these estimated parameters, direct choice probabilities can be predicted for every possible alternative actor constellation (Oppewal and

Timmermans 1992 p. 2-3). These estimated parameters themselves just form a solid basis to establish future policy on.

So, in stated choice experiments is assumed that every alternative is defined by a number of attributes which vary on different levels. Every research unit, in this research a potentially involved actor, is assumed to derive a partial utility from each of these attribute levels and to combine them into a total utility for every alternative. It is assumed that this is realised by enumerating those partial utilities (Oppewal and Timmermans 1992 p.2), as expressed in the formula below:

$$U_{ij} = \sum_{k} \beta_k X_{ijk} + \varepsilon_{ij}$$

Where:
U_{ij} = the total utility as derived from alternative j by respondent i
β_k = a to be estimated partial utility for attribute level k
X_{ijk} = an attribute level k for alternative j
ε_{ij} = the random utility component
$\sum_{k} \beta_k X_{ijk} = V_{ij}$ = the non-random utility component

Furthermore, in a stated choice experiment the respondents will be presented choice-sets consisting of a number of alternatives, for which is presumed that the respondents will always choose the alternative with the highest total utility. The alternatives in the choice-sets are described by attribute levels of which is assumed that they influence the respondents' choice. For each choice-set, the respondents have to choose only one alternative. Then, based upon the observed choices, a Multinomial Logit Model (MNL) will be estimated:

$$p_{ij} = \frac{e^{V_{ij}}}{\sum_{j \varepsilon S_i} e^{Vij}}$$

Where:
P*ij* = the probability that respondent i chooses alternative j
V*ij* = the utility as derived from alternative j by respondent i
S*i* = a choice-set of j alternatives presented to respondent i
e = base for the natural logarithm (±2,72)

Finally, based on the estimated model will be concluded from which attribute levels the respondents derive the highest utility and which attribute levels are generally preferred by them. Then, stronger recommendations can be given regarding the preferred alternatives for

the fulfilment of the roles within the actor constellation and the preferred actor constellation itself can be defined.

6.2.2 The experimental design

This subparagraph defines the experimental design as used within this stated choice experiment. First, the selection of attributes and related attribute levels will be described. Next, the composition of the alternatives and choice-sets will be described and finally the model estimation procedure will be explained.

Selection of attributes and levels

The most important objective regarding the selection of attributes and attribute levels is that the final selection should form a realistic reflection of the possible and promising range of alternative actor constellations for the development and implementation of PITA-services.

The last subparagraph of chapter five of this thesis functions as input for the selection of attributes and levels within this stated choice experiment. This subparagraph has investigated that, for the fulfilment of five from the ten roles that have to be fulfilled for the development and implementation of future PITA-services, more then only one highly promising alternative is available. The fulfilments of these five roles are selected as the (categorical) attributes within this choice experiment. In chapter five these promising alternatives for the fulfilment of each of these five roles are already defined. This is done based on some relevant theories; organisational perceptions of the potentially involved actors; and examples of actor constellations within comparable information systems. These promising alternatives for the fulfilment of each of these five roles are used as the different attribute levels. An overview of the attributes and their levels is presented below in table 6.1.

Attribute	Levels
Traffic managers	1 = governmental bodies 2 = private market parties under concession
Road data providers	1 = governmental bodies 2 = private market parties
Exploitation of the Road data integrator (NDW)	1 = governmental body 2 = private market party under concession
Exploitation of the public transit data integrator (NDOV)	1 = governmental body 2 = private market party under concession
Service providers	1 = private market parties under subsidy schemes 2 = private market parties under traditional tendering 3 = governmental bodies and private market parties together by means of a Public-Private Partnership 4 = private market parties with the government as launching customer

Table 6.1 *Attributes and their levels*

Definition of alternatives and choice-sets

The different levels of the five selected attributes as described above are combined into different alternatives. To vary the attributes in a clever and systematic way among these alternatives, *basic plans* are used. *Basic plans* have a number of advantageous characteristics of which the most important is that they are orthogonal. Orthogonal means that the appearance of an attribute level is independent of the appearance of all other

attribute levels (Steenkamp 1985). For example: the attribute level "governmental bodies as traffic managers" appears just as many times together with "governmental bodies as road data providers" as with "private market parties as road data providers".

To restrict the number of alternatives as much as possible in relation to the size of the experiment, the smallest orthogonal fractional design is chosen whereby all main effects can be estimated. For the composition of this experimental design, *basic plan 1* is used. This has led to eight different alternatives of which an example is presented in table 6.2 below (look at appendix C for the construction of all eight alternatives). The used experimental design is also balanced, which means that all levels of an attribute appear an equal number of times.

Role	***Fulfilment by***
Traffic managers	Governmental bodies
Road data providers	Governmental bodies
Exploitation of the road data integrator (NDW)	Governmental body
Exploitation of the public transit data integrator (NDOV)	Governmental body
Service providers	Private market parties under subsidy schemes

Table 6.2 *Alternative 1*

The eight different alternatives for the actor constellation within future PITA-services are distributed among choice-sets consisting of two alternatives as presented in table 6.3 below (look at appendix D for the complete questionnaire (only available in Dutch)). This way the eight different alternatives could be distributed at random among eight different choice-sets. This randomisation is tried few times to finally compose the eight choice-sets in such a way that the correlations between the different attribute levels within the choice-sets are minimized.

Example Choice-set	Constellation A	Constellation B
traffic managers	governmental bodies	private market parties under concession
road data providers	governmental bodies	private market parties
public transit data providers	public transit companies	public transit companies
exploitation of the road data integrator (NDW)	governmental body	governmental body
exploitation of the public transit data integrator (NDOV)	governmental body	governmental body
service providers	private market parties under subsidy schemes	private market parties under traditional tendering
hardware providers	private market parties	private market parties
software developers	private market parties	private market parties
Your Choice:		
	■	□
	Constellation A	Constellation B

Table 6.3 *Example of a choice-set*

Model estimation procedure

As described above, within each choice-set, the respondents must continuously choose between two alternative actor constellations (the preferred one). Because the dependent variable has a nominal measurement scale (choice) and in every choice-set two different alternatives are compared, a Multinomial Logit Model is estimated by help of the software package *Biogeme*. To enable the involvement of all the different attributes and to standardise the different attribute levels, *dummy coding* is applied.

Unfortunately, while estimating the model it seemed to be necessary to recode the attribute levels of the attribute *service providers* to achieve stronger model estimation results. This attribute is recoded in *level of cooperation* (three levels), as can be seen in table 6.4 below. Because this is in the beginning a categorical attribute, for this recoded attribute a continuous linear utility function is presumed.

Service providers (Old)	***Level of cooperation (New)***
1 = private market parties under subsidy schemes 2 = private market parties under traditional tendering 3 = governmental bodies and private market parties together by means of a Public-Private Partnership 4 = private market parties with the government as launching customer	1 = *low* (private market parties with the government as launching customer) 2 = *medium* (private market parties under subsidy schemes or traditional tendering) 3 = *high* (governmental bodies and private market parties together by means of a Public-Private Partnership (PPP))

Table 6.4 *Recoding of the attribute service providers*

6.2.3 Population and the group of respondents

Before starting to distribute the web-based questionnaire, first the population of the research must be defined. Within this research, the population exists of all the actors that might be involved within the fulfilment of one (or more) of the roles within the future actor constellation for the development and implementation of PITA-services in the Netherlands. Furthermore, also researchers in the field of study belong to the population. This makes that the population is pretty small and not really well demarcated. The population is divided into three different actor categories: private market parties, governmental bodies and actors from other kinds of organisations like for example research institutes. The aim was a group of respondents existing of around the same amount of actors from private market parties as from governmental bodies to enable a reliable comparison between these groups.

To carry out a reliable analysis, it is very important that the number of respondents is large enough. For this research, in relation to the characteristics of the analysis and the available time, it was sufficient to aim at a total group of thirty respondents which would mean two hundred and forty observations.

Finally, thirty-six respondents filled in the questionnaire which resulted in two hundred and eighty-eight observations. To get a clear picture of the final group of respondents, the respondents are asked for what kind of organisation they are actually working. Unfortunately, as presented below in table 6.5, the group of respondents exists for (by far) the largest part of private market parties. This makes a reliable comparison between the preferences of governmental bodies and private market parties impossible.

Type of respondents	**#**
Governmental bodies	13
Private market parties	20
Other (e.g. research institutes)	3

Table 6.5 *Characteristics of the group of respondents*

6.3 Results

This paragraph describes the most important results of the stated choice experiment. First, the estimated model is described (the estimated partial utilities of the attribute levels) from which will be derived which fulfilment alternatives for the different roles within the actor constellation are preferred by the group of respondents. Next, some other interesting notions are described regarding the fulfilment of the future actor constellation that are acquired by means of the questionnaire.

6.3.1 The estimated model

Based on the choices of the respondents as observed within the stated choice experiment, an aggregated model is estimated to investigate partial utilities for each of the attribute levels. To standardise the different attribute levels, *dummy coding* is applied. The estimated parameters determine the different partial utilities for each of the attribute levels. A partial utility shows the contribution of an attribute level to the total utility, expressed as a deviation of the average utility. Based on these partial utilities, direct choice probabilities can be predicted for every possible alternative actor constellation.

The Rho-square of the estimated model is equal to 0.14. This Rho-square shows how the estimated model fits to the gathered data. Apparently, the Rho-square of this model is quite low but this was also expected because the respondents had to choose between alternative actor constellations for the future development of PITA-services. Currently, this is still a pretty unknown environment for them. Table 6.6 below shows the partial utilities of all attribute levels together with the values of their t-tests. The fact that most of the estimated parameters are significant having such a small group of respondents is a very good result. Furthermore, within this experiment is presumed that the different attribute levels within the alternatives are independent from each other.

Attribute level	**Partial utility**	**t-test**
1. Traffic managers		
Governmental bodies	0.00	
Private market parties under concession	-1.09	-5.35
2. Road data providers		
Governmental bodies	0.00	
Private market parties	0.31	1.82*
3. Exploitation of the road data integrator (NDW)		
Governmental body	0.00	
Private market party under concession	0.44	2.66
4. Exploitation of the public transit data integrator (NDOV)		
Governmental body	0.00	
Private market party under concession	0.02	0.09**
5. Service providers (Level of cooperation between the public and private parties)		
Low	0.00	
Medium	-0.48	-2.36
High	-0.95	
		* = only significant at an alpha level of 10% ** = insignificant at any reasonable alpha level

Table 6.6 *The estimated partial utilities and their t-values*

Based on these partial utilities (as presented in table 6.6) can be stated that four of the five attributes significantly influence a respondents' choice for a specific actor constellation. These four attributes are the fulfilment of the roles of the *traffic managers*, the exploitation of the *road data integrator (NDW)*, the *service providers* and the *road data providers*.

Regarding the fulfilment of the role of the *public transit data integrator (NDOV)*, no significant results have been acquired. The fulfilment of the role of the traffic managers seems to be the most important attribute. A future fulfilment of this role by private market parties is strongly negatively appreciated. This can be clarified from the traditional viewpoint that governmental bodies must always be able to interrupt in traffic situations which might for example harm the public interest or in case of calamities.

The second most important attribute is the fulfilment of the role of the service providers. When governmental involvement regarding the fulfilment of this role increases, its derived utility strongly decreases. This can be clarified from the recent statement of the Ministry of Transport; Public Works and Water Management that the delivery of the final travel information services will be in first instance a task for the private market parties.

The exploitation of the road data integrator (NDW) is the third important attribute. When the NDW will be utilized by a private market party instead of a governmental body, this will be very positively appreciated. This can be clarified by the early technological problems the NDW has been faced by right after its operational start. Due to these problems the database was shut down again for one more month already two weeks after this operational start.

The fourth important attribute is the fulfilment of the role of the road data providers. When this role would be fulfilled by private parties instead of governmental bodies, this will be positively appreciated by the involved actors. This can be clarified by the recent development that private parties (e.g. TomTom and Vodafone) prove to be able to develop new technologies (e.g. 'floating car data') to gather their own traffic flow data which might even be of an higher quality then the data as conventionally gathered by governmental bodies.

Obviously, it seems that the different partial utilities of the attribute levels for all these four attributes can be well interpreted. This can be seen as a first confirmation of the validity of the estimated model (face validity). From the estimated partial utilities (see table 6.6), the most and the least preferred actor constellation are derived as presented in figures 6.1 and 6.2 below.

	The most preferred actor constellation	
Role	***Fulfilment by***	***Partial utility***
Traffic managers	Governmental bodies	0.00
Road data providers	Private market parties	0.31
Exploitation of the road data integrator (NDW)	A Private market party under concession	0.44
Exploitation of the public transit data integrator (NDOV)	A Private market party under concession or a Governmental body	insignificant
Service providers	Private market parties with the government as launching customer (Low level of cooperation)	0.00
	Total Utility	***0.75***

Figure 6.1 *The most preferred actor constellation*

The least preferred actor constellation		
Role	***Fulfilment by***	***Partial utility***
Traffic managers	Private market parties under concession	-1.09
Road data providers	Governmental bodies	0.00
Exploitation of the road data integrator (NDW)	Governmental body	0.00
Exploitation of the public transit data integrator (NDOV)	A Private market party under concession or a Governmental body	insignificant
Service providers	Governmental bodies and private market parties together by means of a Public-Private Partnership (High level of cooperation)	-0.95
	Total Utility	***-2.04***

Figure 6.2 *The least preferred actor constellation*

Based on the estimated partial utilities, direct choice probabilities can be predicted for the most and the least preferred actor constellation but also for every other possible alternative actor constellation. If a potentially involved actor has to choose between the most- and the least preferred actor constellation (as presented above), the probability that this potentially involved actor will choose for the most preferred actor constellation is equal to 94%. So, the probability that a potentially involved actor will choose for the least preferred actor constellation is equal to 6%.

As earlier described, the importance of the different attributes regarding these choice-probabilities differs. The fulfilment of the roles of the *traffic managers* and the *service providers* have the largest impact on the probability that a potentially involved actor chooses for a specific alternative actor constellation. For instance, when the role of the traffic managers would be fulfilled by private market parties under concession instead of governmental bodies within the most preferred actor constellation, the probability that an actor will choose for this most preferred actor constellation (instead of the least preferred actor constellation) decreases from 94% to 85%. And, when the role of the service providers would be fulfilled by means of a stronger cooperation model like traditional tendering or Public-Private Partnership (PPP), the probability that an actor will choose for this most preferred actor constellation (instead of the least preferred actor constellation) decreases from 94% to respectively 91% and 86%.

Next to these most and least preferred actor constellation, which are derived from the estimated partial utilities, also *the most likely actor constellation* is identified. The most likely actor constellation is the actor constellation which, according to the author's opinion, would be most in line with current policies and recently publicized policy documents (e.g. The approach multimodal travel information (Ministry of Transport; Public Works and Water Management 2009a) and the conclusions of the advisory commission traffic information (Adviescommissie Verkeersinformatie (commissie Laan) 2009)) (see figure 6.3 below). If a potentially involved actor must choose between the most likely and the most preferred actor constellation, the probability that this potentially involved actor will choose for the most likely actor constellation is equal to 32%. So, 68% of the potentially involved actors would prefer the most preferred actor constellation above the most likely actor constellation. Though, this is just an outlook based on the author's opinion and observed policy trends which are uncertain and might actually change rapidly.

The most likely actor constellation		
Role	***Fulfilment by***	***Partial utility***
Traffic managers	Governmental bodies	0.00
Road data providers	Governmental bodies	0.00
Exploitation of the road data integrator (NDW)	Governmental body	0.00
Exploitation of the public transit data integrator (NDOV)	A Governmental body	insignificant
Service providers	Private market parties with the government as launching customer (Low level of cooperation)	0.00
	Total Utility	***0.00***

Figure 6.3 *The most likely actor constellation*

To conclude, it must be stated that the estimated partial utilities and derived choice probabilities as presented in this paragraph form a solid basis to establish future policy on. Unfortunately, the derived choice probabilities are not further applied in this experiment to determine the real predictive capacity of the model by use of *holdout profiles*. The total group of respondents is too small to do this.

6.3.2 Additional interesting perceptions of the respondents

In the questionnaire, next to the choice-sets, the respondents is asked how the actor constellation of their own specific preference would be fulfilled and/or whether they have other interesting ideas or remarks regarding this actor constellation for the development and implementation of PITA-services. This subparagraph describes the most important ones of these additional results of the experiment.

First, related to the role of the road data providers, an interesting thought is noticed. In the near future, a new technology may enable the gathering of both dynamic road traffic flow data and dynamic public transit data, using smart phones in combination with GPS. When this becomes possible, individual private parties might be able to cover the whole process of delivering information to travellers themselves. Then, these private parties could freely compete for the support of the data provider (which will be the travellers/consumers themselves in such a situation). However, the problem of realizing a profitable business case will still be in place.

Secondly, many respondents state that in their opinion the role of the service providers could really be fulfilled by private market parties independently and without any governmental involvement. However, in chapter five is argued why this will probably not be feasible for them. An important additional notion here is the statement of one of the respondents that the government cannot expect from private market parties that they will deliver services which generate merely societal revenues. That is the moment the government should interfere instead of holding to the dogma that 'the market has to pick it up'.

Thirdly, some respondents state that not only the actor constellation is important but also 'the road to' this actor constellation. It has been suggested that it might be better if the

fulfilment of some of the roles change during the development- and implementation process of PITA-services. Another opinion is that in the current situation there is lack of vision, identity and self-reflection among the involved governmental bodies. The central government does not have the capacity to realise its own objectives while it actually pays more then 70% of all developments in road- and public transit. Simultaneously, the private parties move as bees around the honey (*free rider behaviour*) and lack any interior compass which is fatal for real innovations.

A fourth additional result of the experiment is that the respondents generally have the opinion that regarding the fulfilment of the roles of the data integrators (NDW/NDOV), the pure utilization could be done by private parties but that the governments must be able to act as director and set boundary conditions to the use of these different data (for example regarding preference roads). Regarding the NDOV, the link to the requirements regarding dynamic data as part of concessions (concession management) is noticed.

Finally, in compliance with the results of the stated choice experiment, many respondents prefer that the role of the traffic managers will definitely stay a task for the involved governmental bodies. The respondents refer many times to the risk that the public interests might become in danger when this role will be fulfilled by private parties. Though, many respondents have also raised the possibility that only some traffic management tasks could stay in the hands of the government (e.g. strategic choices like the definition of the function of roads) while others could actually better be fulfilled by private parties (e.g. the pure guidance and steering of traffic flows to optimize the utilization of the total road network).

6.4 Implications of the preferred actor constellation

If the future actor constellation for the development and implementation of PITA-services would really be fulfilled in accordance with the most preferred actor constellation, as presented in figure 6.1, this will have several implications. Firstly, a fulfilment of the role of the traffic managers by governmental bodies ensures that public interests (*liveability, traffic safety, accessibility, sustainability*) can be optimally secured in situations of incident- or evacuation management. Furthermore, if the governmental bodies, in their role of traffic managers, ensure that their traffic management information is integrated (via the NDW) in the services of the service providers, a situation of PITA-services contributing to a system optimum may be realized (opportunity). This is crucial because it will also prevent that travellers get contradictory information. As described in paragraph 5.3.3, against such an integration of traffic management information in the services of the service providers, no major resistance among the private parties is foreseen.

Secondly, by a fulfilment of the role of the road data providers by private market parties which sell their gathered data to the NDW and/or directly to traffic managers and service providers, a market might be created. And, according to Schumpeter's view on entrepreneurship (paragraph 5.3.2), a firm's profit-making capacity on a market is only determined by the advantage it achieves on its competitors by introducing an innovation. So, this may lead to the introduction of innovative and improved technologies or methods regarding the process of (road) data gathering/provision. A good example in the current situation is the existing service 'TomTom HD Traffic' (paragraph 5.2.3). TomTom already uses an innovative technology to gather traffic flow data ('floating car data') and proves to provide more accurate information then services based on data which are gathered by use of conventional technologies.

Thirdly, the exploitation of the road data integrator (the NDW) by a private party under concession may lead to an improvement of the functioning of the database and to a decrease of suffer related to technological problems. In addition, a private party might better (then a governmental body) be able to act as an intermediary between the traffic managers and the service providers and to realise that the traffic management information is perfectly integrated in all travel information services.

Fourthly, a fulfilment of the role of the service providers by private market parties with the government as launching customer (low level of cooperation) could actually only be realised when these market parties will (almost) be able to develop a sound business case (paragraph 5.3.2). Despite the fact that this is currently not expected (chapter four), the implementation of a complete NDW and NDOV (which probably leads to a substantial decrease in investment costs for the service providers) could enable this. The implementation of these databases will probably also lead to a significant decrease in strategic- and free rider behaviour among the private parties. If this will all be realised, a market with many different service providers delivering advanced PITA-services could be a final situation. Then, also innovations will be stimulated.

Fifth, this preferred actor constellation, with a private fulfilment of the role of the road data providers and a private exploitation of the NDW, differs from the system of the KNMI in which the gathering and integration of the data is a public task (paragraph 5.2.1). Though, this is not a reason to conclude that this preferred actor constellation will not work well for the development and implementation of PITA-services. It might even be vice versa: The system of the KNMI might also be improved by a private fulfilment of the roles of the data providers and –integrator. As long as the ministry just clearly distinguishes its public and private roles.

Finally, as seen in the example of the 'land registry office', part of the quality of the information can be secured if some of the data providers to a specific database simultaneously act as consumers of the integrated data as delivered by that database. Within the preferred actor constellation for the development and implementation of PITA-services, this will also be the case. The traffic managers which deliver their traffic management data to the NDW will probably also make use of the integrated data as delivered by this NDW. Furthermore, if TomTom will act as road data provider in the future, providing their floating car data to the NDW, they could simultaneously act as service provider and make use of the integrated data as delivered by the NDW. Also remember the examples of the actor constellations within 'TomTom HD Traffic' and the 'iPhone application Trein' (paragraphs 5.2.3 and 5.2.4), in which is demonstrated that a single party can fulfil multiple roles within the same actor constellation.

6.5 Integration of the actor preferences in an adaptive PITA-policy

As described in paragraph 5.2.4, the adaptive approach to policy-making allows policy-makers to cope with the uncertainties and dynamics that confront them by creating policies that respond to changes over time and that make explicit provision for learning. Regarding PITA-services, one of these uncertainties is related to the fulfilment of the roles. This paragraph explains how the preferences of the involved public and private parties regarding the fulfilment of these roles, as described in paragraph 6.3, could be integrated in an (to be implemented) adaptive PITA-policy. This paragraph should not be seen as a detailed design of a complete adaptive PITA-policy. Instead, for every step in the adaptive policy-making process (as presented in figure 6.4 below) is shortly described how the preferred actor constellation could be taken into account (Walker, Adnan Rahman et al. 2001 p.282-284).

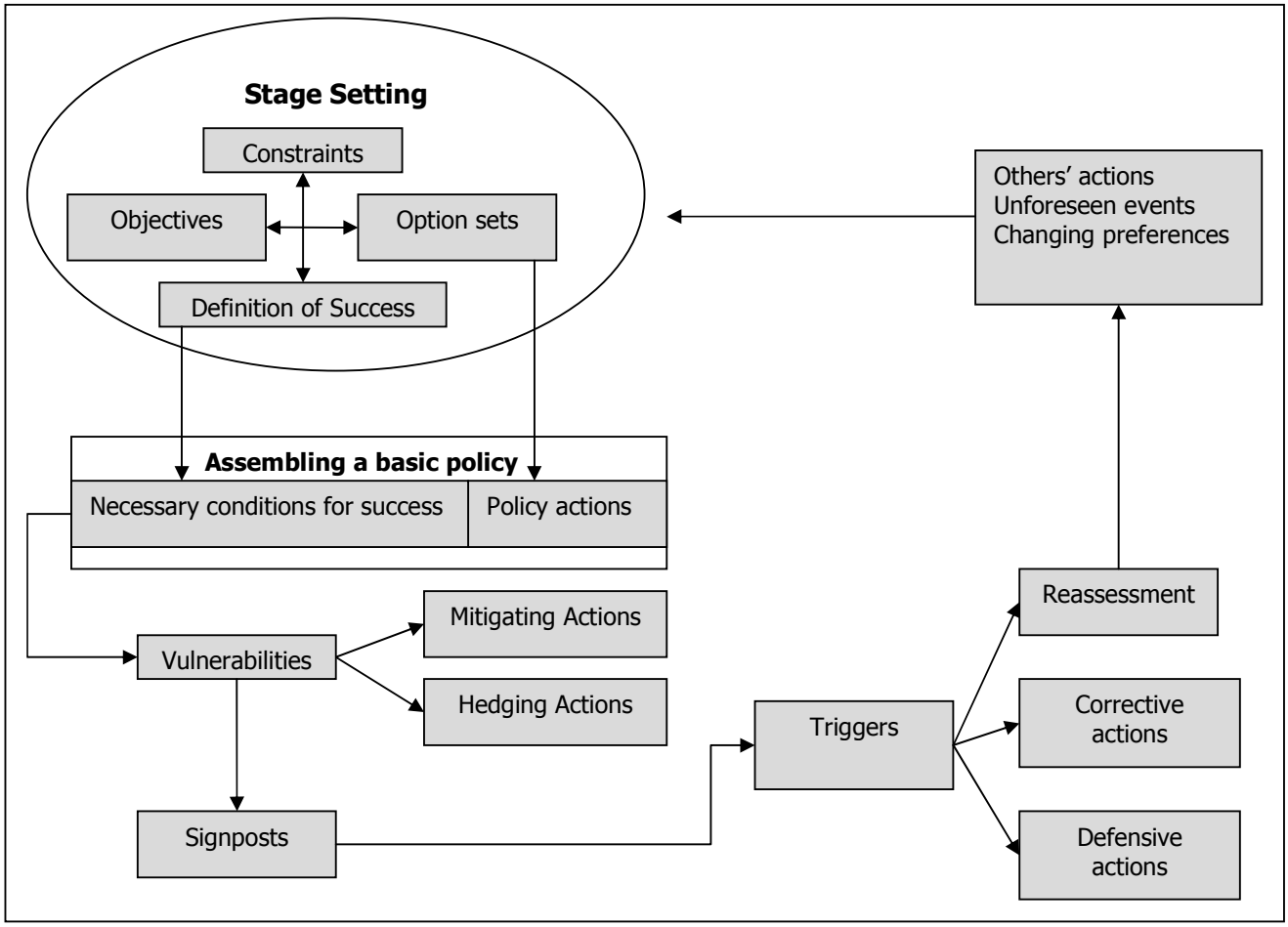

Figure 6.4 *The adaptive policy-making process*

The first step of developing an adaptive PITA-policy will be the *stage setting* step. In this step, constraints could for example be related to the available budget for the central government to be involved in the development and implementation of PITA-services. Furthermore, objectives related to the implementation of PITA-services would for instance be a decrease in congestion and in the amount of vehicle-hours of delay. Finally, a definition of success might be that every individual traveller has continuous access to individual, dynamic and multimodal travel information.

Next, in the second step of developing an adaptive PITA-policy (*the assembly of a basic policy*), the following 'basic' policy actions could be included to integrate the identified actor preferences regarding the fulfilment of the actor constellation:

- Regarding the fulfilment of the role of the traffic managers, at least some of the traffic management tasks should stay the responsibility of the governmental bodies (in line with the current situation). For instance, the decision on strategic choices regarding the road network (e.g. choices regarding the functions of roads or in situations of incident- or evacuation management when (national) safety becomes in danger). For other traffic management tasks, the government should reconsider whether they could more efficiently be fulfilled by private parties (e.g. the pure

guidance and steering of traffic flows to optimize the utilization of the transport networks) or not.
- Stimulate private market parties to develop new technologies for the gathering and provision of road data and to become road data providers. Then, it will become possible for the NDW and/or other parties (e.g. service providers or traffic managers) to buy these road data freely in the market. Furthermore, as traffic manager, make use of these data as provided by those future private road data providers.
- Grant a concession to a private market party (or a consortium of private parties) to exploit the NDW, especially for efficiency reasons and to improve its performance.
- Take the responsibility to construct the NDOV (together with the public transit authorities and/or the public transit companies). This policy action is actually in line with the recently published approach multimodal travel information (Ministry of Transport; Public Works and Water Management 2009a).
- Give the market the responsibility to develop and implement services like PITA themselves and without any governmental involvement. This policy action is also in line with the recently published approach multimodal travel information (Ministry of Transport; Public Works and Water Management 2009a) and supports creativity and innovations.

Finally, in the third step of developing an adaptive PITA-policy, *specifying the rest of the policy*, several vulnerabilities, signposts and triggers may be identified which may require any mitigating, hedging, defensive or corrective policy actions. The vulnerabilities, signposts and related actions which are identified in relation to the policy actions as defined above are presented in table 6.7 below. However, there are probably even more vulnerabilities which remain unidentified (*unknown unknowns*) in this thesis.

Vulnerabilities	**Mitigating/Hedging actions**	**Possible signposts/triggers and defensive or corrective actions**
1. *Uncertain*: The ability of the private parties to develop a sound business case for PITA-services themselves and to fulfil the role of the service providers independently	*Hedging* action: Act as a launching customer to stimulate the commercial development of the PITA-services	Monitor whether PITA-services can be developed by private market parties independently. If not (trigger), implement *corrective* actions (e.g. provide subsidies or use traditional tendering or maybe even public-private partnership) to realize the implementation of PITA-services. Though, only implement such *corrective* actions taking the second vulnerability into account
2. *Uncertain*: Whether PITA-services would generate higher societal revenues then they would bring societal costs	*Hedging* action: Facilitate experiments or other research activities to investigate the 'real' effects of future PITA-services (e.g. carry out experiments to research the potential effects of PITA on the utilization of the total transport networks or on a potential modal shift in the direction of public transit; or carry out social cost-benefit	Monitor the results of the research activities. When societal costs seem to be higher then societal revenues (trigger), undertake *corrective* actions (e.g. reduce or stop (part of) the (financial) governmental involvement)

	analyses)	
3. *Uncertain*: The willingness among the private market parties to develop new and innovative technologies regarding the gathering and provision of road data and to become road data providers	*Hedging* action: Act as a launching customer to stimulate the development of such new and innovative technologies	Monitor the development of such new technologies. If the market itself fails to motivate firms for innovative performances and simultaneously societal revenues of PITA seem to be higher then societal costs, subsidies could be provided (*corrective* action)
4. *Uncertain*: The ability of the private parties to fulfil some of the traffic management tasks more efficiently then the governmental bodies do	*Hedging* action: Accomplish a market consultation in which presented solutions and ideas of interested market parties could be investigated and tested	Monitor the results of the market consultation. When market parties really seems to be better able to fulfil some traffic management tasks then the governmental bodies themselves, concessions could be granted to market parties regarding the fulfilment of those tasks (*corrective* action)

Table 6.7 *Dealing with vulnerabilities related to the defined 'basic' policy actions*

Once the above policy is agreed upon, the basic PITA-policy is implemented and signpost information begins to be collected. The adaptive policy-making process is suspended until a trigger event is reached. In case of such a trigger event, the pre-defined action could be undertaken.

One last important notion is that also some vulnerabilities may occur for which only full *reassessment* of the basic policy would be sufficient. Regarding the fulfilment of the actor constellation for the development and implementation of PITA-services, such a vulnerability might be that one or few of the key actors, fulfilling one or more roles within the future actor constellation, are not willing to participate anymore. A reason for this might be that returns on investment remain too low (Marchau, Walker et al. 2008 p.406).

7 Conclusions and Recommendations

7.1 Introduction

This thesis has studied the road to *Personal Intelligent Travel Assistants* or PITA-services. During the last years the development of advanced travel information services has been going very rapidly. This thesis has provided an overview of the currently available travel information services including the services that may be expected to become available till 2015. Next to this, the roles within the process of delivering information to travellers have been defined and a detailed analysis is made of the specific public/private actor arena. All actors have been identified that may be involved in the future development and implementation of PITA-services. Furthermore, a study is made on the expected effects of future PITA-services as perceived by these potentially involved public and private actors. Finally, an investigation has been made of the most promising alternatives for the fulfilment of each of the roles within the future actor constellation for the development and implementation of PITA-services and of the preferences of the potentially involved actors regarding the fulfilment of these roles. The research in this thesis has been carried out on behalf of *AT Osborne*, an independent management- and consultancy company for which the travel information market is a high-potential new market. *AT Osborne* sees business opportunities in being involved in the development- and implementation process of future travel information services like PITA-services.

Within the first parts of the research carried out in this thesis, *literature/desk research* has played a major role in optimally providing an overview of the available travel information services and in further specifying the actor arena. Also in defining the highly promising alternatives for the fulfilment of each of the different roles within the future actor constellation for the development and implementation of PITA-services, extensive *literature/desk research* has been used. Furthermore, *explorative interviews* have been done with different public and private actors that may be involved in the future development and implementation of PITA-services. Goal was to investigate their expectations of such services, but also to investigate other issues like the opportunities and resistances that can be expected regarding a future cooperation between the involved actors. Finally, a *stated choice experiment* has been carried out to discover which fulfilment alternatives for the roles within the future actor constellation are preferred by the potentially involved actors themselves and to determine how this preferred actor constellation looks like.

This chapter firstly draws the conclusions from the research results as presented in chapters' two to six of this thesis (paragraph 7.2). Next, paragraph 7.3 gives some important recommendations for both the problem-owner *AT Osborne* and for the central government, but also some scientifically challenging directions for further research. Finally, paragraph 7.4 gives a reflection on the research as carried out in this thesis.

7.2 Conclusions

This paragraph draws the conclusions from the research results as presented in this thesis, related to the three main research questions as defined in the first chapter.

7.2.1 The state-of-the-art in travel information services

This subparagraph draws conclusions from the results of the first part of this research which relates to the first main research question:

> 1. What is the state-of-the-art in travel information services including the services that may be expected to become available till 2015?

This thesis started to define the concept of travel information services and some different classifications of it, followed by the definitions of the more specific concepts of "pre-PITA"- and "PITA"-services and of the process of delivering information to travellers. Chapter two also showed an extensive overview of the currently available travel information services. It has been investigated that only few of the currently available travel information services already combine three of the four PITA characteristics (*mobile, dynamic, multimodal* and *personalized*). The three most advanced travel information services that are currently available and which tend most to future PITA-services are *'TomTom HD Traffic'*, the iPhone application *'Trein'* and *'Haaglanden Mobile'*. TomTom HD Traffic is a navigation system that determines real-time traffic speeds, congestion levels and delays on the basis of 'floating car data' and adjusts the calculated route-advices to this gathered information. The data are gathered via mobile phones and via the users of the service itself. Trein is an application that makes the 'Travel Planner Xtra' of the Dutch railways available on the iPhone and is additionally linked to GPS. Finally, Haaglanden Mobile provides information on mobile phones regarding the actual situation on both the public transit- and the car network in the specific region of Haaglanden.

Furthermore, the thesis showed that it will be really questionable whether PITA-services will become available before 2015 or even 2020 and that opinions regarding the speed of this development strongly diverge among the involved actors. Next to this development of PITA-services, existing pre-PITA services will improve during the coming five years and many new pre-PITA services will become available which will be of an increased quality compared to the services that are available at the moment. For example, services like 'TomTom HD Traffic' or the 'car & OV' travel planner of 9292OV will probably be further improved and become more reliable and accurate services. Finally, the development of other (information) services (VAS: *Value Added Services*) that might be bundled to future PITA-services is also very important. Regarding this bundling of services, *software developers* will play a major role (e.g. companies like Hyves, Google, Microsoft, Apple, etc.). Software developers are able to strongly enrich the value of data by bundling different services and developing advanced applications which will increase the value of each of the services individually. Services that may be bundled to future PITA-services are for instance other in-car services (ITS), social networking services (Hyves, Linkedin), services of telecommunication providers (Kpn, Vodafone, etc.) or developments in the field of ABvM (Dutch: Anders Betalen voor Mobiliteit).

7.2.2 The expected effects of PITA-services as perceived by the involved public and private parties

This subparagraph draws conclusions from the results of the second part of this research which relates to the second main research question:

> 2. What are, as perceived by the involved public and private parties, the expected effects of future PITA-services?

This thesis showed that the potentially involved public and private actors have many different expectations regarding the effects of future PITA-services (chapter four). The most important expectation among the public parties is that the implementation of PITA-services will cause the effect that travellers will make more conscious travel decisions. However, whether this will cause a better utilization of the total transport systems is very uncertain. The public expectations regarding this effect differ. Also regarding the effect on the modal shift in the direction of public transit that could be caused by future PITA-services, the expectations diverge and are very uncertain. Another expectation of the public parties is that, through the introduction of PITA-services, the total amount of road traffic might be better distributed about the available road network levels. Furthermore, two social effects of PITA-services are expected by the public parties. First, the vulnerability that users might become too dependent on future PITA-services which can cause problems in cases of failure. Secondly, a potential shift in responsibility from the different public and private parties back to the travellers themselves.

Among the private parties, the most important expectation is that they do not expect to be able to make a sound business case for PITA-services because of three different reasons. Firstly, they have stated that there is a very small margin on travel information services because travellers are still not willing to pay for them. Secondly, they have stated that the investment costs related to the development and implementation of services like PITA are very high. It has been identified that these high investment costs are a strong reason for private parties to show *strategic*- and/or *free rider* behaviour (chapters five and six). An important development related to this is the recent commitment of the Ministry of Transport, Public Works and Water Management together with the other involved governmental bodies to take the responsibility to construct the two databases consisting of public transit- and car data, respectively the NDOV and the NDW. A significant proportion of the investment costs of PITA-services will be attributable to the acquisition and integration of the data, so this will probably make it easier for private parties to make a sound business case. However, because this is still uncertain and in the context of *adaptive policy-making*, this thesis has in first instance presumed that the market will fail to successfully develop and implement PITA-services themselves and that any governmental involvement will be needed. Furthermore, it is important to emphasize that the other policy choice of the ministry, that it will in first instance be the responsibility of the private market parties to develop services like PITA, strongly conflicts with this expectation of the private parties that they will not be able to make a sound business case for such services.

Finally, the third reason why private parties expect that PITA-services will not be profitable services is the lack of European standards regarding public transit data. This will hamper a Europe-wide introduction of PITA-services on a short term. Despite this fact that the private parties expect that they cannot make a sound business case for PITA-services, a related expectation among the subcategory of public transit companies is that PITA-services may positively influence the satisfaction of their customers. And indirectly, a higher customer satisfaction might positively influence sales numbers.

7.2.3 The preferred actor constellation for the development and implementation of PITA-services

This subparagraph draws conclusions from the results of the last part of this research which relates to the third main research question:

> 3. What is, among the involved public and private parties, the preferred actor constellation for the development and implementation of PITA-services?

The third part of this thesis started to define some highly promising alternatives for the fulfilment of each of the ten roles within the future actor constellation for the development and implementation of PITA-services (chapter five). These promising alternatives have been defined based on examples of actor constellations within comparable information systems; relevant theoretical notions; and perceptions of the potentially involved actors. For only five of the roles, more then one alternative for its fulfilment seemed to be really promising: the *traffic managers*, the *road data providers*, the *road data integrator (NDW)*, the *public transit data integrator (NDOV)* and the *service providers*. Furthermore, the role of the *policy-makers* will definitely be fulfilled by governmental bodies. For the fulfilment of the role of the *public transit data providers*, the only promising alternative is a fulfilment by the different public transit companies. Finally, for the roles of the *hardware providers*, *software developers* and *consultancy companies*, the only promising alternative for their fulfilment is by private market parties. An additional important notion regarding the fulfilment of these roles is that the fact that there are ten different roles within the future actor constellation does not immediately mean that these ten roles are fulfilled by ten different actors. It might be well possible that any actor fulfils multiple (or even all) roles.

The five roles for which there was more then one promising alternative have been included in a stated choice experiment (chapter six). Based on the observations as gathered in this experiment, different model parameters have been estimated and these parameters have been used to determine partial utilities for all fulfilment alternatives of each of the five roles. Subsequently, based on these estimated partial utilities, the most and the least preferred actor constellation have been defined together with their direct choice probabilities.

These results of the experiment have firstly showed that a future fulfilment of the role of the traffic managers by private market parties under concession will be strongly negatively appreciated. But, in addition to this, many respondents have stated to prefer that only some traffic management tasks stay in the hands of the government (e.g. 'strategic choices' like the definition of the function of roads or in situations of crisis- or evacuation management) while others could better be fulfilled by private parties (e.g. the pure guidance and steering of traffic flows to optimize the utilization of the different transport networks). By a fulfilment of the role of the traffic managers by governmental bodies, public interests (*liveability, traffic safety, accessibility, sustainability*) may optimally be secured.

Secondly, the results showed that when the level of governmental involvement regarding the fulfilment of the role of the service providers increases, its derived utility strongly decreases. Some respondents have even stated that they still think that the role of the service providers could be fulfilled by private market parties independently. Though, this could actually only be realized when these private market parties will (almost) be able to develop a sound business case. Chapter four and five of this thesis showed why this may not be feasible.

Thirdly, the results showed that when the role of the road data integrator (NDW) would be fulfilled by a private market party under concession instead of a governmental body, this will be very positively appreciated. Such a fulfilment may lead to an improvement of the functioning of the database and to a decrease of suffer related to technological problems.

Finally, the results showed that when the role of the road data providers would be fulfilled by private market parties instead of governmental bodies, this will also be positively appreciated by the involved actors. Such a fulfilment may lead to the introduction of innovative and improved technologies or methods regarding the processes of (road) data gathering and -provision. Regarding the fulfilment of the role of the public transit data integrator (NDOV), no significant results have been acquired. Combining these experimental results with the fulfilment of the other five roles for which only one promising alternative has been defined (chapter five), it is concluded that the actor constellation for the development and implementation of PITA-services which is preferred among the involved actors would be the actor constellation as presented in figure 7.1 below.

The Preferred Actor Constellation for the Development and Implementation of PITA-services

Role	Fulfilment by
Policy-makers	Governmental bodies
Traffic managers	Governmental bodies
Road data providers	Private market parties
Public transit data providers	Public transit companies
Exploitation of the road data integrator (NDW)	A Private market party under concession
Exploitation of the public transit data integrator (NDOV)	A Private market party under concession or a Governmental body
Service providers	Private market parties with the government as launching customer (Low level of cooperation)
Hardware providers	Private market parties
Software developers	Private market parties
Consultancy companies	Private market parties

Figure 7.1 *The preferred actor constellation*

A last important notion regarding the fulfilment of this future actor constellation is that the mutual relationships between the actors that fulfil the roles and the interoperability between the different subsystems of the future PITA-services (as described in chapter three) will play a crucial role. Interoperability is one of the most important problems in the domain of multimodal travel information. During the development and implementation of the services these issues must have continuous attention. Every involved actor should recognize and efficiently manage the interfaces and relationships in which it is involved out of its own role.

7.3 Recommendations

Based on the results of the research, this paragraph gives some important recommendations for both the problem-owner *AT Osborne* and the central government. Furthermore, some scientifically challenging directions for further research will be given.

7.3.1 Recommendations for *AT Osborne*

Grab opportunities which will definitely arise

The results of the research carried out in this thesis have confirmed the high potential of the travel information market for *AT Osborne*. Based on the definition of the process of delivering information to travellers and the promising alternatives for the fulfilment of the roles within this process, can be stated that many future developments, projects and processes will be in place in which *AT Osborne* (as manager or consultant) could be involved. Within the further specification of the actor arena (chapter three), the public/private character has been described and especially those processes in which public and private parties need to find each other will raise interesting opportunities for *AT Osborne*:

- The management of different kinds of *Tendering- and concession procedures*: For instance regarding the (private) gathering and provision of road data in regions for which such data are currently still insufficiently available or even completely unavailable; regarding the development of the future NDOV; regarding the (private) exploitation of the databases NDW and NDOV; or even regarding the development of future travel information services.
- The management (*project*- and/or *process*-) of different kinds of *experiments/pilots* that may be accomplished regarding the development of future travel information services when governmental bodies will be involved. In this context, *AT Osborne* already has a strong position having the experience of managing the two large experiments with ABvM in the regions of Amsterdam and Haaglanden.
- The management (*project*- and/or *process*-) of all kinds of *cooperation models* that might be used for the development and implementation of future travel information services. The models that seem the most promising have been defined in chapter five of this thesis: *Subsidy schemes, Public-private partnerships (PPP)* and again *traditional tendering-* or *concession procedures*.

Furthermore, a potential business opportunity will arise at the interface of mobility and housing- and organisation advisory. Currently, in the Netherlands, the support for what is called *'the new way of working'* is rapidly growing among governments and large companies. A large scale implementation of this phenomenon might really help mitigating the negative externalities of reaching the capacity limits of our transport networks (: high congestion, low traffic safety, emissions, economical damage, etc.). *AT Osborne* could play a crucial role in processes related to this, combining their extensive knowledge and experience in both the complex field of housing- and organisation advisory and the complex field of mobility. To conclude, the importance should be noticed of continuously being alert for other new business opportunities.

Clearly distinguish your position in the market

As explained in the section above, for *AT Osborne*, many different new business opportunities will probably arise in the near future. Though, currently is observed that many management- and consulting companies from different disciplines converge to each other at the mobility market and are poaching each others territory: advisory companies in the specific field of mobility like *Inno-V* and *Mobycon*; more technologically oriented companies like *Vialis, Peek traffic* and *Accenture*; large engineering agencies like *Arcadis, DHV* and *Oranjewoud*; and finally the pure management- and consulting-oriented companies like *AT Osborne* and *T&G*.

This development grounds that it will be crucial for *AT Osborne* to stay close to their current expertise and core business. *AT Osborne*'s ambition to be one of the top players in this

market, in which so many different players are currently becoming active, can only be realized by strongly distinguishing itself in its way of approaching the market. The business opportunities as described in the first section of this paragraph are all in line with the current expertise of *AT Osborne*. Finally, this recommendation to stay close to the core business will probably imply staying close to existing principals (ministries, regional governmental bodies, large companies, public transit authorities, etc.).

Broaden your technological (IT) knowledge

This recommendation might appear a bit contradictory in relation to the foregoing. Nevertheless, it will be important for *AT Osborne* to broaden their technological (IT) knowledge in the field of travel information and mobility. Although this thesis primarily focussed on the organisational development of future PITA-services, the gathered results also showed that still some technological issues must be eliminated (e.g. the gathering and integration of the different kinds of data; the bundling of different kinds of information (services) to increase their individual value; the interoperability between the different subsystems of future services like PITA; or the increasing possibilities of all kinds of new software- or hardware applications).

To be able to optimally identify new business opportunities and to improve its knowledge and experience on the subject matter, it will be very important for *AT Osborne* to be familiar with these pure technological developments. Two possible measures are available which might contribute to this:

1. Recruit somebody who is technologically experienced in this field of travel information (IT) and ideally also has experience with other developments in mobility.
2. Increase the technological (IT) knowledge of the current (mobility) consultants and managers of *AT Osborne*.

7.3.2 Recommendations for the central government

Implement an Adaptive PITA-policy

This thesis has shown that up till now, regarding the fulfilment of the roles within the future actor constellation for the development and implementation of PITA-services, very little 'hard' policy choices are already made by the central government. Actually, the only policy choice which is already made by the central government is that it will be their responsibility to construct the two databases consisting of public transit- and car data (respectively the NDOV and the NDW) and that the market parties will in first instance be responsible for the development and implementation of the future services (like PITA).

Furthermore, this thesis has identified the preferred actor constellation among the potentially involved actors (see paragraph 7.2.3). The central government is recommended to integrate these actor preferences in an (to be implemented) adaptive PITA-policy. This adaptive approach to policy-making allows the central government to cope with the uncertainties and dynamics that confront them by creating policies that respond to changes over time and that make explicit provision for learning. To implement such an adaptive PITA-policy, the three steps of the adaptive policy-making process should be accomplished (*stage setting*, *assembling a basic policy*, and *specifying the rest of the policy*) and related policy actions should be taken. First, during the stage setting phase, the different policy objectives, -constraints and -options should be specified and this phase results in a definition of success. A definition of success regarding the implementation of PITA-services could be that every individual traveller has continuous access to individual, dynamic and multimodal travel information.

Next, during the assembly of the basic policy, the following policy actions are recommended to be taken to integrate the actor preferences regarding the fulfilment of the actor constellation:

- Regarding the fulfilment of the role of the traffic managers, at least some of the traffic management tasks should stay the responsibility of the governmental bodies (in line with the current situation). For instance, the decision on strategic choices regarding the road network (e.g. choices regarding the functions of roads or in situations of incident- or evacuation management when (national) safety becomes in danger). For other traffic management tasks, the government should reconsider whether they could more efficiently be fulfilled by private parties (e.g. the pure guidance and steering of traffic flows to optimize the utilization of the transport networks) or not.
- Stimulate private market parties to develop new technologies for the gathering and provision of road data and to become road data providers. Then, it will become possible for the NDW and/or other actors (e.g. service providers or traffic managers) to buy these road data freely in the market. Furthermore, as traffic manager, make use of these data as provided by those future private road data providers.
- Grant a concession to a private market party (or a consortium of private parties) to exploit the NDW, especially for efficiency reasons and to improve its performance.
- Take the responsibility to construct the NDOV (together with the public transit authorities and/or the public transit companies). This policy action is actually in line with the recently published approach multimodal travel information.
- Give the market the responsibility to develop and implement services like PITA themselves and without any governmental involvement. This policy action is also in line with the recently published approach multimodal travel information and may support creativity and innovations.

Finally, in the third step of the adaptive policy-making process (specifying the rest of the policy), several vulnerabilities, signposts, triggers and related actions (hedging- and corrective actions) are recommended to be integrated which are related to the 'basic' policy actions as defined above. These are all presented in table 7.1 below.

Vulnerabilities	**Hedging actions**	**Signposts/triggers and corrective actions**
1. *Uncertain*: The ability of the private parties to develop a sound business case for PITA-services themselves and to fulfil the role of the service providers independently	*Hedging* action: Act as a launching customer to stimulate the commercial development of the PITA-services	Monitor whether PITA-services can be developed by private market parties independently. If not (trigger), implement *corrective* actions (e.g. provide subsidies or use traditional tendering or maybe even public-private partnership) to realize the implementation of PITA-services. Though, only implement such *corrective* actions taking the second vulnerability into account
2. *Uncertain*: Whether PITA-services would generate higher societal revenues then they would bring societal costs	*Hedging* action: Facilitate experiments or other research activities to investigate the 'real' effects	Monitor the results of the research activities. When societal costs seem to be higher then societal revenues (trigger), undertake *corrective* actions

	of future PITA-services (e.g. carry out experiments to research the potential effects of PITA on the utilization of the total transport networks or on a potential modal shift in the direction of public transit; or carry out social cost-benefit analyses)	(e.g. reduce or stop (part of) the (financial) governmental involvement)
3. *Uncertain*: The willingness among the private market parties to develop new and innovative technologies regarding the gathering and provision of road data and to become road data providers	*Hedging* action: Act as a launching customer to stimulate the development of such new and innovative technologies	Monitor the development of such new technologies. If the market itself fails to motivate firms for innovative performances and simultaneously societal revenues of PITA seem to be higher then societal costs, subsidies could be provided (*corrective* action)
4. *Uncertain*: The ability of the private parties to fulfil some of the traffic management tasks more efficiently then the governmental bodies do	*Hedging* action: Accomplish a market consultation in which presented solutions and ideas of interested market parties could be investigated and tested	Monitor the results of the market consultation. When market parties really seem to be better able to fulfil some traffic management tasks then the governmental bodies themselves, concessions could be granted to market parties regarding the fulfilment of those tasks (*corrective* action)

Table 7.1 *Vulnerabilities, signposts, triggers and recommended hedging- and corrective actions*

Once the above recommended policy is agreed upon, the basic PITA-policy is implemented and signpost information begins to be collected. The adaptive policy-making process is suspended until a trigger event is reached. In case of such a trigger event, it is recommended to undertake the related pre-defined action.

Furthermore, during this implementation phase of the adaptive PITA-policy, the central government is recommended to act decisively and to take its responsibilities where this appears to be necessary. Finally, to contribute to the security of the public interests, the central government should at least take the responsibility to realize (via the NDW) that all relevant traffic management information is totally consistent with the information as provided by the different travel information services. This is crucial to prevent that travellers get contradictory information.

7.3.3 Scientifically challenging directions for further research

The real effects of PITA-services

In this thesis, the expected effects of future PITA-services have been described as they are perceived by the potentially involved public and private actors. An interesting subject for further research would be to try to estimate these effects of future PITA-services. For instance, an estimation of the real effects of PITA-services on the utilization of the total transport networks, or on the modal shift, could be made by carrying out pilots or experiments. Based on the results of such experiments, it might also be possible to carry out a societal cost benefit analysis (SCBA) for PITA-services. Furthermore, whether the private

market parties will really not be able to make a sound business case for PITA-services could be researched by carrying out an extensive cost benefit analysis in combination with market research and an investigation of the requirements of the potential consumers of the services (see the next section).

The role and wishes of the end user

Regarding the success and the potential effects of future PITA-services, travellers as being the end users will play a crucial role. You can implement technologically perfectly working services but if the end users are not willing to make use of them, which is not unthinkable because the extent to which usefulness for the individual equates to behavioural change by the individual is still not clear, they will also not make better and more conscious travel choices (as expected by the governmental bodies). Then, the alleviating effects on the negative externalities of reaching the capacity limits of our transport networks will also be none. Next to the usefulness of future PITA-services, a lot of other important factors influence whether travellers will really use such services or not and in which way they will use them. Think of the reliability and the price of the service, the bundling to other useful services and the quality of the Dutch public transit system. More and better research regarding this 'human factor' and the wishes and requirements of the end users may enable a development of services which will better meet the needs of the potential consumers and so have a larger probability to be successful. For private market parties, such knowledge can substantially contribute to the realization of a sound business case.

The design of the organisational structure

In this thesis, the preferred actor constellation for the development and implementation of PITA-services has been defined (among the involved public and private parties). This raises the opportunity to go one step further by really designing the organisational structure for the development and implementation of future PITA-services. Issues that should be further researched to enable such a design are for example institutional issues around the mutual relationships between the actors that will fulfil the different roles. Tasks, responsibilities, costs and risks should clearly be distributed between the involved actors (e.g. by means of contracting). Further research might help to define the optimal shape of these different relationships.

7.4 Reflection on the research

This paragraph gives a reflection on the research as carried out in this thesis. First, a note is given about the investigation of the expected effects. Next, some unidentified critical interests regarding the future development and implementation of personal intelligent travel assistants will be described. Thirdly, the validity of the estimated model will be discussed. Fourthly, it will be explained that the used combination of stated choice theory and adaptive policy-making is a slightly wringing combination. Fifth, the international context and -value of the research will be outlined and finally will be reflected on the structure and process of the research project.

7.4.1 A note about the investigation of the expected effects

As already mentioned in the first chapter of the thesis, to define the expected effects of future PITA-services as perceived by the potentially involved actors, it was important to do explorative interviews with actors that may be involved in the future actor constellation. It has been tried to interview at least one potentially involved actor for each of the different actor roles. Simply stated, this objective is realized but then TomTom and 9292OV are not only seen as service providers but also as software developers and TomTom even also as

hardware provider. Though, it would have been more complete to additionally interview both an independent software developer and hardware provider. However, the large importance of these two roles actually became clear later on in the project. Furthermore, it is unknown whether a potential operator of the public transit data integrator (NDOV) has been interviewed which is logical because this database is even not under development at the moment.

Altogether, eleven different actors have been interviewed (see appendix B for the complete list of interviewees), leading to many different expected effects (chapter four). Whether the findings of these interviews have led to a complete investigation of expected effects or not is uncertain but due to given budget- and time constraints, this was the maximum feasible number of interviews. Furthermore, due to changes in the research environment, it might be possible that some of the expectations among the interviewees have changed in the meantime. For instance, the commitment of the central government to construct the NDW and the NDOV, consisting of all the needed data to develop future PITA-services, may have influenced the opinions regarding the investment costs of such services among the private service providers. In the current situation, some private parties may expect that it will indeed be possible to make a sound business case for PITA-services.

Furthermore, the possibility must be mentioned that some of the interview results might be based on wrong perceptions of the interviewees. It is also possible that some of the interviewees behaved strategically during the interviews. These two possibilities cause that some of the interview results may be unreliable. To a certain extent, this may also negatively influence the reliability of some of the conclusions regarding the expected effects of PITA-services as perceived by the involved public and private parties (paragraph 7.2.2). Therefore, these conclusions should be interpreted with care. The reliability of all other conclusions and recommendations as stated in this thesis has not been influenced by this, because those are not substantially based on the interview results.

7.4.2 Unidentified critical interests regarding PITA-implementation

Chapter three of this thesis has further specified the actor arena according to the identified roles within the process of delivering information to travellers. It has provided an extensive overview of the actors that fulfil these roles together with their general goals and interests. Though, it is important to state that some *critical* interests regarding the implementation of future PITA-services may not have been addressed in this actor analysis. Critical interests, in this context, are interests which play a decisive role in the choice of a specific actor to be involved in the development and implementation of future PITA-services or not. For example, for the involved service providers a critical interest (which has been addressed but is not labelled as such) may be the profitability of the services. Especially for the involved governmental bodies, some of these critical interests may not have been addressed. For instance, it is imaginable that the privacy of the future users would be a critical interest for the governmental bodies in relation to their choice to be involved or not. In this thesis, not any word has been spent to this privacy. In my opinion, this privacy will not be a large problem because future PITA-services will probably not cause a larger invasion of privacy then existing mobile phones or navigation systems do.

Another interest which has not been addressed in this thesis but which may be of critical value for the involved governmental bodies is the relationship between the societal costs and -benefits of future PITA-services. It is imaginable that governmental bodies will only choose to be involved to an extent at which the societal benefits of such services will be higher then societal costs. Though, this is very difficult to forecast beforehand. Actually, the execution of

such a societal cost-benefit analysis (SCBA) is part of the first challenging direction for further research (paragraph 7.3.3: *The real effects of PITA-services*).

The fact that some of these critical interests of the involved actors might not have been addressed in this thesis may have two different reasons. Firstly, in the analysis of the actor arena (chapter three), only the general interests of the actors and their objectives regarding travel information services are distinguished. No explicit analysis has been made of their critical interests regarding future PITA-services. Secondly, the interviews that have been carried out were explorative interviews. Unless the fact that the interviewees have been asked to their specific interests and objectives regarding travel information services (and future PITA-services), no explicit question has been asked regarding which of these interests they would see as the critical one(s). To conclude, as described in this paragraph, some of the actors' critical interests regarding PITA-services may really remain unidentified in this thesis. However, most of them are certainly identified somewhere in the thesis but only not labelled as such.

7.4.3 The validity of the estimated model in the stated choice experiment

Usually, stated choice experiments are used to investigate preferences related to day-to-day behaviour like travel choice behaviour or consumer behaviour. In such experiments, respondents usually have to choose between two or more comparable products or travel alternatives in a number of choice-sets. The application of a stated choice experiment to investigate more policy-related preferences among public and private actors in a specific field (here: travel information) is rather new. An important difference is that the respondents in this choice experiment cannot choose which alternative they would prefer to buy or use, but only which actor constellation they would prefer to participate in. Furthermore, choices that have been made within this experiment regarding the preferred fulfilment of the future actor constellation for the development and implementation of PITA-services, were choices in a pretty unknown environment for the respondents and can not be seen as day-to-day choices like travel choices. For these reasons, it must be stated that the model estimation results of experiments like the one carried out in this research should be interpreted with care.

Regarding this interpretation of the results, it must be emphasized that the respondents are asked, in each different choice set, which actor constellation they would *prefer*. Therefore, it has only been valid in this thesis to conclude how the preferred actor constellation looks like in the perception of the potentially involved actors. Subsequently, these actor preferences have been used to define recommendations for the central government regarding the implementation of an adaptive PITA-policy. Though, only based on the results of this experiment, it is unsound to conclude how the actor constellation *should* be fulfilled or how the actor constellation *would probably* or *most likely* be fulfilled.

Furthermore, because the alternative actor constellations in the choice-sets consisted of different fulfilment alternatives for the five actor roles, it would have been easier for the respondents to have a clear description of the roles and the related fulfilment alternatives (as presented in the introduction of the questionnaire) at hand when making their choices. However, this problem might have been partly solved by the fact that the first trial of the questionnaire contained a large bug which has caused that it was necessary to do a second trial for the experiment (see also paragraph 7.4.6). It is well possible that the respondents of the second trial, which also participated in the first trial, have learned from this first version and were able to make more reliable choices in the second trial. This might also clarify the fact that most of the estimated model parameters were significant while having a small group of respondents, which is actually a pretty good result.

Some other important notions are worth to be mentioned here. First, while estimating the model it seemed to be necessary to recode the attribute levels of the attribute *service providers* to achieve stronger model estimation results. This attribute has been recoded in *level of cooperation*. The attribute service providers was in the beginning a categorical attribute but for the recoded attribute a continuous linear utility function had to be presumed. Such a recoding is obviously not ideal for the reliability of the results but it was necessary in this experiment to achieve stronger model estimation results. Secondly, the estimated results unfortunately have only been validated 'at face'. It was not possible to do a stronger validation using holdout profiles because the total group of respondents was too small for this. Thirdly, this small group of respondents consisted for a large part of private parties which made it also impossible to make a comparison between the preferences of the involved public and private parties.

A final notion of reflection on the estimated model is made regarding the bandwidth of the choice probabilities as derived from the estimated partial utilities. These choice probabilities are derived using logit transformation. By using logit transformation, the total utilities of the different alternative actor constellations are transformed into choice probabilities. All possible total utilities on the entire real line can so be transformed into choice probabilities on the range (0,1). If the difference in total utility between two alternatives is zero, their related choice probabilities are also equal (both 50%). Furthermore, if the difference in total utility between two alternatives in- or decreases, the difference between the choice probabilities of these alternatives in- or decreases along. Though, an equal increase or decrease in utility difference close to 0 causes a larger in- or decrease in choice probability difference then far from 0 (i.e. the difference in choice probabilities as a function of the difference in total utilities is steeper around 0). For instance, the difference in utility of 0.75 between the *most preferred*- (0.75) and the *most likely* actor constellation (0.00) represents a difference in choice probability of 36% (68%-32%). But, a utility difference of 1.50 is equivalent to a difference in choice probability of 64% and a utility difference of 2.25 represents a difference in choice probability of 80%. This final notion of reflection better clarifies the bandwidth of the different model estimation results.

7.4.4 Stated choice theory and Adaptive policy-making: A slightly wringing combination

As described in this thesis (paragraph 5.3.4), the adaptive approach to policy-making assumes that, for most systems of interest today, the future can not be predicted accurately. However, for most of these systems, policies must be devised despite of profound uncertainties about the future. The adaptive approach to policy-making allows policy-makers to cope with these uncertainties and dynamics that confront them by creating policies that respond to changes over time and that make explicit provision for learning. Such policies are designed to be incremental, adaptive and conditional.

Next to this, stated choice theory (chapter six) assumes that only the estimated model parameters (based on gathered observations in the experiment) and derived choice probabilities form a solid basis to establish future policy on. It actually assumes an entirely predictable reality. These assumptions are related to the economic origin of stated choice theory. Stated choice experiments have initially been used for market research purposes. They are especially used to investigate consumer preferences and these preferences are assumed to form a solid base to predict market shares. In such experiments, consumers choose the product they prefer within each choice-set. In reality, these consumers make comparable choices when they choose to buy a certain product. But, the stated choice

experiment in this research has investigated the preferences of actors regarding the fulfilment of a future actor constellation, for which these actors in reality will only be able to choose whether they will participate in it or not.

The combination of these two theories for scientific research has been an innovative and adventurous activity. Simultaneously, it was also slightly wringing. On the one hand, adaptive policy-making assumes an uncertain and unpredictable future and allows policy-makers to cope with these uncertainties by creating policies that respond to changes over time and that make explicit provision for learning. On the other hand, stated choice theory actually assumes an entirely predictable future. Despite these wringing assumptions, this thesis has fortunately showed that the two theories can effectively be combined.

7.4.5 The international context and -value of the research

In the first chapter of this thesis has been demarcated that, mainly due to given budget- and time constraints, the thesis has focussed on the road to personal intelligent travel assistance in the Netherlands. The international context of travel information services has been out of the scope of this research project. This demarcation had two consequences which are worth to reflect on. First, though it seems to be unlikely, it might be possible that in some countries travel information services are already introduced which are much more advanced then the services that are currently available in the Netherlands. For traffic information services this will probably not be the case because TomTom (as the supplier of TomTom HD Traffic) is worldwide one of the market leaders regarding navigation- and traffic information services. But, regarding public transit information services or multimodal services, in other countries already more advanced services may be available. An example of such an advanced travel information service which is not (yet) available in the Netherlands is 'Google Transit'. Though, it is questionable whether this service is more advanced then 'Haaglanden Mobile' or '9292OV Mobile'. However, developments of this kind or foreign developments of new technologies related to travel information services may also influence the speed of such developments in the Netherlands and are worth to be monitored.

A second consequence of this demarcation was that, regarding the definition of the promising alternatives for the fulfilment of the roles within the actor constellation for the development and implementation of future PITA-services (chapter five), no foreign examples have been taken into account. Though, this may not be a real shortcoming because the institutional context of such an actor constellation probably strongly differs for each country. Especially in the Netherlands, this institutional context seems to be unique. For instance, in the Netherlands is stated in concessions of public transit companies that "they should perform in such a way that they are judged by their customers with an average grade of at least seven". This kind of institutional issues makes it very difficult to compare different countries. It also implicates that the results which have been achieved in this research project, like the preferences regarding the fulfilment of the actor constellation (chapter six), are probably very difficult translatable into foreign policy strategies.

7.4.6 The structure and process of the research project

As described in the first chapter, this research project has been divided into three different parts relating to three different research questions. At first, there were some doubts about whether it would still be possible to write a well running thesis having these three different parts or not. Looking back, it can be concluded that this did not lead to any problems. The three parts of the thesis have been connected by clear and obvious transitions and it really became 'one story'. These transitions have been realized as follows: In the first part of the

thesis, the general process of delivering information to travellers has been defined together with the different actor roles that could be distinguished within this process. Next, in the second part of the thesis, this process and the related roles have been applied to the future development and implementation of PITA-services to give a complete overview of all the potentially involved actors, before investigating the expected effects of such services as perceived by them. Finally, in the third part of the thesis, the investigation of all the different roles that must be fulfilled within the actor constellation for the development and implementation of PITA-services (as defined in the second part) formed the starting point to define the preferred actor constellation.

Furthermore, at the start of the project, the research objectives seemed to be pretty ambitious related to the available time. Though, the complete research actually turned out to be well do-able in accordance with the time-planning of the project. The most important reason for this probably was that almost everything during the project did go as expected: the research methods fitted well to the different research questions, the available contacts through the external relationships of *AT Osborne* were very willing to cooperate and the planning of the project fitted well to the duration of the different activities that have been carried out. Though, of course there was also a research activity that did not pass fluently. Unfortunately, the first trial of the questionnaire in the stated choice experiment did have a large bug. This made the gathered observations in this first experiment completely useless and caused that only one solution was left: immediately set-up up a new questionnaire, hope that the very enthusiastic respondents of the first trial would be so nice to participate in the second trial again and keeping fingers crossed. Thankfully, enough respondents were indeed willing to participate again which has led to a new (useful) set of observations and finally to some very interesting model estimation results (chapter six).

Epilogue

While carrying out this research project during the last seven months, the high value of mobile, dynamic, multimodal and personalized travel information which will be provided by future Personal Intelligent Travel Assistants (PITA-services) became increasingly more obvious to me. Many times, I have run into delays while travelling to AT Osborne (Baarn), University (Delft) or interviews throughout the whole country. This could have been avoided when I would have had the availability of my own PITA. It could have spared me a lot of problems, irritation and waste of time. Because of this, I would really be willing to pay a reasonable price for a reliable PITA and I think, in contrast with the expectation among the private parties, that more people like me would be willing to pay for a well-functioning PITA. Together with the ongoing increase in mobility problems, this willingness may be expected to grow further in the coming years.

This research project has been very exciting, especially because of the current strong attention for the subject matter and the major changes in the research context since I started the project. Just before and during the project, two important policy documents came out which contain the only policy choices regarding the fulfilment of the actor constellation that are currently made and so had major consequences for this research: *The conclusions of the advisory commission traffic information* (April 2009) and *The approach multimodal travel information* (July 2009). The development which had the largest influence was the commitment of the Ministry of Transport; Public Works and Water Management together with the other involved governmental bodies to take the responsibility to construct the two databases consisting of public transit- and car data, respectively the NDOV and the NDW. I expect that this is a very good policy choice and that it will substantially decrease the investment costs for private service providers to develop PITA-services. This, combined with my expectation that the willingness to pay for such services increases, will finally result in the possibility to make a sound business case. It is to the private market parties to discover this themselves and I think they will certainly do.

Though, it will take some time to overcome the last technological problems. The NDW has already faced some early technological difficulties and for many regions the availability of data is still insufficient. This kind of problems regarding the availability, bundling and standardization of data may also be expected to hamper the development of the future NDOV. Because the current financial situation has also slightly slowed down the process, in my opinion, the first PITA-services will be implemented somewhere between 2015 and 2020.

As described above, policy choices like the one made by the governmental bodies regarding the construction of the databases will be crucial for a successful development and implementation of PITA-services. More such guiding policy actions are needed regarding the fulfilment of all the different roles within the actor constellation and this should finally lead to the implementation of an adaptive PITA-policy in line with my recommendations. As also recommended in this thesis, interesting business opportunities for AT Osborne will especially arise in those processes in which public and private parties need to find each other. As one of these potential business opportunities, I mentioned any tendering- or concession procedures, e.g. regarding the development and the exploitation of the NDOV. How fun it is that, while finishing the final chapter of this thesis, already the news comes out that the central government (together with the different public transit authorities) will start a tendering procedure regarding the construction and exploitation of the NDOV. The first real opportunity arises!

Furthermore, it is worth to mention that a true mitigation of the negative externalities of reaching the capacity limits of our total transport networks (congestion, low traffic safety, environmental damage, economical damage, etc.) may only be realized if all the different actors in the research environment take their own responsibilities. First, it is clear that it is the responsibility of the public and private parties to develop and implement services like PITA and to provide all travel information that is relevant for travellers given their time and place in the multimodal transport network. Secondly, these public and private parties are also responsible for the implementation of additional measures which belong to the pillar of *utilizing* (e.g. ITS). Furthermore, also measures from the other two pillars are needed: *building* and *road pricing*. Examples might be the introduction of ABvM (*road pricing*) or the construction of new infrastructures (*building*). Regarding the effects of each single measure, it will be very important with which other measures it will be combined. For instance, if future PITA-services are implemented having the objective to realize a modal shift in the direction of public transit, this objective may only be realized when also sufficient park and ride facilities (P+R) will be included in our transport networks and/or when the general quality level of the available public transit networks will be increased.

In relation to this, it is crucial that all these (combinations of) measures aiming to mitigate the negative externalities of reaching the capacity limits of our transport networks are implemented on a short term. Because of the current credit crunch, mobility is not growing very rapidly at the moment so the problem of these negative externalities is also relatively small. But, when our economy will rise again, our mobility figures are expected to explode and it is crucial that our transport networks will be prepared for this. Therefore, the central government cannot start fast enough implementing an efficient combination of measures to increase the capacity of these transport networks.

Furthermore, it is the responsibility of the individual travellers and their employers (e.g. by introducing 'the new way of working') to really use these future PITA-services and efficiently utilize these additional measures by making conscious and better travel choices and changing their individual travel patterns. Related to this, I agree with Caspar Chorus, my first supervisor, who has indicated that it is nonsense to expect that travellers will make more conscious travel choices purely through the implementation of services like PITA. It is vice versa: when travellers already make conscious travel choices, they will also use services like PITA. So, basically it is the responsibility of those individual travellers themselves to make *conscious* choices and future PITA-services may only help them to make *better* choices. It is this individual responsibility of which I think there is very much to win at in the Netherlands.

Finally, if all these responsibilities will be sufficiently taken, only a small change in travel behaviour might even have massive effects. Researchers in the field have estimated that, when only 20% of all the Dutch travellers will change their current travel patterns, the total level of congestion could be decreased with 80% (The 20% - 80% rule).

References

9292OV. (2009a). from www.9292ov.nl {only available in Dutch}.

9292OV. (2009b). from www.9292ov.nl/9292ov1.asp <http://www.9292ov.nl/9292ov1.asp> {only available in Dutch}.

9292OV. (2009c). from www.9292ov.nl/9292OV1171.asp <http://www.9292ov.nl/9292OV1171.asp> {only available in Dutch}.

9292OV (2009d). Aanpak multimodale reisinformatie: *Alleenrecht 9292 vervalt*. Reiswijzer {only available in Dutch}. **16e jaargang, nummer 1:** 3.

Abdel-Aty, M., A. (1999). "A simplified approach for developing a multi-modal travel planner." Journal of Intelligent Transportation Systems **5**: 195-215.

Adler, J. L. and V. J. Blue (1998). "Toward the design of intelligent traveler information systems." Transportation Research Part C **6**: 157-172.

Adviescommissie Verkeersinformatie (commissie Laan) (2009). Eindrapport adviescommissie verkeersinformatie {only available in Dutch}.

Advisory body of the Ministry of Transport; Public Works and Water Management (2007). Van wegbeheer naar netwerkbeheer. *Advies over het anders organiseren van wegbeheer* {only available in Dutch}. Den Haag.

ANP (2009). Databank weginformatie weer stil gelegd {only available in Dutch}. NU.nl.

ANWB. (2009a). from www.anwb.nl {only available in Dutch}.

ANWB. (2009b). from <http://pda.anwb.nl/> {only available in Dutch}.

AT Osborne (2009). Document Samenwerkingsvormen Overheid - Markt, *bijlage plan van aanpak marktdialoog interregionaal programma individuele reisinformatie & In Car* {only available in Dutch}.

Austin, J., A. Duff, et al. (2001). Traveller information systems research: a Review and Recommendations for Transport Direct.

Bakker, N. and M. Maartens (2007). "Overheid moet eens ophouden te denken dat ze verkeer kan sturen, *'Ben Rutten gelooft in zelfsturend vermogen nieuwe TomTom"* {only available in Dutch}." Verkeerskunde **6**: 18-21.

Bruntsch, S., H.-J. Mentz, et al. (2007). "Assisting Multimodal Travelers: Design and prototypical implementation of a personal travel companion." IEEE transactions on ITS **8**(1): 31-42.

Chorus, C. G. (2007a). Traveler Response to Information. TPM. Delft, University of Technology. **PhD Thesis**.

Chorus, C. G., T. Arentze, et al. (2006a). "Personal Intelligent Travel Assistants: PITA {only available in Dutch}." Tijdschrift Vervoerswetenschap **2**: 4-9.

Chorus, C. G., T. Arentze, et al. (2007b). "information impact on quality of multimodal travel choices: conceptualizations and empirical analyses." Transportation **34**: 625-645.

Chorus, C. G., E. Molin, et al. (2006b). "Use and effects of Advanced Traveller Information Services: A literature review." Transport Reviews **26**(2): 127-149.

Chorus, C. G. and H. J. P. Timmermans (2009). Personal Intelligent Travel Assistants. Handbook in Transport Economics. Edward Elgar. United Kingdom.

Commission of the European communities (2007). Green paper: *Towards a new culture for urban mobility*. Brussels.

Connekt (2007). Sneller en Beter op weg met in-car systemen {only available in Dutch}.

Connekt. (2009). "BISON {only available in Dutch}." from <http://bison.connekt.nl/over_bison/>.

Connekt, ARS T&TT, et al. (2003). Markt Modellen Mobiliteits Informatie, *Vormen en Voorwaarden* {only available in Dutch}. Connekt. Delft.

Connexxion. (2009). from www.connexxion.nl {only available in Dutch}.

de Bruin, H., E. ten Heuvelhof, et al. (2002). Process Management. *Why Project Management Fails in Complex Decision-Making Processes*. Dordrecht, Kluwer Academic publishers.

Eileen. (2009). from www.eileen.nl/page/file-smsl <http://www.eileen.nl/page/file-smsl> {only available in Dutch}.

GOVI. (2009). from www.govi.nu {only available in Dutch}.

Groenhuijzen, L. (2007). Verkeersmanagement volgens TomTom {only available in Dutch}. NM Magazine. **3:** 4-11.

Haaglanden Mobiel. (2009). from <http://www.haaglandenmobiel.nl/telefoon.html> {only available in Dutch}.

Haalmeeruitdeweg. (2009). from www.haalmeeruitdeweg.nl {only available in Dutch}.

Happel, M. and E. Vaes (2009). Projectplan PTA pre-alfa {only available in Dutch}. Amsterdam.

Hertogh, M. (2009). Allianties, *effectief risico's delen en kansen pakken* {only available in Dutch}. Symposium PPS en Mobiliteit.

Klijn, E. H. and M. v. Twist (2007). PPS in Nederland: Retoriek of bloeiende praktijk? {only available in Dutch}.

KplusV organisatieadvies. (2009). "Privatisering en Verzelfstandiging {only available in Dutch}." from http://www.kplusv.nl/index.cfm/kpv/home/markt/Toezicht-en-Veiligheid/product/Privatisering-en-verzelfstandiging.

KPMG Bea (2004). Het land van (n)ooit, *een verkenning van de minimale overheidsrol op de mobiliteitsmarkt.* {only available in Dutch}. Amstelveen.

Levinson, D. (2003). "The value of advanced traveler information systems for route choice." Transportation Research Part C **11**: 75-87.

Lijesen, M., J. Kolkman, et al. (2007). Publieke Belangen en Weginfrastructuur. Koninklijke De Swart. Den Haag, *Kennisinstituut voor Mobiliteitsbeleid.* {only available in Dutch}.

Lingham, V. (2006). "Striking a Balance: A policy analysis of Public Private Partnerships in Advanced Traveler Information Systems." CE250 Transportation Policy: 1-17.

Lyons, G. (2006). "The role of information in decision-making with regard to travel." IEE Proc. ITS **153**(3): 199-212.

Lyons, G. and S. Kenyon (2003). "The value of integrated multimodal traveller information and its potential contribution to modal change." Transportation Research Part F **6**: 1-21.

Marchau, V., W. E. Walker, et al. (2008). "An adaptive approach to implementing innovative urban transport solutions." Transport Policy **15**: 405-412.

Ministry of Transport; Public Works and Water Management (1997). 7 trends, *Mobiliteit in een veranderend Nederland* {only available in Dutch}. Den Haag.

Ministry of Transport; Public Works and Water Management (2006). Private distributie reisinformatie, *historische achtergrond* {only available in Dutch}.

Ministry of Transport; Public Works and Water Management (2007). Wegbeheer in Nederland, feiten en ontwikkelingen. Rapportage fase 1 van het project anders organiseren van wegbeheer {only available in Dutch}. Den Haag.

Ministry of Transport; Public Works and Water Management (2008a). Mobiliteitsaanpak, *vlot en veilig van deur tot deur* {only available in Dutch}. Den Haag.

Ministry of Transport; Public Works and Water Management (2008b). Beleidskader Benutten, *één van de peilers voor een betere bereikbaarheid* {only available in Dutch}. Den Haag.

Ministry of Transport; Public Works and Water Management (2009a). Aanpak Multimodale Reisinformatie {only available in Dutch}. Den Haag.

Ministry of Transport; Public Works and Water Management. (2009b). "PPS bij het Rijk {only available in Dutch}." from http://www.ppsbijhetrijk.nl/.

Ministry of Transport; Public Works and Water Management. (2009c). from www.rws.nl/wegen/actuele_verkeersinformatie/index.aspx {only available in Dutch}.

Ministry of Transport; Public Works and Water Management and Ministry of Housing; Spatial Planning and the Environment (2004). Nota Mobiliteit, *naar een betrouwbare en voorspelbare bereikbaarheid*. {only available in Dutch}.

Nationale Databank Wegverkeersgegevens (2008). Ondernemingsplan 2008-2013 {only available in Dutch}.

Oppewal, H. and H. J. P. Timmermans (1992). Conjuncte Keuze Experimenten: achtergronden, theorie, toepassingen en ontwikkelingen {only available in Dutch}. NVVM Jaarboek**:** 1-28.

Plug, P., M. van Twist, et al. (2003). Sturing van Marktwerking, *De bestuurlijke gevolgen van liberalisering en privatisering* {only available in Dutch}. Assen, van Gorcum.

Regio Brabant, Zuidvleugel Randstad, et al. (2008). Interregionaal programmavoorstel "individuele reisinformatie & In Car" {only available in Dutch}.

Romanillos, L. (2009). Treininformatie op je mobiel, *NS biedt uitgebreide info met reisplanner Xtra* {only available in Dutch}. Metro.

SenterNovem. (2009a). "iMetro {only available in Dutch}." from www.senternovem.nl.

SenterNovem. (2009b). "Bikeplanner {only available in Dutch}." from www.senternovem.nl.

Spruijtenburg, E. (2009a). Interview Report R. Roding and G. Klijn (District of Noord-Brabant) *{only available in Dutch and available from the author on request}*.

Spruijtenburg, E. (2009b). Interview Report J.J. van Dijke (District of Utrecht) *{only available in Dutch and available from the author on request}*.

Spruijtenburg, E. (2009c). Interview Report M. van Strien (NDW) *{only available in Dutch and available from the author on request}*.

Spruijtenburg, E. (2009d). Interview Report M. van Gelderen (Ministry of Transport, Public Works and Water Management) *{only available in Dutch and available from the author on request}*.

Spruijtenburg, E. (2009e). Interview Report W. Benschop (City-Region of Haaglanden) *{only available in Dutch and available from the author on request}*.

Spruijtenburg, E. (2009f). Interview Report M. de Vreeze (Connekt) *{only available in Dutch and available from the author on request}*.

Spruijtenburg, E. (2009g). Interview Report B. Rutten (TomTom) *{only available in Dutch and available from the author on request}*.

Spruijtenburg, E. (2009h). Interview Report B. Munnik (9292OV) *{only available in Dutch and available from the Author on request}*.

Spruijtenburg, E. (2009i). Interview Report Dutch Public Transit company *{only available in Dutch and available from the author on request}*.

Spruijtenburg, E. (2009j). Interview Report M. van Heumen (Dutch Railways) *{only available in Dutch and available from the author on request}*.

Spruijtenburg, E. (2009k). Interview Report J.M. van den Berg (Municipality of Amsterdam) *{only available in Dutch and available from the author on request}*.

Steenkamp, J. E. B. M. (1985). De constructie van profielensets voor het schatten van hoofdeffecten en interacties bij conjunct meten {only available in Dutch}. NVVM Jaarboek**:** 125-155.

The Dutch Railways. (2009a). from www.ns.nl.

The Dutch Railways. (2009b). from www.ns.nl/cs/Satellite/ns-sms-uitleg#sms-reisplanner-id <http://www.ns.nl/cs/Satellite/ns-sms-uitleg#sms-reisplanner-id>.

The Dutch Railways. (2009c). from www.ns.nl/reisplanner-v2/index.shtml?language=nl <http://www.ns.nl/reisplanner-v2/index.shtml?language=nl>.

TomTom. (2009). from www.tomtom.com

Transportation research board (2004) "User information systems; Developments and issues for the 21st century." TRB millennium papers.

van Gent, C. and P. A. G. van Bergeijk (2000). Basisboek Markt- en micro-economie {only available in Dutch}. Groningen, Wolters-Noordhoff.

van Koningsbruggen, P. and M. Westerman (2007). De balans tussen zelforganisatie en sturing {only available in Dutch}. NM Magzine. **4:** 14-24.

Van Ringelestijn, T. (2008). "Special: Trein app populair op iPhone {only available in Dutch}." from http://www.bright.nl/special-trein-app-populair-op-iphone.

Veeneman, W. and A. van der Elst (2006). Reizen door het RIS, *organisatorische structuur rond multimodale reisinformatie.* {only available in Dutch}.

VID. (2009). from www.vid.nl/sms.html <http://www.vid.nl/sms.html> {only available in Dutch}.

Walker, W. E., S. Adnan Rahman, et al. (2001). "Adaptive policies, policy analysis, and policy-making." European Journal of Operational Research **128**: 282-289.

Wetenschappelijke Raad voor het Regerinsbeleid (2000). Het borgen van publiek belang {only available in Dutch}. Den Haag.

Wolf, C. (1993). Markets or Governments, *choosing between imperfect alternatives*. USA, MIT press.

Appendix A – Scientific Paper

The Development and Implementation of Personal Intelligent Travel Assistants

The Preferred Actor Constellation

By Ewoud Spruijtenburg

Delft, University of Technology: *Faculty of Technology, Policy and Management*

Final Version: November the 23rd, 2009 (6938 words)

Abstract An advanced category of travel information services that may be expected to become available within the coming decade is the category of personal intelligent travel assistants (PITA-services). To realize a successful development and implementation of such PITA-services, ten different actor roles must be fulfilled. For five of these roles there is only one promising alternative for its fulfilment. The role of the *policy-makers* will be fulfilled by governmental bodies; the role of the *public transit data providers* will be fulfilled by the public transit companies; and the roles of the *hardware providers, software developers* and *consultancy companies* will be fulfilled by private parties. for the other five roles, more than one promising alternative is distinguished. In this paper, these alternatives are identified and, by means of a *stated choice experiment*, the preferred actor constellation among the potentially involved actors themselves has been defined. Within this preferred actor constellation, the role of the *traffic managers* is fulfilled by governmental bodies; the role of the *road data providers* is fulfilled by private parties; the *road data integrator (NDW)* is exploited by a private market party under concession; and the role of the *service providers* is fulfilled by private market parties with the government as launching customer. Regarding the preferred fulfilment of the exploitation of the *public transit data integrator (NDOV)*, no significant experimental results have been acquired.

Keywords: Personal Intelligent Travel Assistants (or PITA-services), the Netherlands, Stated Choice Experiment, Preferred Actor Constellation

Introduction

During the last years, the development of travel information services has been going very rapidly (Chorus and Timmermans 2009 p.1). For instance, a recent occurrence in this field in the Netherlands is the introduction of a travel information service by the Dutch Railways, providing actual travel information on mobile phones regarding delays and failures in the train schedule and also providing alternative routes and/or departure times (Romanillos 2009). Next to this example of the Dutch Railways, lots of other advanced travel information services are available or will be available in the near future. One specific category of these travel information services that may be expected to become available within the coming five to ten years is the category of *Personal Intelligent Travel Assistants* or PITA-services.

(Chorus and Timmermans 2009 p.5). "PITA-services are envisaged to be able to provide at any time a traveller with all the travel information, asked for and unasked for, that is relevant given his time and place in the multimodal transport network and his or her personal characteristics" (Chorus, Molin et al. 2006b p.127).

The process of delivering an information service, like these PITA-services, will usually involve a number of organisations spanning the public and private sectors (Austin, Duff et al. 2001 p.18; Lyons 2006 p.208). Usually, these different parties have different goals and interests and sometimes these may be in conflict (Lyons 2006 p.208; Veeneman and van der Elst 2006 p.6). For example, it is strongly desired by the involved public parties that PITA-services help to alleviate the negative externalities of reaching the capacity limits of our transport networks (e.g. increasing congestion levels, high environmental damage, low traffic safety levels, etc.). To realize this, PITA-services should aim at an optimal utilization of the total transport networks. Though, the private parties, which are usually the developers and providers of travel information services, look at travel information services as a business case and so strive for more productive individual travellers instead of more productive total transport networks. These kinds of contradictions and interdependencies illustrate the organizational complexity around the development and implementation of future PITA-services. As such, the process of delivering PITA-services will necessitate any form of cooperation between these organisations for the services to be developed, to function and to achieve success (Austin, Duff et al. 2001 p.18; Lyons 2006 p.208).

Based on recently publicized policy documents (e.g. The approach multimodal travel information (Ministry of Transport; Public Works and Water Management 2009a p.9) and the conclusions of the advisory commission traffic information (Adviescommissie Verkeersinformatie (commissie Laan) 2009 p.26)) is stated that, regarding the fulfilment of the roles within this process of delivering information to travellers, very little 'hard' policy-related choices are already made. At the moment, most policy strategies are only formulated as: "Regarding the process of delivering information to travellers, cooperation between the involved public and private parties is needed in a way that every involved party can contribute to the improvement of this process from its own role and responsibility" (Ministry of Transport; Public Works and Water Management 2009a p.9); or: "Further arrangements must be made between the involved public and private parties regarding ownership of data, liability and other issues" (Adviescommissie Verkeersinformatie (commissie Laan) 2009 p.26).

The remaining question is how the different roles within the future actor constellation for the development and implementation of PITA-services could really be fulfilled and what the preferences of the potentially involved actors themselves are regarding the fulfilment of these roles? In this paper, we will try to answer this research question by means of a *stated choice experiment*. First, we will define the different roles within the process of delivering future PITA-services and we will identify the most promising alternatives for the fulfilment of each of these roles. Next, we will explain the used methodology (*stated choice experiment*). Thirdly, we will describe the experimental results. Finally, based on these results, we will define the preferred actor constellation among the involved public and private parties and we will give some concluding remarks.

Promising Alternatives for the Fulfilment of the Roles

Within the process of delivering future PITA-services to travellers, ten different roles are distinguished that must be fulfilled for a successful development and implementation: *Policy-makers; Traffic managers; Road data providers; Public transit data providers; Road data integrator (NDW); Public transit data integrator (NDOV); Service providers; Hardware*

providers; Software developers and *Consultancy companies*. Figure 1 below illustrates the relationships between these roles and the process of delivering information to travellers.

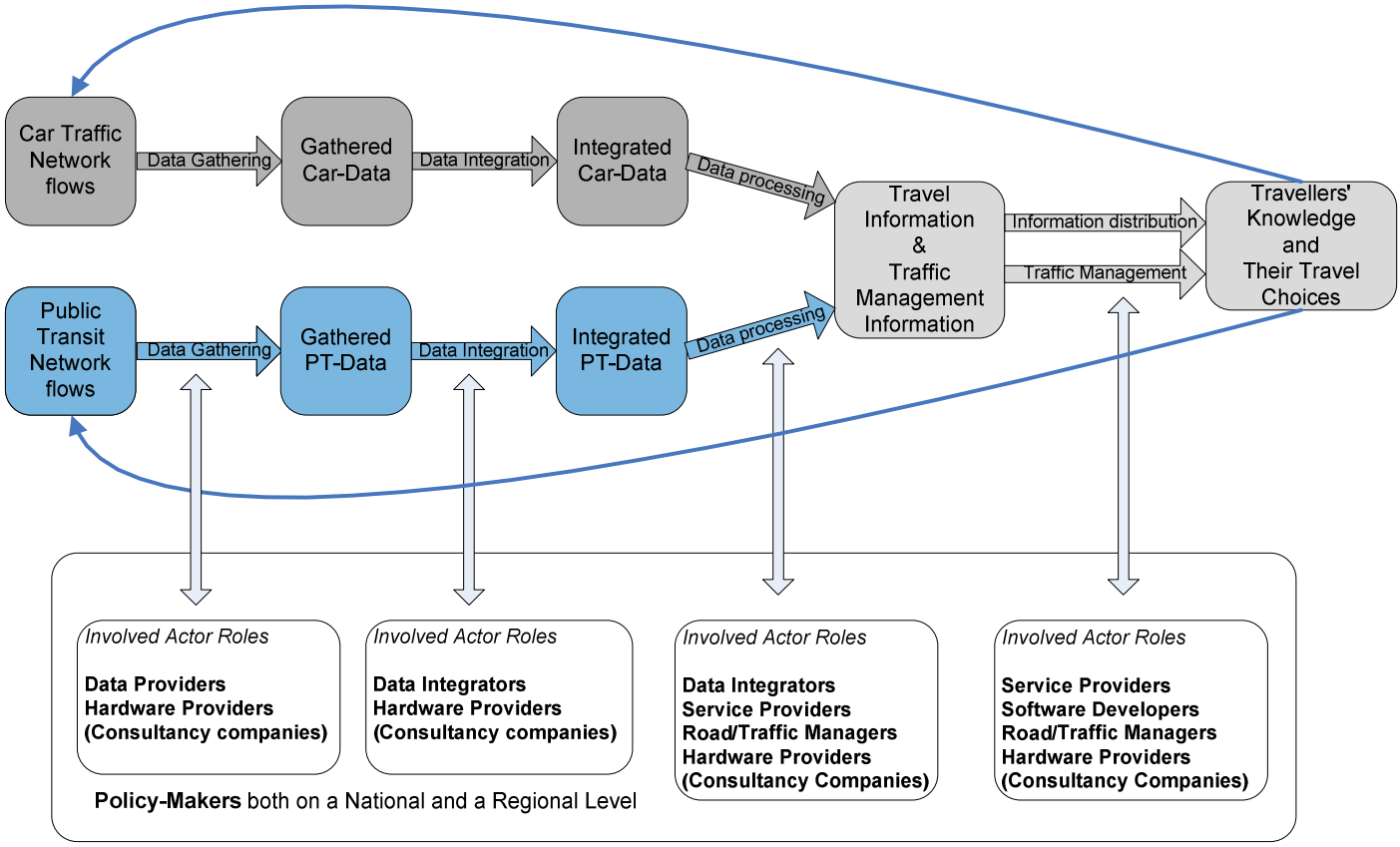

Figure 1 *The different roles within the process of delivering information to travellers*

We will now define the most promising alternatives for the fulfilment of each of these different roles individually. "An important question around the fulfilment of these actor roles is the consideration between public and private fulfilment, and possibly the fulfilment of a role by use of any model for cooperation between the public and private parties. Public and private parties have their own specific boundary conditions and strengths which might be combined to fulfil some of the roles in an optimal way" (Veeneman and van der Elst 2006 p.6). Furthermore, the fact that there are ten different roles within the actor constellation does not immediately mean that these ten roles will also be fulfilled by ten different actors. It might be well possible that a single actor will fulfil multiple (or even all) roles.

Policy-Makers

The first important role that is distinguished within the process of future PITA-services is the role of the policy-makers. However, little attention has to be paid to the fulfilment of this role because it is by definition fulfilled publicly and in this paper is presumed that it is currently not possible to privatise a policy-making body in the Netherlands.

Traffic Managers

The role of the traffic managers is currently fulfilled by different governmental bodies (as the road managers) for the different levels of the road networks: The Ministry of Transport, Public Works and Water Management for the high road network and the different districts and municipalities for the lower level networks. So, this role is publicly fulfilled in the current

situation because the general thought is that this way the public interests of *sustainability, liveability, traffic safety* and *accessibility* can be optimally secured.

However, as private companies might become more effective in the gathering of road traffic flow data then the public parties, it may be also imaginable that private parties could more effectively gather and provide traffic management data and fulfil the role of the traffic managers.

> "The role of the traffic managers could easily be fulfilled by private parties. Many thinkable consortia are able to do this. They say: 'Give us a clear assignment regarding the security of the public interests and a little bit freedom and we arrange it!' " (Quote J.J. van Dijke (District of Utrecht) in Spruijtenburg 2009b).

If this role would be fulfilled by private market parties (or by a few private parties together in a consortium), the cooperation model that seems as the most interesting is to grant a concession, which is a specific form of traditional tendering. So, for the fulfilment of the role of the traffic managers actually two promising alternatives are available:

1) By governmental bodies (current situation)
2) By private market parties under concession

Road Data Providers

Road data providers are defined in this paper as purely the providers of *traffic flow data*. This role is at the moment mostly fulfilled by public parties (as being the road managers). However, more and more new technologies become available which also enable private market parties to gather traffic flow data and this way to become a road data provider themselves (Ministry of Transport; Public Works and Water Management 2006 slide 6). TomTom with Vodafone as private parties already prove with travel information service 'TomTom HD Traffic' that the role of provider of traffic flow data could easily (and maybe even better) be fulfilled by private parties.

> "A situation that might be possible in the future is that there will be made use of private parties for the provision of traffic flow data. Think about *'floating car data'* as already gathered by TomTom and Vodafone at the moment or in the future maybe by another private party. This data might have a higher quality and anyway be cheaper then the data as traditionally gathered by the ministry itself" (Quote M. van Gelderen (Ministry of Transport; Public Works and Water Management) in Spruijtenburg 2009d).

So, for the fulfilment of the role of the road data providers also two promising alternatives are available:

1) By governmental bodies (current situation)
2) By private market parties

Public Transit Data Providers

The public transit data providers in the Netherlands are the public transit companies as they are required via the concessions. In this research is presumed that no other promising alternatives are available for the fulfilment of this role.

> "I see us and the other public transit companies more and more in the role of Data Provider" (Quote from a Public Transit company in Spruijtenburg 2009i).

Road Data Integrator (NDW)
At the moment the road data integrator in the Netherlands (NDW) can be described as an agency of the different involved governmental bodies so this role is publicly fulfilled at the moment.

> "Up till now the position of the governmental bodies is as follows: We take the responsibility to construct the databases (NDW and NDOV) but to develop the actual services based on the integrated data in these databases is a task for the market" (Quote J.J. van Dijke (district of Utrecht) in Spruijtenburg 2009b).

Although the role of the NDW is publicly fulfilled at the moment, it might be thinkable that private parties could exploit this database more efficiently under concession. Think in relation to this also about the early technological problems the NDW has been faced by. Due to these problems the database is shut down again already two weeks after its operational start for at least one more month (ANP 2009).

> "We are a governmental body as we are an agency financed by a number of governmental bodies: The Ministry of Transport, Public Works and Water Management in cooperation with some districts, municipalities and city-regions. However, actually we feel more like a firm and that is also the reason why we have a real Business Plan" (Quote M. van Strien (NDW) in Spruijtenburg 2009c).

So, for the fulfilment of the exploitation of the road data integrator (the NDW), two promising alternatives are available:
1) By a governmental body (current situation)
2) By a private market party under concession

Public Transit Data Integrator (NDOV)
Next to the introduction of the NDW, currently also strong developments are in place towards the introduction of a national data warehouse regarding public transit data (NDOV). This NDOV must be operational in the year 2011 and it is planned to be developed by the Ministry of transport, public works and water management in combination with the public transit companies and the Dutch public transit authorities. The goal of this NDOV is comparable to that of the NDW: Providing one national, central database that integrates all the needed data and giving other parties the possibility to develop and introduce all kinds of new travel information services (Ministry of Transport; Public Works and Water Management 2009a p.3).

For this NDOV, as for the NDW, might also yield that private parties will be able to exploit such a database more efficiently (under concession) then the governmental bodies. So, for the fulfilment of the exploitation of the NDOV also two promising alternatives are available:
1) By a governmental body
2) By a private market party under concession

Service Providers
Service providers are usually private parties that deliver services to travellers/users consisting of all kinds of travel information. Normally they translate the data as provided by the different data providers and/or data integrators into useful travel information services for travellers (Regio Brabant, Zuidvleugel Randstad et al. 2008 p.16). Currently, it is a recent policy choice of the involved policy-making bodies that the provision and integration of the

data is a task for the governmental bodies and that the delivery of the final services will be a task for the market (Ministry of Transport; Public Works and Water Management 2006 slide 5; Ministry of Transport; Public Works and Water Management 2009a p.3). Also in a comparable information system like the KNMI, the tasks of provision and integration of the data are fulfilled by public parties while the delivery of the final services is seen as a task for private market parties (Veeneman and van der Elst 2006 p.9).

> "The development and supply of the final services is a task for the market parties. The question is whether this will really result in a profitable business case or not" (Quote M. van Gelderen (the Ministry of Transport, Public Works and Water Management) in Spruijtenburg 2009d).

However, market parties currently are still not able to make a sound business case for the development and implementation of PITA-services. This market failure has three different reasons. Firstly, in general there is a very small margin on multimodal travel information services. Secondly, there is a lack of European standards regarding public transit data and finally, the investment costs for such services are still relatively high. Although the commitment of the Ministry of Transport, Public Works and Water Management together with the other involved governmental bodies by taking the responsibility to build up the two databases consisting of public transit- and car data (NDW; NDOV) may substantially decrease those investment costs, a situation in which the private market parties are still not able to create a valuable business case for PITA-services can really be expected. From this starting point that the market fails to develop and implement PITA-services themselves, the public parties should probably also be involved and cooperate with the private parties to achieve a successful development and implementation.

> "When the private parties can not make a sound business case for a PITA-service, involvement of the public parties could work to put the market into motion. Possibilities to do this are for example by subsidy schemes or traditional tendering (which worked well for 'Haaglanden Mobile')" (Quote W. Benschop in Spruijtenburg 2009e).

To realize this involvement of the public parties for the fulfilment of the role of the service providers, the following four promising cooperation models could be used:

1) By private market parties under subsidy schemes
2) By private market parties under traditional tendering
3) By governmental bodies and private market parties completely together by means of a Public-Private Partnership
4) By private market parties with the government as 'launching customer'

Hardware Providers; Software Developers and Consultancy Companies

These three roles are mostly supporting roles within the process and in this research is presumed that they will by definition be fulfilled by private parties. Though, the roles of these private software developers and hardware providers will become increasingly more important for a successful development and implementation of future services like PITA so their roles must definitely not be under-appreciated.

To summarize, within the future actor constellation for the development and implementation of PITA-services there are five roles for which there is more then one promising alternative for its fulfilment. Related to this, it might be very helpful to gather information about the preferences of the potentially involved actors themselves regarding the fulfilment of these five roles. This information is gathered by means of a stated choice experiment which will be

described in the next sections of this paper. By doing this, the complete actor constellation will be defined which is preferred among the involved public and private actors.

The used Methodology: Stated Choice Experiment

In this section we will describe the used methodology. We will firstly explain why there is chosen to carry out a stated choice experiment and describe the theory. Secondly, we will define the experimental design and finally the population will be identified and we will state how the respondents have been selected.

Stated choice theory

In this research has been chosen to carry out a stated choice experiment because by means of such an experiment more insights can be acquired in the preferences of the actors that might be involved in the development and implementation of PITA-services, which is required to give strong recommendations regarding the preferred fulfilment of the future actor constellation for the development and implementation of such services. A choice based experiment has been carried out instead of a rating based experiment because in reality the potentially involved actors also have to choose whether they participate in a specific actor constellation for the development and implementation of PITA-services or not.

The general objective of the experiment is to define which alternative actor constellation is preferred by the potentially involved actors. In the experiment, the respondents have to choose the alternative actor constellation they prefer within eight different choice-sets which each consist of two alternative actor constellations. An alternative actor constellation exists of different attributes (roles) which all vary on different levels (fulfilment alternatives). This way a large number of observations (choices) is gathered. Based on the acquired data-set of observations, model parameters can be estimated for each individual attribute level. Then, based on these estimated parameters, direct choice probabilities can be predicted for every possible alternative actor constellation (Oppewal and Timmermans 1992 p. 2-3). These estimated parameters themselves just form a solid basis to establish future policy on.

So, in stated choice experiments is assumed that every alternative is defined by a number of attributes which vary on different levels. Every research unit, in this research a potentially involved actor, is assumed to derive a partial utility from each of these attribute levels and to combine them into a total utility for every alternative. It is assumed that this is realised by enumerating those partial utilities (Oppewal and Timmermans 1992 p.2), as also expressed in the formula below:

$$U_{ij} = \sum_{k} \beta_k X_{ijk} + \varepsilon_{ij}$$

Where:

U_{ij} = the total utility as derived from alternative j by respondent i

β_k = a to be estimated partial utility for attribute level k

X_{ijk} = an attribute level k for alternative j

ε_{ij} = the random utility component

$\sum_k \beta_k X_{ijk}$ = V_{ij} = the non-random utility component

Furthermore, in stated choice experiments the respondents will be presented some choice-sets consisting of a number of alternatives, for which is presumed that the respondents will always choose the alternative with the highest total utility. The alternatives in the choice-sets are described by attribute levels of which is assumed that they influence the respondents' choice. For each choice-set, the respondents have to choose only one alternative. Then, based upon the observed choices, a Multinomial Logit Model (MNL) will be estimated:

$$p_{ij} = \frac{e^{V_{ij}}}{\sum_{j \varepsilon S_i} e^{Vij}}$$

Where:
P*ij* = the probability that respondent i chooses alternative j
V*ij* = the utility as derived from alternative j by respondent i
S*i* = a choice-set of j alternatives presented to respondent i
e = base for the natural logarithm (±2,72)

Finally, based on the estimated model will be concluded from which attribute levels the respondents derive the highest utility and which attribute levels are generally preferred by them. Then, stronger recommendations can be given regarding the preferred alternatives for the fulfilment of the roles within the actor constellation and the preferred actor constellation itself can be defined.

The experimental design

This section defines the experimental design as used within this stated choice experiment. First, the selection of attributes and related attribute levels will be described. Then, the composition of the alternatives and choice-sets will be described and finally the model estimation procedure will be explained.

Selection of attributes and levels

The most important objective regarding the selection of attributes and attribute levels is that the final selection should form a realistic reflection of the possible and promising range of alternative actor constellations for the development and implementation of PITA-services.

The section *promising alternatives for the fulfilment of the roles*, as described above, functions as input for the selection of attributes and levels within this stated choice experiment. From this section can be concluded that for the fulfilment of five from the ten different roles, more then only one highly promising alternative is available. These five roles are selected as the (categorical) attributes and the different promising alternatives for the fulfilment of each of these five roles are used as the different attribute levels. An overview of the attributes and their levels is given in table 1 below.

Attribute	Levels
Traffic managers	1 = governmental bodies 2 = private market parties under concession
Road data providers	1 = governmental bodies 2 = private market parties
Exploitation of the Road data integrator (NDW)	1 = governmental body 2 = private market party under concession
Exploitation of the Public transit data integrator (NDOV)	1 = governmental body 2 = private market party under concession
Service providers (Level of cooperation)	1 = *low* (private market parties with the government as launching customer) 2 = *medium* (private market parties under subsidy schemes or traditional tendering) 3 = *high* (governmental bodies and private market parties together by means of a Public-Private Partnership (PPP))

Table 1 *The different attributes and their levels*

Definition of alternatives and choice-sets

The different levels of the five selected attributes as described above are combined into different alternatives. To vary the attributes in a clever and systematic way among these alternatives, *basic plans* are used. *Basic plans* have a number of advantageous characteristics of which the most important is that they are orthogonal. Orthogonal means that the appearance of an attribute level is independent of the appearance of all other attribute levels (Steenkamp 1985). For example: the attribute level "governmental bodies as traffic managers" appears just as many times together with "governmental bodies as road data providers" as with "private market parties as road data providers".

To restrict the number of alternatives as much as possible in relation to the size of the experiment, the smallest orthogonal fractional design is chosen whereby all main effects can be estimated. For the composition of this experimental design, *basic plan 1* is used. This has led to eight different alternatives of which an example is presented in table 2 below. The used experimental design is also balanced, which means that all levels of an attribute appear an equal number of times.

Role	***Fulfilment by***
Traffic managers	Governmental bodies
Road data providers	Governmental bodies
Exploitation of the road data integrator (NDW)	Governmental body
Exploitation of the public transit data integrator (NDOV)	Governmental body
Service providers	Private market parties under subsidy schemes (medium level of cooperation)

Table 2 *Alternative 1*

The eight different alternatives for the actor constellation within future PITA-services are distributed among choice-sets consisting of two alternatives as presented in table 3 below. This way the eight different alternatives could be distributed at random among eight different choice-sets. This randomisation is tried few times to finally compose the eight

choice-sets in such a way that the correlations between the different attribute levels within the choice-sets are minimized.

Example Choice-set	**Constellation A**	**Constellation B**
traffic managers	governmental bodies	private market parties under concession
road data providers	governmental bodies	private market parties
public transit data providers	public transit companies	public transit companies
exploitation of the road data integrator (NDW)	governmental body	governmental body
exploitation of the public transit data integrator (NDOV)	governmental body	governmental body
service providers	private market parties under subsidy schemes	private market parties under traditional tendering
hardware providers	private market parties	private market parties
software developers	private market parties	private market parties
Your Choice:		
	■	□
	Constellation A	Constellation B

Table 3 *Example of a choice-set*

Model estimation procedure
As described above, within each choice-set, the respondents must continuously choose between two alternative actor constellations. Because the dependent variable has a nominal measurement scale (choice) and in every choice-set two different alternatives are compared, a Multinomial Logit Model is estimated by help of the software package *Biogeme*. To enable the involvement of all the different attributes and to standardise the different attribute levels, *dummy-coding* is applied.

Population and the group of respondents

Before starting to distribute the web-based questionnaire, first the population of the research must be defined. Within this research, the population exists of all the actors that might be involved within the fulfilment of one (or more) of the roles within the future actor constellation for the development and implementation of PITA-services in the Netherlands. Furthermore, also researchers in the field of study belong to the population. This makes that the population is pretty small and not really well demarcated. The population can be divided into three different actor categories: private market parties, governmental bodies and actors from other kinds of organisations like for example research institutes. The aim was a group of respondents existing of around the same amount of actors from private market parties as from governmental bodies to enable a reliable comparison between these groups.

To carry out a reliable analysis, it is very important that the number of respondents is large enough. For this research, in relation to the characteristics of the analysis and the available time, it was sufficient to aim at a total group of thirty respondents which would mean two hundred and forty observations. Finally, thirty-six respondents filled in the questionnaire

which resulted in two hundred and eighty-eight observations. To get a clear picture of the final group of respondents, the respondents are also asked for what kind of organisation they are actually working. Unfortunately, as can be seen below in table 4, the group of respondents exists for (by far) the largest part of private market parties. This makes a reliable comparison between the preferences of governmental bodies and private market parties impossible.

Type of respondents	**#**
Governmental bodies	13
Private market parties	20
Other (e.g. research institutes)	3

Table 4 *Characteristics of the group of respondents*

The Preferred Actor Constellation

This section describes the most important results of the stated choice experiment. First, the estimated model will be described (the estimated partial utilities of the attribute levels) from which can be concluded which fulfilment alternatives for each of the different roles within the actor constellation are preferred by the group of respondents. Next, some additional interesting notions are described regarding the fulfilment of the future actor constellation which are also acquired by means of the questionnaire.

The estimated model

Based on the choices of the respondents as observed within the experiment, an aggregated model is estimated to investigate partial utilities for each of the attribute levels. To standardise the different attribute levels, *dummy-coding* is applied. The estimated parameters determine the different partial utilities for each of the attribute levels. A partial utility shows the contribution of an attribute level to the total utility, expressed as a deviation of the average utility. Based on these partial utilities, direct choice probabilities can be predicted for every possible alternative actor constellation.

The Rho-square of the estimated model is equal to 0.14. This Rho-square shows how the estimated model fits to the gathered data. Apparently, the Rho-square of this model is quite low but this could also be expected because the respondents had to choose between alternative actor constellations for the future development of PITA-services which is currently still a pretty unknown environment for them. Table 5 below shows the partial utilities of all attribute levels together with the values of their t-tests. The fact that most of the estimated parameters are significant having such a small group of respondents is a very good result. Furthermore, within this experiment is presumed that the different attribute levels within the alternatives are independent from each other.

Attribute level	**Partial utility**	**t-test**
1. Traffic managers		
Governmental bodies	0.00	
Private market parties under concession	-1.09	-5.35

2. Road data providers		
Governmental bodies	0.00	
Private market parties	0.31	1.82*
3. Exploitation of the road data integrator (NDW)		
Governmental body	0.00	
Private market party under concession	0.44	2.66
4. Exploitation of the public transit data integrator (NDOV)		
Governmental body	0.00	
Private market party under concession	0.02	0.09**
5. Service providers (Level of cooperation between the public and private parties)		
Low	0.00	
Medium	-0.48	-2.36
High	-0.95	
		* = only significant at an alpha level of 10% ** = insignificant at any reasonable alpha level

Table 5 *The estimated partial utilities and their t-values*

Based on these partial utilities can be stated that four of the five attributes significantly influence a respondents' choice for a specific actor constellation. These four attributes are the fulfilment of the roles of the *traffic managers*, the exploitation of the *road data integrator (NDW)*, the *service providers* and the *road data providers*. Regarding the fulfilment of the role of the *public transit data integrator (NDOV)*, no significant results have been acquired. The fulfilment of the role of the traffic managers seems to be the most important attribute. A future fulfilment of this role by private market parties is strongly negatively appreciated. This can be clarified from the traditional viewpoint that governmental bodies must always be able to interrupt in traffic situations which might for example harm the public interest or in case of calamities.

The second most important attribute is the fulfilment of the role of the service providers. When governmental involvement regarding the fulfilment of this role increases, its derived utility strongly decreases. This can be clarified from the recent statement of the Ministry of Transport; Public Works and Water Management that the delivery of the final travel information services will be in first instance a task for the private market parties.

The exploitation of the road data integrator (NDW) is the third important attribute. When the NDW will be utilized by a private market party instead of a governmental body, this will be very positively appreciated. This can be clarified by the early technological problems the NDW has been faced by right after its operational start. Due to these problems the database was shut down again for one more month already two weeks after this operational start.

The fourth important attribute is the fulfilment of the role of the road data providers. When this role would be fulfilled by private parties instead of governmental bodies, this will be positively appreciated by the involved actors. This can be clarified by the recent development that private parties (e.g. TomTom and Vodafone) prove to be able to develop new technologies (e.g. 'floating car data') to gather their own traffic flow data which might even be of an higher quality then the data as conventionally gathered by governmental bodies.

Obviously, it seems that the different partial utilities of the attribute levels for all these four attributes can be well interpreted. This can be seen as a first confirmation of the validity of the estimated model (face validity). From the estimated partial utilities (see table 5), the most and the least preferred actor constellation are derived as presented in figures 2 and 3 below.

The most preferred actor constellation		
Role	***Fulfilment by***	***Partial utility***
Traffic managers	Governmental bodies	0.00
Road data providers	Private market parties	0.31
Exploitation of the road data integrator (NDW)	A Private market party under concession	0.44
Exploitation of the public transit data integrator (NDOV)	A Private market party under concession or a Governmental body	insignificant
Service providers	Private market parties with the government as launching customer (Low level of cooperation)	0.00
	Total Utility	***0.75***

Figure 2 *The most preferred actor constellation*

The least preferred actor constellation		
Role	***Fulfilment by***	***Partial utility***
Traffic managers	Private market parties under concession	-1.09
Road data providers	Governmental bodies	0.00
Exploitation of the road data integrator (NDW)	Governmental body	0.00
Exploitation of the public transit data integrator (NDOV)	A Private market party under concession or a Governmental body	insignificant
Service providers	Governmental bodies and private market parties together by means of a Public-Private Partnership (High level of cooperation)	-0.95
	Total Utility	***-2.04***

Figure 3 *The least preferred actor constellation*

Based on the estimated partial utilities, direct choice probabilities can be predicted for the most and the least preferred actor constellation but also for every other possible alternative actor constellation. If a potentially involved actor has to choose between the most- and the least preferred actor constellation (as presented above), the probability that this potentially involved actor will choose for the most preferred actor constellation is equal to 94%. So, the

probability that a potentially involved actor will choose for the least preferred actor constellation is equal to 6%.

As earlier described, the importance of the different attributes regarding these choice-probabilities differs. The fulfilment of the roles of the *traffic managers* and the *service providers* have the largest impact on the probability that a potentially involved actor chooses for a specific alternative actor constellation. For instance, when the role of the traffic managers would be fulfilled by private market parties under concession instead of governmental bodies within the most preferred actor constellation, the probability that an actor will choose for this most preferred actor constellation (instead of the least preferred actor constellation) decreases from 94% to 85%. And, when the role of the service providers would be fulfilled by means of a stronger cooperation model like traditional tendering or Public-Private Partnership (PPP), the probability that an actor will choose for this most preferred actor constellation (instead of the least preferred actor constellation) decreases from 94% to respectively 91% and 86%.

Next to these most and least preferred actor constellation, which are derived from the estimated partial utilities, also *the most likely actor constellation* is defined. The most likely actor constellation is the actor constellation which, according to the author's opinion, would be most in line with current policies and recently publicized policy documents (e.g. The approach multimodal travel information (Ministry of Transport; Public Works and Water Management 2009a) and the conclusions of the advisory commission traffic information (Adviescommissie Verkeersinformatie (commissie Laan) 2009)) (see figure 4 below). If a potentially involved actor must choose between the most likely and the most preferred actor constellation, the probability that this potentially involved actor will choose for the most likely actor constellation is equal to 32%. So, 68% of the potentially involved actors would prefer the most preferred actor constellation above the most likely actor constellation. Though, this is just an outlook based on the author's opinion and observed policy trends which are uncertain and might actually change rapidly.

The most likely actor constellation		
Role	***Fulfilment by***	***Partial utility***
Traffic managers	Governmental bodies	0.00
Road data providers	Governmental bodies	0.00
Exploitation of the road data integrator (NDW)	Governmental body	0.00
Exploitation of the public transit data integrator (NDOV)	A Governmental body	insignificant
Service providers	Private market parties with the government as launching customer (Low level of cooperation)	0.00
	Total Utility	***0.00***

Figure 4 *The most likely actor constellation*

To conclude, it must be stated that the estimated partial utilities and derived choice probabilities as presented in this subsection form a solid basis to establish future policy on. Unfortunately, the derived choice probabilities are not further applied in this experiment to determine the real predictive capacity of the model by use of *holdout profiles*. The total group of respondents is too small to do this.

Additional interesting perceptions of the respondents

In the questionnaire, next to the choice-sets, the respondents are also asked how they individually think that the future actor constellation should look like and/or whether they have other interesting ideas or remarks regarding this actor constellation for the development and implementation of PITA-services or not. This subsection describes the most important ones of these additional results of the experiment.

Firstly, related to the role of the road data providers, an interesting thought is noticed. In the near future a new technology may enable the gathering of both dynamic road traffic flow data and dynamic public transit data using smartphones in combination with GPS. When this becomes possible, individual private parties might be able to cover the whole process of delivering information to travellers themselves. Then these private parties could freely compete for the support of the data provider (which will be the travellers/consumers themselves in such a situation). However, the problem of realizing a sound business case will still be in place.

Secondly, many respondents state that in their opinion the role of the service providers could really be fulfilled by private market parties independently and without any governmental involvement. However, in the section *promising alternatives for the fulfilment of the roles* is argued why this will probably not be feasible for them. An important additional notion here is the statement of one of the respondents that the government cannot expect from private market parties that they will deliver services which generate merely societal revenues. That is the moment the government should interfere instead of holding to the dogma that 'the market has to pick it up'.

Thirdly, some respondents state that not only the actor constellation is important but also 'the road to' this actor constellation. Pointed is at the fact that it might be better if the fulfilment of some of the roles change during the development- and implementation process of PITA-services. Another opinion is that, in the current situation, the involved governmental bodies lack vision, identity and self-reflection. The central government does not have the capacity to realise its own objectives while it actually pays more then 70% of all developments in road- and public transit. Simultaneously, the private parties move as bees around the honey and lack any interior compass which is fatal for real innovations.

A fourth additional result of the experiment is that the respondents generally have the opinion that regarding the fulfilment of the roles of the data integrators (NDW and NDOV), the pure utilization could be done by private parties but that the governments must be able to act as director and set boundary conditions to the use of these different data (for example regarding preference roads). Regarding the NDOV, the link to the requirements regarding dynamic data as part of concessions (concession management) is noticed.

Finally, in compliance with the results of the stated choice experiment, many times is stated that the role of the traffic managers should definitely stay a task for the involved governmental bodies. The respondents refer many times to the risk that public interests might become in danger when this role will be fulfilled by private parties. However, many respondents also raised the opportunity that only some traffic management tasks should stay in the hands of the government (e.g. strategic choices like the definition of the function of roads) while others could actually better be fulfilled by private parties (e.g. the pure guidance and steering of traffic flows to optimize the utilization of the total road network).

Concluding Remarks

For a successful development and implementation of future PITA-services, ten different roles must be fulfilled. Regarding the fulfilment of these roles, very little 'hard' policy-related choices are already made within the Netherlands. In this paper, we have investigated the preferences of the potentially involved public and private actors regarding the fulfilment of these roles. This has been accomplished by means of a stated choice experiment. First, we have defined the most promising alternatives for the fulfilment of each of the roles. For only five of these roles, more then one alternative for its fulfilment seemed to be really promising: the *traffic managers*, the *road data providers*, the *road data integrator (NDW)*, the *public transit data integrator (NDOV)* and the *service providers*.

Furthermore, the role of the *policy-makers* will definitely be fulfilled by governmental bodies and for the fulfilment of the role of the *public transit data providers*, the only promising alternative is a fulfilment by the public transit companies. Finally, for the roles of the *hardware providers*, *software developers* and *consultancy companies*, the only promising alternative for their fulfilment is by private market parties.

The five roles for which there was more then one promising alternative have been included in a stated choice experiment. Combining the experimental results with the fulfilment of the other five roles for which only one promising alternative has been defined, it is concluded that the actor constellation for the development and implementation of PITA-services which is preferred among the involved actors would be the actor constellation as presented in figure 5 below.

The Preferred Actor Constellation for the Development and Implementation of PITA-services

Role	Fulfilment by
Policy-makers	Governmental bodies
Traffic managers	Governmental bodies
Road data providers	Private market parties
Public transit data providers	Public transit companies
Exploitation of the road data integrator (NDW)	A Private market party under concession
Exploitation of the public transit data integrator (NDOV)	A Private market party under concession or a Governmental body
Service providers	Private market parties with the government as launching customer (Low level of cooperation)
Hardware providers	Private market parties
Software developers	Private market parties
Consultancy companies	Private market parties

Figure 5 *The preferred actor constellation*

Related to the fulfilment of this actor constellation, a few additional conclusions can be drawn from the experimental results. Firstly, many respondents have stated that in their opinion only some traffic management tasks should stay in the hands of the governmental bodies (e.g. 'strategic choices' like the definition of the function of roads) while others could actually better be fulfilled by private parties (e.g. the pure guidance and steering of traffic flows to optimize the utilization of the transport networks). Secondly, some respondents have stated that they still think that the role of the service providers could be fulfilled by private market parties independently, but in the section *promising alternatives for the*

fulfilment of the roles has been argued why this will probably not be feasible. These respondents have stated that the only moment when the government should interfere would be the moment that the government expects from the private market parties that they will deliver services which generate merely societal revenues. Then, the government can no longer hold to the dogma that 'the market has to pick it up'.

To conclude, it is important to mention that not only the preferred actor constellation as presented above is important but also 'the road to' this actor constellation will be crucial. It may be effective if the fulfilment of some of the roles change during the development- and implementation process of the future PITA-services. So, do not see the preferred actor constellation as defined in this paper as a fixed and irreversible constellation but rather as a preferred final version.

Paper References

Adviescommissie Verkeersinformatie (commissie Laan) (2009). Eindrapport adviescommissie verkeersinformatie {only available in Dutch}.

ANP (2009). Databank weginformatie weer stil gelegd {only available in Dutch}. NU.nl.

Austin, J., A. Duff, et al. (2001). Traveller information systems research: a Review and Recommendations for Transport Direct.

Chorus, C. G., E. Molin, et al. (2006b). "Use and effects of Advanced Traveller Information Services: A literature review." Transport Reviews **26**(2): 127-149.

Chorus, C. G. and H. J. P. Timmermans (2009). Personal Intelligent Travel Assistants. Handbook in Transport Economics. Edward Elgar. United Kingdom.

Lyons, G. (2006). "The role of information in decision-making with regard to travel." IEE Proc. ITS **153**(3): 199-212.

Ministry of Transport; Public Works and Water Management (2006). Private distributie reisinformatie, *historische achtergrond* {only available in Dutch}.

Ministry of Transport; Public Works and Water Management (2009a). Aanpak Multimodale Reisinformatie {only available in Dutch}. Den Haag.

Oppewal, H. and H. J. P. Timmermans (1992). Conjuncte Keuze Experimenten: achtergronden, theorie, toepassingen en ontwikkelingen {only available in Dutch}. NVVM Jaarboek**:** 1-28.

Regio Brabant, Zuidvleugel Randstad, et al. (2008). Interregionaal programmavoorstel "individuele reisinformatie & In Car" {only available in Dutch}.

Romanillos, L. (2009). Treininformatie op je mobiel, *NS biedt uitgebreide info met reisplanner Xtra* {only available in Dutch}. Metro.

Spruijtenburg, E. (2009b). Interview Report J.J. van Dijke (District of Utrecht) *{only available in Dutch and available from the author on request}*.

Spruijtenburg, E. (2009c). Interview Report M. van Strien (NDW) *{only available in Dutch and available from the author on request}*.

Spruijtenburg, E. (2009d). Interview Report M. van Gelderen (Ministry of Transport, Public Works and Water Management) *{only available in Dutch and available from the author on request}*.

Spruijtenburg, E. (2009e). Interview Report W. Benschop (City-Region of Haaglanden) *{only available in Dutch and available from the author on request}*.

Spruijtenburg, E. (2009i). Interview Report Dutch Public Transit company *{only available in Dutch and available from the author on request}*.

Steenkamp, J. E. B. M. (1985). De constructie van profielensets voor het schatten van hoofdeffecten en interacties bij conjunct meten {only available in Dutch}. NVVM Jaarboek**:** 125-155.

Veeneman, W. and A. van der Elst (2006). Reizen door het RIS, *organisatorische structuur rond multimodale reisinformatie.* {only available in Dutch}.

Appendix B – List of interviewees

- **Mr. Bram Munnik**
  Organisation: 9292OV
  Function: *Senior Project Manager*

- **Mr. Jan-Maarten van den Berg**
  Organisation: Municipality of Amsterdam
  Function: *Policy Strategist*

- **Mrs. Marije de Vreeze**
  Organization: Connekt
  Function: *Project Manager*

- **Mr. Marc van Heumen**
  Organization: The Dutch Railways (NS Hispeed)
  Function: *Cluster Manager Travel Information*

- **Mr. Willem Benschop**
  Organization: City-region of Haaglanden
  Function: *Head of Section Traffic and Transport*

- **Mrs. Marja van Strien**
  Organization: NDW
  Function: *Director*

- **Mr. Gerbrand Klijn en Mr. Rogier Roding**
  Organization: District of Noord-Brabant
  Function: *Policy Advisor Mobility* (G. Klijn) & *Policy Advisor Public Transit* (R. Roding)

- **Mr. Ben Rutten**
  Organization: TomTom
  Function: *Manager Special Projects*

- **Mr. Martin van Gelderen**
  Organization: The Ministry of Transport, Public Works and Water Management
  Function: *Policy Advisor Mobility*

- **Mr. Jan-Jaap van Dijke**
  Organization: District of Utrecht
  Function: *Policy Advisor Mobility*

- **Mr. Anonymous**
  Organization: Dutch Public Transit Company
  Function: *Project leader Public Transit*

Appendix C – Construction of the alternatives

Alternative 1

Role	***Fulfilment by***
Traffic managers	Governmental bodies
Road data providers	Governmental bodies
Exploitation of the road data integrator (NDW)	Governmental body
Exploitation of the public transit data integrator (NDOV)	Governmental body
Service providers	Private market parties under subsidy schemes

Alternative 2

Role	***Fulfilment by***
Traffic managers	Private market parties under concession
Road data providers	Private market parties
Exploitation of the road data integrator (NDW)	Private market party under concession
Exploitation of the public transit data integrator (NDOV)	Private market party under concession
Service providers	Private market parties under subsidy schemes

Alternative 3

Role	***Fulfilment by***
Traffic managers	Governmental bodies
Road data providers	Governmental bodies
Exploitation of the road data integrator (NDW)	Private market party under concession
Exploitation of the public transit data integrator (NDOV)	Private market party under concession
Service providers	Private market parties under traditional tendering

Alternative 4

Role	***Fulfilment by***
Traffic managers	Private market parties under concession
Road data providers	Private market parties
Exploitation of the road data integrator (NDW)	Governmental body
Exploitation of the public transit data integrator (NDOV)	Governmental body
Service providers	Private market parties under traditional tendering

Alternative 5

Role	***Fulfilment by***
Traffic managers	Governmental bodies
Road data providers	Private market parties
Exploitation of the road data integrator (NDW)	Governmental body
Exploitation of the public transit data integrator (NDOV)	Private market party under concession
Service providers	Governmental bodies and private market parties together by means of a Public-Private Partnership

Alternative 6

Role	***Fulfilment by***
Traffic managers	Private market parties under concession
Road data providers	Governmental bodies
Exploitation of the road data integrator (NDW)	Private market party under concession
Exploitation of the public transit data integrator (NDOV)	Governmental body
Service providers	Governmental bodies and private market parties together by means of a Public-Private Partnership

Alternative 7

Role	***Fulfilment by***
Traffic managers	Governmental bodies
Road data providers	Private market parties
Exploitation of the road data integrator (NDW)	Private market party under concession
Exploitation of the public transit data integrator (NDOV)	Governmental body
Service providers	Private market parties with the government as launching customer

Alternative 8

Role	***Fulfilment by***
Traffic managers	Private market parties under concession
Road data providers	Governmental bodies
Exploitation of the road data integrator (NDW)	Governmental body
Exploitation of the public transit data integrator (NDOV)	Private market party under concession
Service providers	Private market parties with the government as launching customer

Appendix D – Questionnaire for the stated choice experiment (Dutch)

Inleiding

De ontwikkeling van reisinformatiediensten in Nederland gaat de laatste jaren erg snel. Het is slechts een kwestie van tijd voordat een dienst beschikbaar is die je op elk moment van de dag voorziet in alle reisinformatie die voor jou relevant is gegeven je actuele plaats in het multimodale transportnetwerk, een zogenaamde PITA-dienst: De Personal Intelligent Travel Assistant. De vier basiskenmerken van deze PITA-dienst zijn dat hij *mobiel* (te ontvangen op een mobiel apparaat) moet zijn*, dynamisch* (aangepast voor de actuele toestand van het transportnetwerk)*, multimodaal* (auto, trein, bus, fiets, etc.) en *persoonlijk* (rekening houdend met je specifieke locatie en persoonlijke kenmerken en voorkeuren).

In het proces van de ontwikkeling en implementatie van een PITA-dienst kan een aantal rollen worden onderscheiden die op verschillende manieren kunnen worden vervuld. In het kader van mijn afstudeeronderzoek (voor mijn studie Technische Bestuurskunde aan de TU Delft) wat ik uitvoer bij AT Osborne probeer ik in kaart te brengen hoe deze rolverdeling het beste kan worden ingevuld. Om dit zo goed mogelijk te kunnen doen is het van groot belang om te achterhalen wat, ten opzichte van deze toekomstige rolverdeling, de mening is van de betrokken partijen in het veld die eventueel zelf een rol kunnen spelen bij de ontwikkeling en implementatie van zo'n dienst. Ik wil u bij voorbaat hartelijk danken voor uw medewerking.
Ewoud Spruijtenburg

Binnen de rolverdeling voor de ontwikkeling en implementatie van een toekomstige PITA-dienst kunnen acht rollen worden onderscheiden: *verkeersmanagers*; *Road data providers*; *OV data providers*; *Road data integrator (NDW)*; *OV data integrator (NDOV); Service providers*; *Hardware providers* en *Software ontwikkelaars*. De invulling van sommige van deze rollen ligt vast terwijl voor de invulling van andere rollen meerdere mogelijkheden zijn.

1. Verkeersmanagers
Verkeersmanagers sturen en begeleiden het wegverkeer door bijvoorbeeld het gebruik van verkeersborden, toeritdosering en dynamische route-informatie panelen (DRIP's). Waar dat nodig is doen zij dat ook in afwijkende situaties zoals bij evenementen of wegwerkzaamheden.

2. Road data providers
Road data providers zijn de partijen die data aanleveren met betrekking tot verkeersstromen op het wegennet. Op dit moment worden deze data vooral geleverd door Rijkswaterstaat maar private ondernemingen bewijzen de laatste tijd dat er steeds meer nieuwe technologieën (zoals floating car data) ontwikkeld worden die hiervoor ook gebruikt zouden kunnen worden.

3. OV data providers
OV data providers zijn de leveranciers van zowel statische als actuele, dynamische data over de verkeersstromen op de netwerken van de OV-modaliteiten. Deze rol wordt per definitie vervuld door de verschillende OV-bedrijven.

4. Road data integrator (NDW)
De road data integrator is het Nationaal Data Warehouse (het NDW). Op het moment is dit een samenwerkingsverband van verschillende overheidsorganisaties waarin alle data die geleverd worden met betrekking tot het wegverkeer gebundeld en geïntegreerd worden.

5. OV data integrator (NDOV)
Naast het NDW moet er in 2011 ook een Nationale Databank OV-gegevens operationeel zijn waarin alle data als geleverd dor de verschillende OV-bedrijven gebundeld en geïntegreerd dienen te worden.

6. Service Providers
De service providers zijn die partijen die uiteindelijk de PITA-diensten gaan ontwikkelen en aan de reizigers zullen leveren waarbij gebruik gemaakt wordt van de data uit de twee databases (het NDW en het NDOV).

7. Hardware Providers
De hardware providers zijn per definitie private ondernemingen die de benodigde hardware leveren om de ontwikkeling en implementatie van PITA-diensten te ondersteunen.

8. Software ontwikkelaars
De software ontwikkelaars zijn, net als de hardware providers, per definitie private ondernemingen die de software ontwikkelen en leveren welke benodigd is om PITA-diensten te kunnen ontwikkelen en implementeren.

1. Voor wat voor soort organisatie werkt u momenteel?
    - 0 Een Overheidsorganisatie
    - 0 Een Private onderneming
    - 0 Overig (zoals semi-overheden, onderzoeksinstituten, etc.)

Nu presenteer ik u een aantal keuzesituaties met telkens twee mogelijke rolverdelingen voor de ontwikkeling van een PITA-dienst. Elke keuzesituatie bestaat uit twee alternatieve rolverdelingen die worden beschreven aan de hand van de acht rollen zoals die hierboven zijn beschreven. Elk van deze acht rollen kan als volgt worden ingevuld:

1 De verkeersmanagers:
    - o ingevuld door overheidsorganisaties
    - o ingevuld door private ondernemingen onder concessieverlening.

2 De road data providers:
    - o ingevuld door overheidsorganisaties
    - o ingevuld door private ondernemingen.

3 De OV data providers:
    - o per definitie ingevuld door de OV-bedrijven.

4 De road data integrator (het NDW):
    - o exploitatie door een overheidsorganisatie
    - o exploitatie door een private onderneming onder concessie.

5 De OV data integrator (het NDOV):
    - o exploitatie door een overheidsorganisatie
    - o exploitatie door een private onderneming onder concessie.

6 De service providers:
    - o ingevuld door private ondernemingen met behulp van subsidieregelingen
    - o ingevuld door private ondernemingen onder een traditionele aanbesteding (opdrachtgever-opdrachtnemer relatie)
    - o geheel gezamenlijk ingevuld door overheidsorganisaties en private ondernemingen d.m.v. PPS (publiek-private samenwerking)
    - o ingevuld door private ondernemingen met de overheid in de rol van 'launching customer' (hierbij neemt de overheid direct een grote hoeveelheid van de dienst af om zo een overgang naar grootschalige productie van de dienst mogelijk te maken).

7 De hardware providers:
    - o per definitie ingevuld door private ondernemingen.

8 De software ontwikkelaars:
    - o per definitie ingevuld door private ondernemingen.

Op de volgende pagina treft u acht keuzesituaties met twee alternatieven voor de rolverdeling. U kunt telkens kiezen voor de rolverdeling die uw voorkeur heeft. Voordat daadwerkelijk wordt begonnen met de keuzesituaties geef ik eerst een voorbeeld.

Voorbeeldkeuzesituatie	Rolverdeling A	Rolverdeling B
verkeersmanagers	overheidsorganisaties	private ondernemingen onder concessie
road data providers	overheidsorganisaties	private ondernemingen
OV data providers	OV-bedrijven	OV-bedrijven
road data integrator (NDW)	exploitatie door een overheidsorganisatie	exploitatie door een overheidsorganisatie
OV data integrator (NDOV)	exploitatie door een overheidsorganisatie	exploitatie door een overheidsorganisatie
service providers	private ondernemingen met behulp van subsidieregelingen	private ondernemingen onder traditionele aanbesteding
hardware providers	private ondernemingen	private ondernemingen
software developers	private ondernemingen	private ondernemingen
Uw keuze:		
	■	□
	Rolverdeling A	Rolverdeling B

Zoals u kunt zien verschilt rolverdeling A op een aantal punten van rolverdeling B. Blijkbaar vindt de respondent in dit voorbeeld rolverdeling A aantrekkelijker dan B. Hieronder volgen de keuzesituaties waarin ik u wil vragen uw voorkeur aan te geven.

Keuzesituaties

Keuzesituatie 1	Rolverdeling A	Rolverdeling B
verkeersmanagers	overheidsorganisaties	private ondernemingen onder concessie
road data providers	overheidsorganisaties	overheidsorganisaties
OV data providers	OV-bedrijven	OV-bedrijven
road data integrator (NDW)	exploitatie door een overheidsorganisatie	exploitatie door een overheidsorganisatie
OV data integrator (NDOV)	exploitatie door een overheidsorganisatie	exploitatie door een private onderneming onder concessie
service providers	private ondernemingen met behulp van subsidieregelingen	private ondernemingen met de overheid als launching customer
hardware providers	private ondernemingen	private ondernemingen
software developers	private ondernemingen	private ondernemingen

Keuzesituatie 2	Rolverdeling A	Rolverdeling B
verkeersmanagers	private ondernemingen onder concessie	overheidsorganisaties
road data providers	private ondernemingen	overheidsorganisaties
OV data providers	OV-bedrijven	OV-bedrijven
road data integrator (NDW)	exploitatie door een private onderneming onder concessie	exploitatie door een private onderneming onder concessie
OV data integrator (NDOV)	exploitatie door een private onderneming onder concessie	exploitatie door een private onderneming onder concessie
service providers	private ondernemingen met behulp van subsidieregelingen	private ondernemingen onder traditionele aanbesteding
hardware providers	private ondernemingen	private ondernemingen
software developers	private ondernemingen	private ondernemingen

Keuzesituatie 3	Rolverdeling A	Rolverdeling B
verkeersmanagers	overheidsorganisaties	overheidsorganisaties
road data providers	overheidsorganisaties	private ondernemingen
OV data providers	OV-bedrijven	OV-bedrijven
road data integrator (NDW)	exploitatie door een private onderneming onder concessie	exploitatie door een overheidsorganisatie
OV data integrator (NDOV)	exploitatie door een private onderneming onder concessie	exploitatie door een private onderneming onder concessie
service providers	private ondernemingen onder traditionele aanbesteding	gezamenlijk door overheidsorganisaties en private ondernemingen d.m.v. PPS
hardware providers	private ondernemingen	private ondernemingen
software developers	private ondernemingen	private ondernemingen

Keuzesituatie 4	Rolverdeling A	Rolverdeling B
verkeersmanagers	private ondernemingen onder concessie	private ondernemingen onder concessie
road data providers	private ondernemingen	private ondernemingen
OV data providers	OV-bedrijven	OV-bedrijven
road data integrator (NDW)	exploitatie door een overheidsorganisatie	exploitatie door een private onderneming onder concessie
OV data integrator (NDOV)	exploitatie door een overheidsorganisatie	exploitatie door een private onderneming onder concessie
service providers	private ondernemingen onder traditionele aanbesteding	private ondernemingen met behulp van subsidieregelingen
hardware providers	private ondernemingen	private ondernemingen
software developers	private ondernemingen	private ondernemingen

Keuzesituatie 5	Rolverdeling A	Rolverdeling B
verkeersmanagers	overheidsorganisaties	private ondernemingen onder concessie
road data providers	private ondernemingen	overheidsorganisaties
OV data providers	OV-bedrijven	OV-bedrijven
road data integrator (NDW)	exploitatie door een overheidsorganisatie	exploitatie door een private onderneming onder concessie
OV data integrator (NDOV)	exploitatie door een private onderneming onder concessie	exploitatie door een overheidsorganisatie
service providers	gezamenlijk door overheidsorganisaties en private ondernemingen d.m.v. PPS	gezamenlijk door overheidsorganisaties en private ondernemingen d.m.v. PPS
hardware providers	private ondernemingen	private ondernemingen
software developers	private ondernemingen	private ondernemingen

Keuzesituatie 6	Rolverdeling A	Rolverdeling B
verkeersmanagers	private ondernemingen onder concessie	private ondernemingen onder concessie
road data providers	overheidsorganisaties	private ondernemingen
OV data providers	OV-bedrijven	OV-bedrijven
road data integrator (NDW)	exploitatie door een private onderneming onder concessie	exploitatie door een overheidsorganisatie
OV data integrator (NDOV)	exploitatie door een overheidsorganisatie	exploitatie door een overheidsorganisatie
service providers	gezamenlijk door overheidsorganisaties en private ondernemingen d.m.v. PPS	private ondernemingen onder traditionele aanbesteding
hardware providers	private ondernemingen	private ondernemingen
software developers	private ondernemingen	private ondernemingen

Keuzesituatie 7	Rolverdeling A	Rolverdeling B
verkeersmanagers	overheidsorganisaties	overheidsorganisaties
road data providers	private ondernemingen	overheidsorganisaties
OV data providers	OV-bedrijven	OV-bedrijven
road data integrator (NDW)	exploitatie door een private onderneming onder concessie	exploitatie door een overheidsorganisatie
OV data integrator (NDOV)	exploitatie door een overheidsorganisatie	exploitatie door een overheidsorganisatie
service providers	private ondernemingen met de overheid als launching customer	private ondernemingen met behulp van subsidieregelingen
hardware providers	private ondernemingen	private ondernemingen
software developers	private ondernemingen	private ondernemingen

Keuzesituatie 8	**Rolverdeling A**	**Rolverdeling B**
verkeersmanagers	private ondernemingen onder concessie	overheidsorganisaties
road data providers	overheidsorganisaties	private ondernemingen
OV data providers	OV-bedrijven	OV-bedrijven
road data integrator (NDW)	exploitatie door een overheidsorganisatie	exploitatie door een private onderneming onder concessie
OV data integrator (NDOV)	exploitatie door een private onderneming onder concessie	exploitatie door een overheidsorganisatie
service providers	private ondernemingen met de overheid als launching customer	private ondernemingen met de overheid als launching customer
hardware providers	private ondernemingen	private ondernemingen
software developers	private ondernemingen	private ondernemingen

Nogmaals Hartelijk Dank voor uw medewerking.