

Europe within reach

A new navigation system for holiday purposes

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Enschede - The Netherlands

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Prologue

Dear reader,

At this moment you are reading the result of 10 weeks of hard working. The result is a design of a navigation system for holiday purposes together with a strategy how to put into the market.

We would like to thank some of the members of the department of Centre for Transport Studies (CTS) for their input during the project and their comments in the process meetings. We would like to mention Thijs Muizelaar for his expertise on utility functions and assistance with the programme Biogeme. Also Nina Schaap for her remarks on the questionnaires and the progress of this report. We thank Bart van Arem for his lectures and his enthusiasm on ITS.

Especially, we would like to thank all of our relatives, friends, acquaintances and fellow students, whom answered our questionnaires and accepted our spam for it.

Our fellow students also thanks for your comments during the process meetings and your presence in room WH217.

We had a pleasant cooperation in this project and we have learnt a lot from all the critical remarks we gave on each work.

Good luck with reading this report!

Lieuwe Krol
Margreet Nederveen
Anthonie Renes

Enschede,
January 31th, 2008

Management summary

The development of navigation systems is a continuous process. New functions are added to a current standard system, in order to give more information about places and points of interest.

As a next step, a special navigation system for holidays is developed. The basic system gives information about the locations of gas station with actual gas prices, locations and telephone numbers of emergency services and locations of cash machines. A more extended version of the navigation system gives also information about points of interest, restaurants and tourist offices. This information can be very useful on holidays.

For an upgrade from the basic system to the extended version, customers are willing to pay about €60. The recommended business model for this system is a model in which customers buy their system and do not have to pay monthly or yearly amount for keeping the information up to date. In the purchase price some differentiation can be made, in order to have a system which can be updated daily and a system which can not be updated. A successful cooperation in the development can be obtained when a development team is set up. In this team the main participants are the navigation system developer and the information providers. A good cooperation gives advantages to all parties.

For the introduction of the system a stepwise introduction is recommended. The first step of the introduction is to launch the product in one country and evaluate the benefits. With this information the system can adapted for other countries, with similar characteristics. After this evaluation the system can be launched worldwide.

One of the main risks of the development of the system is a lack of good and reliable information. For a reliable assessment of the user needs and the willingness to pay, more respondents are required. This will also result in a more representative sample. Furthermore, the system has to be tested in a simulator or in the real world, to find out the workload and the satisfaction of the system.

Another risk is found in the financial feasibility. Research is needed to get a more detailed willingness to pay and the willingness of consumers to buy the system.

The development of the system can be feasible, under some restrictions. In the general development of navigation systems, the development of a holiday version is a logical next step. As a result of the research can be concluded that there is a willingness to pay for a navigation system for holiday purposes.

For more detailed information about the user needs and the financial feasibility more research is needed.

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1. Introduction

“Just before a three weeks camping holiday in France I go to the ANWB to get the latest highway map of West-Europe. Also the guides about gas station and camping sites along the highway I take along with me. Besides that, the guide ‘Wat en hoe in het Frans?’ and the ANWB camping guide I already have in my possession”

The ordinary holidaymaker takes along all sorts of information guides. With the introduction of navigation systems a map of the holiday destination is already superfluous. Other information is still bought in abundance as well for long-term as short-term holidays. This need of information is the starting point of this project. A new service that fulfils user needs is developed during the last two months.

With this research, answers are found on what sort of information holiday travellers would like to receive on their Portable Navigation Device (PND) and what functions are implemented in the basic design of such a service. The financial side of this project plays an important part. Extra attention is given to this.

The structure of this report is as follows:

In chapter 2 an analysis of the problem area is given, which results in a problem description, together with objectives and the research questions. Also a short description of the used methodology is expounded. In chapter 3 the stakeholders are analysed, together with their interests and actions. This resulted in 2 main stakeholders: the developers and the users. In chapter 4 the design of the service is given. The functions which are put into the service are described. In chapter 5 a financial plan and marketing plan are described. The financial plan exists of a description of the recommended model and the financial cooperation, together with the willingness to pay (WTP) of the service and a short cost-benefit analyses. The marketing plan exists of 4 parts: Product, Price, Promotion and Places for selling. In the end an introduction to market is described. In chapter 6 the main risks of this product are analysed and recommendations are given how to avoid or to control these risks. In the last chapter (chapter 7) the conclusions are written down, together with a discussion and recommendations for further research are given. In the last paragraph the vision of the project team on the future of Portable Navigation Devices (PND's) is presented.

2. Problem analysis

Navigation systems are commonly used by car drivers. In 2007 one of the main system providers has launched a navigation system with real-time traffic information. This business is rapidly growing and continuously developing.

These navigation systems are also used by tourists. They are especially useful for travelling in unknown surroundings. Functions, such as route guidance and finding the nearest Point of Interest (POI), are already of great use by the present holiday maker. Besides this, some companies already started with the development of download(able) packages focused on navigation systems focused on the holiday maker.

In this chapter a description of the present situation of the development of portable navigation systems and the present situation on tourist information is given (§2.1). This is followed by a description of the current problem, scope and the objectives of this research. This has led to a couple of research questions that are answered during the project. At last follows the description of the used methodologies.

2.1. Present situation

In this paragraph a short description is given of the present situation on the markets of (portable) navigation systems and of tourist information. Because of the continuous development in this market area, it is hard to describe the present standards. Therefore the coming descriptions of these markets are only-up-to date for short time period. Besides this, the descriptions are not intended to be complete.

2.1.1. Present situation of portable navigation systems

Nowadays an ordinary navigation system has many functions. A standard navigation system is capable to give reliable route guidance with the capacity to fast (re-)calculation of the route. Besides this, they give access to traffic information, information on locations of speed radars and information on and the location of Points of Interest (such as restaurants, hotels, museums, etc). There is also a possibility for users to share information, such as temporarily road blocks. This gives the users up to date maps. Other up-coming functions are voice recognition and HD (high definition) traffic information.

A lot of companies are active on the market for PND's. In Europe the biggest player is TomTom. Other big players are Garmin and Mio(Tech). These companies are rapidly growing. For example the revenue of TomTom (TomTom, 2006) grew from 720 million euro in 2005 to 1.364 million euro in 2006. This is a grow rate of 89%. The number of units sold (TomTom, 2006) in these years grew from 2.212.000 to 5.030.000. This is a growth rate of 127%. More and more vehicles are nowadays equipped with navigation systems.

The average purchase price of a navigation system is about €250. Receiving updates of information is commonly for free. The foundations of these assumptions are found in appendix A.

2.1.2. Present situation of tourist information

Going on holiday is an activity most of the Dutch people like to do. About 81% of the Dutch went on holiday in 2006. This percentage is constant over the last 10 years. In 2006 a total of 34.5 million holidays were spent, from which 17.8 million had their destination in the Netherlands and 16.8 million had their destination abroad. These are 2.12 holiday trips per person per year. From the trips abroad 56.5 % were done by car (ANVR, 2007). Due to the growing individualism tourist behaviour becomes harder to predict. However the

expectation is that in the future the number of holidays will grow, but their duration will be shorter (NBTC, 2007).

Tourist information is provided in many ways. In the traditional way it was provided by means of travel guides, travel agencies and travel brochures. The last 10 years the internet has become more and more the major source for touristic information. Therefore the tourist himself gets back in control on tourist information. This tendency provides opportunities for tourist information on navigation systems. The information can be adapted to individual wishes and the individual can control the information he gets.

2.2. *Problem description, objectives and research questions*

Nowadays there is a huge amount of tourist information available, especially on the internet. However, this information is hard to carry with you when you're on a holiday. There are possibilities to download it and print it or take a laptop with you when you're on a holiday, but these solutions are not very practical. Travel guides are a solution in which all tourist information is merged. However they do not always contain the information, which the tourist found at home on the internet. Besides this, they only contain small maps of the roads at your holiday destination and of course there information is static. Expected is that there is a need for a product that integrates tourist information and travel information better and in a more dynamical way. In this way the information can be more up to date and more personal.

Looking to these current developments on the market of tourist information and navigation systems, they support the hypothesis that there is a need for navigation systems focused on the holiday maker.

This hypothesis is confirmed among other things by the growing number of sold navigation systems. More and more persons are getting used to have a navigation system and rely on it when they travel. The switch of having a navigation system towards having a navigation system focused on the holiday maker is smaller in comparison to from having nothing towards a navigation system with so many functions. Besides that, consumers are more and more searching on the internet for tourist information. Therefore they are used to deal with this kind of information and likely they are therefore more capable to deal with this kind of information on navigation systems. Thirdly, the expectation is that in the future Dutch people are going more often on a holiday for a shorter time period. Therefore a system that reacts on this development can be successful. The navigation system focused on the holiday maker can be such kind of system. Fourthly and lastly, the growing number of activities from navigation system companies and tourist companies on this market supports the idea that there is a need for a navigation system focused on the holiday maker.

The objective of this research is therefore to examine the need for a new navigation system focused on the holiday maker, with the aim of proposing a new navigation system. This results in 1 main question and 2 sub-questions:

- What is the feasibility of a PND for holiday purposes?
 1. What are the user needs for a PND for holiday purposes?
 2. How does this system come to the market?

To be able to answer this question it is important to define the research area (the scope). Besides this, the sub-questions are split in sub-sub-questions, to help the answering of the main questions and to define the boundaries of this research.

The scope of the research

The research is bounded to:

- Dutch users (easier to receive information from)
- Holidays in Europe by car
- If the new service is developed, it is going to enter the market in 2 years. Therefore there has to be a need for it within 2 years.
- The system has to pay itself back within 5 years.
- There is no design made of the service in detail. Thus no design of the HMI (Human Machine Interface) or other of the components. Besides that, it means that no exact implementation of the service is prescribed, but only recommendations for the development are given.

Besides this, there is the assumption that this research is part of the research and development of one of the major companies in the PND-market. For example: TomTom. Of course this is fictitious, but it makes the research more realistic. This assumption also means that there is a reliable route navigation system available.

The sub-questions, which give an answer to the main questions, are:

1. What are the user needs for a PND for holiday purposes?
 - a. What information functions do users would like to have in their PND?
 - b. What system function do users would like to have in their PND?
2. How does this system come to the market?
 - a. What is the financial feasibility of this PND?
 - b. How can the marketing of this product be done?
 - c. How does the cooperation between stakeholders look like?
 - d. What are the main risks of the project?

2.3. Methodology

Different research methods are used to answer the research questions. In this paragraph a short overview of them is given. If necessary these methods are later discussed in more detail.

First, to get an idea of the stakeholders and their characteristics the method Converge (Converge, 1998) is used. This method gives an overview of stakeholders, their interests and their actions. Converge is mainly used to set up an assessment to define user needs and the stated preference survey (financial assessment).

Second, two online questionnaires are developed. The site of Thesis Tools (www.thesistools.com) is used to put the questionnaires online. These questionnaires are sent to relatives and friends. Besides this, also the own network of Thesis Tools is used.

The first questionnaire is a user needs analysis, developed to find out which information the users would like to receive when using this service. The data analysis software SPSS (SPSS Inc.) is used to analyse the results. The second questionnaire is developed to find the main aspects of the service according to the users and their relative willingness to pay. The main part of this questionnaire is a stated preference research. For this, a method described by Hensher is used (Hensher and Button, 2007). A utility function is the basis of the questions in this stated preference research. Biogeme (Bierlaire, 2003) is used to develop and analyse this utility function.

Third, for the development of the business plan a financial model is used. This model is described by 511 Deployment Coalition (2002). In the financial model, the input from the second survey is used for creating a cost-benefit analysis.

Forth and last, to get an overview of the risks for this service the method RAID (European Commission, DG XIII-B5, 1999) is used to classify these risks and to develop mitigation strategies for the main risks. RAID means Risk Analysis for ITS Deployment and is developed with support of the European Commission.

3. Stakeholders

By the development of this ITS service 10 stakeholders are taken into account. Some of them are directly involved in the project, others more indirectly.

The 10 stakeholders are: the traveller, the co-traveller, the producer(s) of the navigation system, (commercial) tourist & travel organisation(s), travel guide companies, government, other companies in the tourist sector, fuel stations, suppliers of ICT components and traffic researchers. This list of stakeholders is not all-embracing.

From each stakeholder his interests and actions are analysed. Besides this, their financial relationships and information exchanges are analysed. Appendix B gives a detailed overview of each stakeholder's interests and actions and also an overview of the financial relationships and information exchange between the stakeholders.

Concluded from the analysis, the main stakeholders are the travellers and the developers of the service. The travellers are private users and they are not only the drivers, but also the other co-travellers. The travellers are the (possible) buyers of the service. Therefore the system needs to fulfil their needs at a price level they are willing to pay. The developers are the stakeholders which are responsible for the development of the service. They need a good return on their investment. Therefore it is important to have a good reliable service, a good marketing strategy and of course a market for their service.

The next paragraphs are used to give a short description about these two stakeholders. Firstly, a short description is given of the participants and their cooperation. A financial cooperation strategy is proposed in §5.2.4. Secondly, a short literature research is done about the specific attributes of tourists (travellers) for this PND.

3.1. *Cooperation between partners*

In the development of the system cooperation plays an important role, because information from different parties is brought together in one system. It is important that the information is correct and up to date. The reliability of the product is very important for the successes of it as appears from the risk analysis (chapter 6).

In the development of a PND for holiday purposes the main partners are the navigation system developer, the tourist sector and the organization which provide actual information about gas prices, opening times or entry prices.

For a good cooperation between all participants, rules have to be clear. Which stakeholder pays what and who shares which information? Who takes the financial risks? This should be made clear in a start-up document, so every stakeholder knows his responsibilities. In the chapter about the financial planning and marketing (chapter 5) the stakeholder cooperation is presented in more detail.

To get support from the tourist sector, it is important that the given information is correct. The reliability must be as high as possible, so the tourist sector cooperates in the process of development. Furthermore, it has to be clear that all companies profit from cooperating in the process.

Profit for companies is gained from more customers who find their company (for instance a hotel, a point of interest, etc). Companies can be suspicious, since they can also loose customers or visitors, because of increased competition between companies.

3.2. *Tourists and travellers*

The travellers and the co-travellers use the navigation system not only when they travel with a holiday purpose, but also for their other travel activities. However for this product, it is important to examine if a holiday maker or a tourist have specific attributes in comparison to a 'normal' traveller, such as a commuter.

There are distinguished three types of tourist on the basis of information acquisition and communication capability (Kim, Oh & Jayakrishnan, 2006):

- The first type of tourists is those who make their decisions relying only on their own information. Although they try to maximize their utilities, their imperfect information becomes the main reason for achieving lower utility. They may unnecessarily waste their time and lose their opportunities to gain more utility.
- The second type of tourists is those who access one-way information through kiosks. Their levels of knowledge depend upon the availability of kiosks and their willingness in using the systems. Taking advantage of their better knowledge of the tour attractions, they could increase their utility.
- Lastly, the third type is assumed to have real-time information on individual attractions under ubiquitous computing and marketing environment, where they acquire optimal tour schedules by providing their desired tour activities.

One of the purposes of the PND for holiday purposes is to raise the utility of the tourists. When looking to these three types of tourists, this PND tries to put their users in the third class. This means, to give them (if possible) real-time information on their individual attractions and to give them the possibility to maximise their utilities. This distinction also shows that tourists make their decisions on their own information (type 1). Therefore it is important that the information on the PND is considered by the users as their own information.

4. Service design

The ITS concept that is developed, provides holiday makers with all the route and tourist information they need. It affects the travel market. It provides 'extra' information through which the users' knowledge of the situation will grow. This raises the value of travelling, which raises the need of travel.

This chapter proposes the design of a holiday service for two kinds of PND's: one with and one without system functions. First the target group for this service is described (§4.1) followed by the technology that is required for such service (§4.2). Subsequently an outline of the functions that are part of the service is given (§4.3). This system functionality is based on input from the results of the surveys. The definitive service design is presented (§4.4).

4.1. Target group

Tourists or holidaymakers who travel by car are the target groups of this ITS concept. These are private users. They can imagine what information they need about the surroundings of the place (like touristic attractions, road maps, timetables of public transport). The hypothesis is that the target group has a relatively high income, is 25-50 years old and they travel probably not by themselves. Of course the service can be used by groups with other characteristics.

Two groups are distinguished, users with and without a navigation system. At first the concept is aimed at the group with a navigation system. If people already have a navigation system, there is probably an opportunity to implement the new system in the existing device. For new users the package is pre-installed on the new device.

4.2. Information and Communication Technology

For the functioning of a navigation system specific technology is required. Information and communication technology that is necessary for the development of the new concept are:

ICT Components

- Portable navigation system with hard disk for data storage;
- GPS sensors, to receive signals;
- Navigation system holder, to fix the portable device in the car;
- Info display(s) that can be attached in the back of the car, so that the co-travellers can watch the screen also (with reservation: only when a DVD function is integrated in the system);
- Remote control can also be important when (one of) the co-travellers component for the new service (already available by different brands);

Communication technology (network operation)

Mobile communication by RDS-TMC/ FM-radio, GP(R)S

Information (Service management)

Localization, information and locations (like POI's), voices

4.3. System functionality

In this project there are two sorts of functions distinguished: information functions that the system can provide (Information functions, §4.3.1) and functions of the system itself (System functions, §4.3.2). Both are based on the outcome of two questionnaires; a user needs analysis to define the needs of potential users and a stated preference survey to define the willingness to pay for the new service.

4.3.1. Information functions

There are two sorts of navigation system services distinguished based on the outcome of the first questionnaire. First a basic navigation system with general functionality and a holiday system, which is a basic system plus extra functions focused on holiday needs. The classification stems from the user needs analysis (Also the two used levels in the stated preference survey; see appendix D).

Basic system

The basic system includes general functions like information about gas stations, locations of cash machines and different help-options (emergency services or car repair companies). These three functions are the foundation of the basic navigation system, together with the ordinary route guidance.

This classification is based on the results of the user needs analysis, shown in figure 1. In this figure a mean score of 0 means that the users value the usefulness of the particular function neutral. 2 is the maximum score and means that the function is very useful; -2 means that the function is very useless.

The results of that survey are described in more detail in appendix D. It comes into sight that the functions with the highest mean for usefulness are information about gas station and help-options (as well for the 'on trip' as 'at destination' situation). To determine the need of the functions, a combination of the 'on trip' and 'at destination' situation is made. For the functions that are assumed the usefulness at the destination is more taken into account, because the system is used more at destination than on trip. As a consequence, the cash machine function (PIN) is chosen to be part of the basic system. This is because the results indicate that at the holiday destination there is a need for information and location of cash machines. So in general there are differences in user needs for the two situations. Those differences are logical and roughly what was expected.

Regarding to the information functions there is no significance difference between the valuations of subgroups (young - elderly, low - high income, male - female) within the sample.

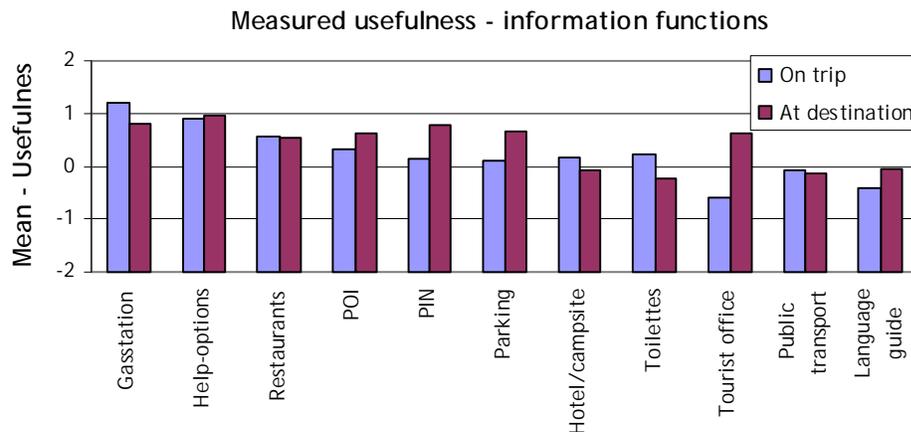


figure 1: Overview of information functions (0 = neutral)

Besides the investigation of the usefulness of the information on the holiday trip and at the holiday destination, it is examined if users will presumably use the holiday PND before they are going on their holiday trip as an information source. The conclusion of this part of the survey is convincing. The respondents do not think that they will use a portable navigation system pre trip to gain information, except for information of hotels/campsites and POI's.

Holiday system

The holiday system is an extended version of the basic system. Special holiday functions as information about POI's, restaurants and tourist offices are added on the basic version.

This choice is made based on the outcome of the user needs analysis, part of it shown in figure 1. The information functions restaurants and POI's have a positive score for the usefulness. The functions 'tourist office' is chosen because of the high usefulness at destination, and because it is typical tourist information, to make the holiday system more complete.

Although for gas stations and help-options there is no difference in subgroups, for the other functions there are interesting differences. The subgroup with high income prefers (after gas stations and help) information about parking, restaurants, POI's and PIN. The subgroup students prefers (after gas stations and help) information about parking, tourist offices and hotels or campsites.

4.3.2. System functions

Besides the information that the navigation system can provide, the electronic system itself can also perform useful functions. These system functions fulfil the so-called 'delight needs' mentioned in appendix C.

In figure 2 a ranking of preferred system functions, based on the user needs analysis, is given. In that user needs survey the respondents had to scale the given system functions for usefulness in three categories: yes, no or perhaps. It is notable that a lot of respondent does not seem to be very interested in system functions like computer games or language courses on a navigation system. The system functions with a convincingly positive value are Mp3 (music), voice recognition and internet access.

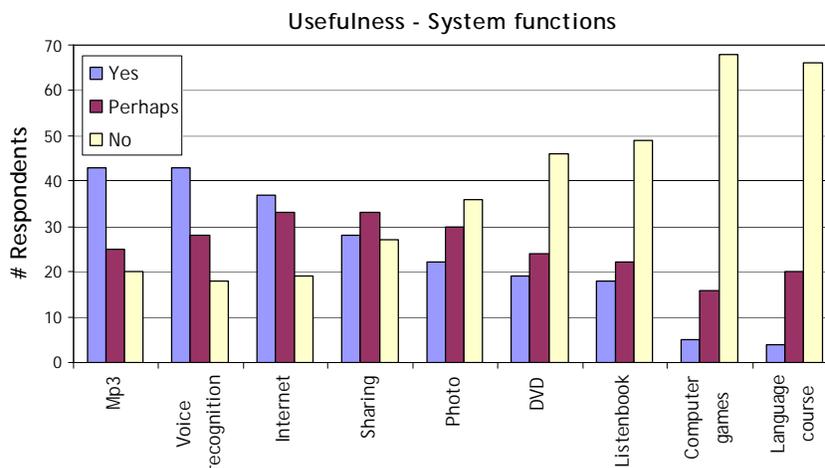


figure 2: Overview of reported usefulness of 9 possible system functions

Those results are also used as input for the second questionnaire, especially for a question about the willingness to pay for a certain combination of system functions. The system functions that are used for this combination are Mp3 and internet access. Voice recognition is not used in it, because it is not innovative due to the fact that it is more and more a standard in navigation systems.

The second survey shows that the average willingness to pay for the combination of Mp3 (music) and internet facilities is about 20 euro (appendix D). This is used in the financial plan that is presented in chapter 5.

4.4. *Final design*

With the gathered information, the service design is specified. The minimum requirement is route guidance. The special holiday edition has to provide, beside the information about gas stations, help-options and cash machines, information about restaurant, points of interest and tourist offices.

Since the need for system functions is not that high, this should be optional for this system. In this way, two different types of PND's for holiday purposes are developed: one with and one without the system functions Mp3 and internet facilities.

The information can be turned off by the user, so he uses the system with his own preferences.

5. Financial and marketing model

Financial and marketing models fit in the framework of business modelling. In this chapter the financial plan is described (§5). This includes information about the chosen business model and the willingness to pay. After that, the marketing plan is proposed (§5.3). But first an introduction to the subject of business models is given.

5.1. Introduction to business models

Business models for ITS-scenarios are mainly about financial aspects and marketing plans. This is part of the implementation of a new ITS. The financial plan can be based on the deployment of the American traveller information number by 511 Deployment Coalition (2002). In this deployment some options are given how money can be earned. The marketing plan can be based on a general model, described on Wikipedia (2007). This model describes the four P's: product, price, promotion and places of selling. In this chapter a financial plan will be worked out and a marketing plan will be presented.

In a broader sense, business models describe more than the implementation of the system. In literature a business model of Zelm, Vernadat and Kosankc (1995) was found. This model describes originally a business case in the computer industry. It can be used in this project cause an ITS is some sort of computer. Other found business models are too general.

The model of Zelm, et al. (1995) describes the following four steps, applies for a PND:

1. Requirements definition: What does the system require, without considering implementation constraints? This is worked out in chapter 4.
2. Design specification: This step is about implementation of the requirements in the system. This is partly done in chapter 4 and falls partly out of scope, since only the conceptual phase is described.
3. Implementation description: Above already is mentioned how this will be worked out in this chapter, in §5 and §5.3.
4. Maintenance model: This is about how service for the product is arranged. This is also out of scope, so it will not be described here.

5.2. Financial plan

Seven business models are described and one is selected as appropriate for this situation. The willingness to pay (WTP) is determined for the navigation system and used as input in the financial plan. Finally the financial cooperation and the cost-benefit analysis are described.

5.2.1. Different models

In 511 Deployment Coalition (2002) six different business models are distinguished. The service of 511 is an ITS: a traveller information number where people gets information about traffic (e.g. congestions, public transport, routing, etc) and tourist information (e.g. points of interest, tourist information, 'where am I', special events, etc). The six models are written from the viewpoint of an ITS service. The seventh model is developed and added by the project team.

These models are:

1. Public Sector Funded Model
2. Subscription Model
3. Pay-Per-Call Model
4. Advertising and Sponsorship Model
5. Loss-Leader or Franchise Model
6. Hybrid Business Models
7. Pay-Once Model

Public Sector Funded Model

In the public sector funded model all financial responsibility is placed on the public sector. The user only pays for the use of data communication. The public sector does all investments and is responsible for maintenance of the system. It is unlikely that the public sector funds the development and deployment of a new navigation system, because it is a luxury product.

Subscription Model

In the subscription model all users are subscribed to the service. They pay a fixed price per month or year. After paying, the user has full and unlimited access to the data.

Pay-Per-Call Model

In the pay-per-call model, users pay per use of the service. In this way, the service provider charges the specific cost of the call. The end user pays through their existing phone service. This model is not relevant, because the system has not the possibility to make a call to update the system.

Advertising and Sponsorship Model

In the advertising and sponsorship model advertisers and sponsors have the ability to place advertisements throughout the service. The benefits of the advertisements cover the costs of the service. The advantage of this model is that users do not pay, so the service can be for free, but the disadvantage is that users are bothered with annoying advertisements. Furthermore, it is possible that advertisements increase the workload of the driver, due to flashing advertisements or annoying sounds, so it decreases traffic safety. It is also possible that the system becomes less reliable since the advertisements can be suggestive. The user may think that the companies with advertisements are preferred by the system over the other companies.

Loss-Leader or Franchise Model

In the loss-leader model the primary service is used at less than the real costs are. The benefits are gained from selling additional services.

Hybrid Business Models

In hybrid models different models are used together. Possible combinations are public sector funded basic service and additional sponsorship and advertising. In this case, the basic service is for free. Short advertisements cover (a part of) the costs of the service.

Pay-Once Model

In the pay-once model users buy the service and get a lifelong update, without additional costs. Advantage of this model is that users only have to pay one time and afterwards can use the service for free. Disadvantage is that it is unsure for the service provider whether he gets his profit or not.

To choose a good business model, information about the willingness to pay (WTP) is needed. In a survey is tried to investigate the difference in WTP when consumers have the possibility to pay a specific amount per year in order to update the navigation system.

5.2.2. Willingness to pay

With the stated preference survey (see appendix D) it was only possible to estimate the relative WTP. For measuring the absolute willingness to pay a much more extended research is needed, with more respondents and more different navigation systems. This means that only the additional costs for a better system are calculated. In particular the willingness to pay for a system with more function is calculated. A basic system gives

information about gas stations, help-options and cash machines. For upgrading to a system which can also give information about points of interest, restaurants and tourist offices, people are willing to pay an additional €60. The additional amount for a higher level of updating is €56.

To get an idea of the absolute willingness to pay, a separate question was used. In this question the respondents were asked what they are willing to pay for an extended system. This system is daily updated for €7.50 per year. On average the respondents are willing to pay €207 (95% between €138 and €275). It is likely that this amount is lower than the real price the respondents are willing to pay.

Also is asked what the respondents are willing to pay for the possibility to listen music and access the internet by their navigation system. On average respondents are willing to pay an additional €21 (95% between €0 and €61). For these functions it is also likely that the real amount is higher.

5.2.3. Recommended model

From the enumeration in §5.2.1 it appears that the subscription and pay-once model are relevant for the designed ITS service. By means of an online survey is investigated which model is most suitable and what users are willing to pay for a navigation system with some specific attributes (system type, purchase price reliability and update price). The survey, with a detailed method description and all its results, is described in appendix B. The main expectation is that users are willing to pay a small amount per year in order to pay a lower purchase price and to get more reliable information by a periodic update.

In the subscription model users have to pay a specific amount per year to keep their system up to date. Therefore the attributes 'system price' and 'update price' are used in the SP survey. The answers of the questionnaire show that users are willing to pay a huge amount for a higher level of updating, even more than the maximum answer possible. The result of the survey is that it is hard to estimate the exact WTP for a subscription model.

For the pay-once model it is easier to estimate the WTP. For this reason, the recommended business model is the pay-once model. The reliability of this model is higher and more accurate, with the outcomes of the stated preference survey.

Chosen business model

A model has to be chosen, considering the advantages and disadvantages of each model. The major advantages of the subscription model are that the purchase price can be lower and that consumers pay for keeping the information up to date. For a pay-once model the major advantages are that customers only pay once for the system and do not have to pay for keeping the system up to date. The purchase price for this possibility is higher. Besides that, the consumer and the company do not have a contract, so there are less administration costs.

Seeing the results of the second survey, it is best to choose the pay-once model. In the second survey no clear results are found for the WTP for a yearly amount for updates or a lower purchase price. Besides that, intuitively it is more likely to pay once and have no more contact with the seller or producer, except for system break downs.

5.2.4. Financial cooperation

For creating a new product, investments have to be made. These investments can be done by one party, for instance the navigation system producer, or by a new firm which is founded by all parties, as a kind of cooperation company.

For the revenues a distribution code has to be created, to avoid discussions about the profit or loss of this product.

In the pay-once model the buyers pay only once an amount for their system. Updating can be done for free, but the companies have to make costs for organising the update possibility. Besides this, some initial investments are necessary to create the new navigation system and to advertise for this system.

In this situation, with a lot of companies involved, it is best to create a new firm. Each company gets his own share of it. In a start-up document all kinds of agreements are listened. In more detail the financial relation are described in appendix B.

The question is which parties need to be the developers of the system. The supplier of the navigation system needs to take the lead. However it is important that other parties also take part in the development, because they have specific knowledge and can therefore give good contributions to the project.

Tourist and travel organisations or travel guide companies possess much knowledge about tourist sector. They have information about (all) tourist companies and activities, but also expertise about the behaviour of tourists. Other arguments why they have to be part of the development team:

- All the three parties have unique knowledge, which for the other parties is hard to get. Therefore cooperation can result in better and faster results.
- The travel guide companies and tourist offices have gathered a lot of information about hotels and points of interest during the years. All this information is combined in one product.
- The complexity of the service.
- There is more money available to invest in the project.
- To make it commercial more successful. All the three parties now have there own market (customers). If this service is going to be a corporate initiative the group of possible customers is larger in comparison to a solitary initiative of one of the parties. Besides this members/customers of one of the parties can get specific discounts as an incentive to buy.
- It is realistic to predict that in the future the markets of these parties are more overlapped. This can result in higher competition between them. However instead of competition, cooperation can be a good option for all three parties to keep or to grow their current share of the market.

There are still some questions to answer. Do both parties (a tourist and travel organisation and a travel guide company) need to be part of the development team? Or can they contribute the same knowledge towards the project? And is it from a commercial point of view more interesting that one of them takes part in the development? Besides this, there can also be legislation problems with the type of cooperation. The question is: are all parties allowed to share, on commercial base, information with the developer of this navigation system, which they receive from other companies.

Other stakeholders do not need to be part of the development team. However it is important that on regular base they take part in the project. This can be done by means of expert's panels, review groups or other forums.

Other important organizations are the traffic researchers, the lawyers, the ICT and the marketing companies. These organizations support the development of the system. The traffic researcher provides the developer with information about user acceptance and user needs. With this information a system can be build, which the user would like to have. For the legacy aspects the lawyer gives the needed information. Which laws and rules are important and how can the system be sufficient to these rules?

With this information the system can be built by the ICT-organizations. The hardware and software has to be developed when it is not build yet. Meanwhile, the marketing process can start. Marketing organizations make a plan how the product can be sold and which promotion is needed.

5.2.5. Cost-benefit analysis

For a successful project the cost-benefit rate has to be positive. To estimate the costs and the benefits information about sale prices, expected numbers of units sold, production costs, development costs and marketing costs is needed. In the second survey only the willingness to pay is investigated. Companies are not willing to give information about investments or revenues, except for the annual reports. This information is not given because of the competition between companies.

To get an idea of the attainability of the product, a cost-benefit analysis is made. Since there is a lack of information, some assumptions are made:

- The cost-benefit analysis is made for additional service of the navigation system. So, not the purchase price is the revenue, but the additional purchase price is the revenue.
- Initial development costs are €5 million, in the first year some adaptations can be made. For this further development €250,000 is expected. In further development this information is obtained from the developer, who defines a budget.
- The marketing for the product costs in the first and second year a bit more than in the other years. Promotion is important and costs a lot of money.
- The number of items sold increases during the year. It is hard to estimate this. TomTom sold, according to the annual report 2006, more than 5 million items. For this reason 100.000 can be possible. When more research is done, these numbers can be updated to more realistic numbers.
- Production costs of the system are estimated to be €30 per item and revenues are €60 per item. The revenue is based on the second survey. In that survey the willingness to pay is defined. It is likely that people are willing to pay €60 more for the additional options. Half of this value is the production cost. More research is needed to sharpen these values, especially the production costs.
- The discount rate is estimated to be 10%.
- Only five years are taken into account. The life time of the system is not expected to be higher. After a couple of years new products are developed, possibly based on this system.

With these assumptions the cost-benefit per year is calculated. In table 1 an overview is given of the first five years of the service.

Cost-benefit (* 1000)						
Year	0	1	2	3	4	5
Investments	€ 5,000	€ 350	€ 100	€ 75	€ 50	€ 50
- Development	€ 5,000	€ 250	€ 0	€ 0	€ 0	€ 0
- Marketing	€ 0	€ 100	€ 100	€ 75	€ 50	€ 50
Items sold	0	15	25	50	75	100
Production costs	€ 0	€ 450	€ 750	€ 1,500	€ 2,250	€ 3,000
Revenues	€ 0	€ 900	€ 1,500	€ 3,000	€ 4,500	€ 6,000
Total	-€ 5,000	€ 100	€ 650	€ 1,425	€ 2,200	€ 2,950

table 1: Overview cost-benefit during 5 years

With the discount rate of 10% it is possible to calculate the net present value (NPV). In table 2 this calculation is made. The NPV is, according to this calculation, positive.

Net present value (* 1000)		
Discount rate	10%	
Year	Total	NPV
0	-€ 5,000	-€ 5,000
1	€ 100	€ 91
2	€ 650	€ 537
3	€ 1,425	€ 1,071
4	€ 2,200	€ 1,503
5	€ 2,950	€ 1,832
Total		€ 33

table 2: Calculation of NPV

Due to the high number of assumptions, the reliability of the cost-benefit analysis is low. Although the NPV is more than 0, it could be much more or less. To gain a better cost-benefit analysis more research is needed.

5.3. Marketing plan

A good idea has to reach the market. A new product has to be promoted and the advantages have to be clear. Before the marketing campaign the producer has to think about who he would like to reach and what he would like to tell to the potential customer. The possible customers are divided in two main groups: those who already are familiar with navigation systems and those who are not. Both groups need a different way of marketing.

Simplifying somewhat, marketing strategies can be seen as the means, or 'game plan', by which marketing objectives are achieved and, in the chosen framework, are generally concerned with the 4 P's: the product, the price, the promotion and the places where the product can be bought (Wikipedia, 2007). Company Consulting Nederland (2007) describes even one more P: personnel. This is about the management plan for the personnel for recruiting employees and coaching and motivating them. This is outside the scope of the project and it is for that reason not further described.

Firstly, the four P's are described, followed by the introduction to the market.

5.3.1. Marketing

Product

This navigation system gives extra information, beside the basic information. According to the first survey, most interest is for the functions that give information about gas stations, help-options and cash machines. Some of these facilities are already present in the current PND's, but these can be extended with extra information about, for instance, actual prices of gasoline.

Beside specific navigation functions a navigation system can also be used for listening music or watching DVD's. As a result of the first survey, the most interesting functions are the use of internet and listening music. In this way people can check their email anytime.

Price

The new system is brought to the market in two ways: as an add-on for existing systems and as a new system, which is fit out with the add-on. The price for a new system is not defined exactly, but it is likely that people are willing to pay about €60 more for a specific holiday navigation system.

More research on this item is needed.

Promotion

Promotion is really important for this new product. As it is a luxury product, it is mainly bought by people with a higher income. The additional holiday functions need good promotion, because people do not know what they miss without it. So it is important to communicate the advantages of this new ITS service towards possible users

One of the advantages of the system is the huge amount of information. Users can choose what they would like to know. The system is especially meant for holiday purposes. All information is available on one system; you do not need maps, you do not need information guides, etcetera. When the product seems to be a success, the given information can be extended, to give a greater value to the system.

The target group of the system is mainly the group of people between 25 and 45, with a more than modal income. They make a lot of holiday trips and have the money to buy the system. If a lot of elderly people, as a result of research, would like to use the system, a special edition can be made with an interface focused on this target group.

For a great success of the system it is necessary that the information is correct and the interface is user friendly and easy to use. The system has to satisfy the traveller. Besides this, the costs should not be too high; otherwise no one would buy it.

In the whole process it is important to be number one with the product. If competitors bring the service to the market before you do, you are behind your competitors.

Places for selling

The system is brought to the market in two different ways. The add-on version is downloadable from the internet, after purchasing it. It is also possible to buy a CD at the travel and tourist shop. This CD can be run at home and set on the navigation system by TomTom Home or something similar.

At a lot of shops it is already possible to buy a navigation system. These shops can also sell the new system. This is either an internet shop or a conventional shop.

5.3.2. Introduction to the market

The introduction of the navigation system can be done in two ways. It is possible to launch the new product in Europe at once or launch it stepwise. Both ways of introduction have their own advantages and disadvantages.

An advantage of a Europe-wide launching of the system is that it is available on the same time on every place. Consumers can look forward to buy the new system. With some computer consoles and PC's this method is used. A disadvantage is that the system can not be adapted to local preferences and needs. With a step-by-step launching it is possible to launch the product in one country, evaluate the working of it and adapt it for next versions of the product. Meanwhile, research can be done to the preferences in other countries where to product is to be launched.

The step-by-step launching is in this case preferable, since the differences between countries are not known. Furthermore, the system is not fully developed yet, so not all development problems are solved. In the risk analysis (chapter 6) the details of this introduction are described.

6. Risk assessment

A lot of risks can influence the proceeding of a project. Also for a new portable navigation device there are a lot of risks possible to occur. Some of them have a higher probability to occur; others have a higher impact on the project. In this chapter the main risks are identified and recommendations are given how to handle them.

The structure used is the RAID-methodology (European Commission, DG XIII-B5, 1999). This is a risk analysis method especially developed for ITS, such as this PND is. RAID gives 15 categories to classify all the areas in ITS where possible risks can occur.

In this method 3 main steps are defined. The first step is the identification of the risks. The second step in the approach is to define the mitigation strategies and in the last step the recommendations are described how to handle these risks. In the last step the mitigation strategies are combined into general recommendations for the project. Therefore only the recommendations are described in this chapter. The mitigations strategies are written down in appendix E.

6.1. Risk identification

For each risk a description is given and possible consequences are described. For each risk the probability of occurrence and the level of impact are scaled on low, medium or high. This results in the scheme given in table 3.

		Level of impact		
		Low	Medium	High
Prob. of occurrence	Low	Blue	Green	Yellow
	Medium	Green	Yellow	Orange
	High	Yellow	Orange	Red

table 3: Cross table impacts and probability

In appendix E more than 50 risks are defined. Below (table 4) the most serious risks, with an orange or red label, are given.

Risk	Description	Consequences	Prob. of occurrence	Level of impact	Scheme
2.4	Overload of information	- Users lose overview - Frustration - Less attention for the other tasks, such as handling the car - System is turned off	Medium	High	Orange
3.6	Demand forecasting risk (under-forecasting)	- Shortage of products - Loss of revenues - Damage in reputation - Damage in relations with distributors and retailers	Medium	High	Orange
5.1	No(t) (enough) funding provision is found	- Delay in development - Without funding the system can not be developed	Medium	High	Orange
7.3	Intellectual property: product already licensed	- Paying other company; - Cancelling or delay of the project	Medium	High	Orange
11.1	No interest from manufacturer (low benefit)	System can not be developed	Medium	High	Orange

Risk	Description	Consequences	Prob. of occurrence	Level of impact	Scheme
13.1	Incorrect information is given (e.g. about hotels)	User does not trust system	Medium	High	Orange
14.1	Users do not buy this system	System will not be used	Medium	High	Orange

table 4: Major risks

The major risks are about the quality of the system (2.4, 7.3, 13.1), the desirability of the system (3.6, 14.1) and the cooperation between stakeholders (5.1, 11.1). Most of the risks originate from a lack of information.

Quality

It is unsure whether the right information is given by the system. Due to a low number of respondents, no good analysis could be done with the results. Most of the respondents are students, with a low income.

Some unanswered questions are: How reliable is the information? How often is the information updated? And who are allowed to update and who not? And when is an update of the information approved and is sent to other users of the system?

Besides this, it is unknown whether another company is already busy with developing this system. In that case, the development is useless, or at least less useful.

Desirability of the system

In the survey mainly the desired functions are investigated. With this information, it is not sure whether enough systems are sold when it is brought to the market. It may be a good indication, but the willingness to pay showed out to be quite low.

Also a comment was made in the survey that it is easier to find information on a desktop PC, with a bigger screen and access to more information.

Cooperation between participants

Due to a lack of information about the main participants, it is difficult to say something for certain about the cooperation. It is unknown whether information providers are willing to cooperate in the development of the system.

Furthermore, the exact development costs and the absolute willingness to pay are uncertain. This results in higher economical risks for the development.

6.2. Mitigation strategies and recommendations

For the seven main risks, mitigations strategies are developed to avoid or control these risks. In appendix E.2 these strategies are described in detail. These mitigation strategies result in recommendations to the project. These recommendations are categorized in extra research, agreements between participants, updates on the information and introduction (marketing) strategy.

Extra research

There is need for extra research in this project in order to reduce the uncertainties in the current research. And if the results of this research are positive, There is extra support for the success of this PND.

On a larger scale research has to be done on the user acceptance and the profitability of the project. This means a larger sample size (at least hundreds instead of tens respondents) and in different countries. Besides this, for the profitability of the project also more research needs to be done about the costs and the benefits of the project.

In order to measure 'real' user acceptance and the effects of using the PND on other driving task (also traffic safety), it is important that a prototype is built and extensive field tests are done with the prototype.

Agreements between participants

It is important that there is clear understanding of the project between the participants. What is the contribution of each participant in the areas such as financial, information (knowledge), man-power and introduction of the PND? What are the costs, benefits and risks of each participant? Agreements need to be written down at the start of the product. Also agreements need to be made about the intellectual property of the product and how to protect it. Awareness needs to be raised and a good protection system towards competitors needs to be developed. Of course a fast development process helps to stay in front of the competitors.

Updates on the information

It is important that there is good policy in the company about how and when to update the information on the system, because the correctness of the information plays an important part in the reliability of this product. For this, three strategies need to be developed. Firstly, the information on the system has to be updated often, because this allows to make adjustments on the information and wrong adjustments are corrected quickly again. Secondly, a control mechanism needs to be developed. The purpose on this strategy is to decide who is allowed to update which information and to prevent wrong adjustments by users. This can be done by using IP-addresses and a black list. Thirdly, the users themselves need to be able to decide what kind of updates they would like to receive. For example, as many updates as possible or only updates which are confirmed by more than 10 other users. In this case, the user himself decides how up to date he would like to receive the information. This last strategy also allowed the producers to give more assurance on the information sent to the customers.

Introduction (marketing) strategy

Because of rapid developments in the market of PND's, it is important that the development time of the product is short and that the product is fast introduced to the market. However a fast development and introduction can result in (major) problems and therefore negative image of the company. Therefore It is better to have a step by step introduction of the new PND. The first step is to introduce it one country (The Netherlands) and to use the feedback on the PND for further development and changes in market introduction strategy. Use this knowledge together with the knowledge about possible cultural difference to introduce the PND in other European countries ('similar' towards the Netherlands), for example, Belgium and Great Britain. After that, introduction can be done in other European countries and in the end on world scale. Of course the introduction strategy depends on other things, such as behaviour of competitors, current market shares in different countries, grow limits (financial, man power and production capacity), etc. The marketing campaign needs to focus on the reasons why the consumers should buy this PND. Make the consumers aware of their need for this kind of PND. Besides this, make the consumers aware that this PND is not only for the driver of the car, but also useful and fun to other occupants of the car. Stress on the personal part of the PND, the user can adjust own preferences on which information to receive and the possibility to share the information with other people (for example, relatives and acquaintances).

7. Conclusions and recommendations

In this research a portable navigation system for holidays is developed. The user needs, the willingness to pay and the financial feasibility are investigated. This chapter contains the conclusions of the research, followed by some discussion (§7.2) and recommendations (§7.3).

7.1. Conclusions

In chapter 2 the main questions are formulated. Below these questions are given.

What is the feasibility of a PND for holiday purposes

1. What are the user needs for a PND for holiday purposes?
2. How does this system come to the market?

What are the user needs for a PND for holiday purposes?

In a user needs survey, 9 information functions and 9 system functions were investigated. All respondents had to answer questions about the usefulness of these functions for before trip, on trip and at destination.

The result of the survey is that from the information functions gas stations and help-options are most preferable, followed by the locations of cash machines, points of interest, restaurants and tourist offices. With this desirability of information functions two system types are developed: a basic system, which only provide useful information about gas stations, help-options and cash machines and a second, more extended, system that is especially focused on holiday purposes. This system provides, beside the basic function, also information about points of interest, restaurants and tourist offices.

Since the need for system functions is not that high, this should be optional for this system. In this way, two different types of holiday PND's are developed: one with and one without the system functions internet access and mp3.

All information can be turned off by the user, so he can use the system with his own preferences.

By a second survey these systems are further investigated on the willingness to pay, in order to answer the second question.

How does this system come to the market?

With a stated preference survey, the willingness to pay (WTP) of the navigation system is investigated. Due to the type of the survey, it was not possible to give an absolute WTP, but only the relative WTP. The WTP for an upgrade to the more extended holiday system is about €60. The respondents could not say whether they would pay for updates. A part of the problem is caused by the number of respondents. About 50 persons filled in the stated preference survey, so the reliability is a bit low. As a conclusion, it is best to choose the pay-once model. This is because no clear results are found for the WTP for updates or a lower purchase price in the second survey. Besides that, intuitively it is more likely to pay once and have no more contact with the seller or producer, except for system break downs. The marketing campaign of the PND has to focus on the usefulness of the system. Since consumers do not know what they miss without the system, the potential users have to gain a lot of positive information about the advantages of the system. Besides that, the marketing has to focus on specific target groups. Not every potential user would like to receive the same information.

The main stakeholders, the navigation systems developer and the information providers, have to form a development team. Both are necessary for the development and deployment. Only when both parties are involved and work together, the project can be a success.

The major risks of the project focus on three items: quality, desirability and cooperation. The quality has to be as high as possible in order to convince potential users. The system has to be reliable and easy to use. These items also increase the desirability of the system. A good cooperation between stakeholders is necessary for the development of the system. When parties work together in the development of the system and the main risks are taken into account, the development of the system will be a success.

The development of the system is feasible, under some restrictions. In the general development of navigation systems, the development of a holiday version is a logical next step. Out of the research can be concluded that there is a willingness to pay for a navigation system for holiday purposes.

For more detailed information about the user needs and the financial feasibility more research is needed.

7.2. Discussion

In this research not all of the research questions are answered fully. This is a consequence of the scope of the project, the way how the research is done and the time factor. It was impossible to do all research at the same detailed level.

With this research it is not possible to say whether the system in the 'real world' would be a success with certainty, due to some assumptions in the scope, the questionnaires and the business model.

Impact of scope

Only Dutch users are surveyed. In countries like Japan the inhabitants have more interest in 'gadgets'. It is likely that the user acceptance of system functions is much higher in Japan, so the system functions are incorporated in the final service design. Therefore the WTP is expected to be higher. So the WTP for a PND with extra system functions is higher and more people would buy such a system. This changes the financial feasibility of the system.

It is unknown whether the system requirements in other countries are the same. In that case the final service design is different, the WTP changes, other risks are expected and also the cooperation strategy may change. No research is done on this item.

Only European holidays were taken into account: These types of holidays can differ from holidays outside Europe. For example: travelling by car in Africa requires other functions in the PND.

First questionnaire

It is not sure whether the acceptance of the functions for the respondents in this research is representative for all users, due to the high representative of young people in the sample. It is even not for certain what the need for such a system is. Need is not the same as acceptance and acceptance is not the same as buying a system. In the survey about 50% are categorized as student, while only 3.5% of the Dutch inhabitants are students. Students mostly do not possess a car and do not spend money on navigation systems. On the other hand, they are the users of the future. The real uncertainty due to this sample is unknown. With the first questionnaire only the usefulness is measured and not the satisfaction. It is unsure how satisfied the respondent are about this PND and how this influences their opinion on buying such a system.

Second questionnaire

Due to the difficult questionnaire and the fact that it was the second invitation for the respondents, fewer respondents filled in the questionnaire. The impact of a smaller sample size is that the reliability and the authority of results are low. Furthermore, since

the sample group consists of mainly students the WTP could be too low. With a representative sample, the willingness to pay is expected to be much higher. The attributes and attribute levels used could be quite suggestive. Are the good attributes and levels used in the stated preference survey and what is the impact when it is not good? Besides this, it is likely that the respondents forgot the holiday situation and just considered the systems.

Business model

It was impossible to define the WTP for updates. As a consequence, the business model is a pay-once model. With a low reliability, a lack of information about investments and possible number of items sold, it was hard to calculate the Net Present Value (NPV). With a lot of assumptions, as realistic as possible, a calculation is made, which turned out to be positive, but the reliability is low.

Quality and content of the information

No research is done to the specific content of the information. Would the users like to receive information about the nearest or the cheapest gas station? For a success of the system, it can be necessary to determine the preferences for attributes, such as distance to travel, travel time and travel costs. However the alternative that the users are able to select their preferences in the system is better.

Bottleneck in the development

A major bottleneck is the cooperation between the major stakeholders. Would the ANWB cooperate in the project? What is the added value for them? Besides that, do ANWB and Lonely Planet (for instance) have conflicting interest when they work together in the development?

It is unknown whether the information providers can freely use the information in the new PND. If this is not possible, the cooperation has to be different and more or other stakeholders should be involved.

Furthermore, it is unknown whether, for instance, hotel owners would like to participate in the development, since they can have their own promotion. Maybe it is a good extra way of promotion, but it can also be that they do not want to participate.

7.3. Recommendations

A lot of research is needed to answer all unanswered questions. This leads to a number of recommendations. The recommendations focus on extra research, participants of the development team and the introduction strategy.

7.3.1. Extra research

In the discussion the imperfectly of the research is mentioned. A number of aspects need to be investigated better and/or more.

User needs

When more respondents answer the surveys about the user needs, the service design can be more detailed and more reliable. For a successful development this is necessary.

Furthermore, the group of respondent should not contain that much students as it did in this research. Students have no money and therefore they are not a representative target group. Beside this, research about user needs has to be done in each larger country in which this PND is introduced in order to adapt the PND to cultural differences. And if the PND is introduced outside Europe, also research needs to be done after the specific characteristics of being on holiday in these parts of the world.

User acceptance

In this research the user acceptance is not totally investigated. With the user needs assessment the useful functions are defined and with the stated preference survey the willingness to pay is defined, but these are not the same as the acceptance. In further research this item should be mentioned, because it answers the questions about market shares and possible numbers of items sold. This information is necessary for a good cost-benefit analysis.

As a part of the user acceptance, research has to be done to the human-machine interface. This research has to include also an operational test. In that test the workload and the satisfaction should be measured.

Willingness to pay

The investigated WTP is only the relative WTP. For a good introduction to the market, the absolute WTP has to be defined, including the WTP for updates. This information is needed for the cost-benefit analysis.

Business model

As mentioned above, a lot of uncertainties are about the cost-benefit analysis. Many variables of the calculation have to be investigated. Besides the cost-benefit analysis, more information is needed on the marketing strategy.

7.3.2. Participants

Clear agreements have to be made between the participants of the development team. These agreements lead to a better cooperation and development of the system. The agreements must contain unambiguous information about the intellectual property.

At this moment, no research is done in the touristic sector. It is unknown whether the information providers would participate in the development of the system.

More research is needed to find whether all participants are necessary, especially the information providers. It may be possible that only one of them is necessary, what will result in more efficient cooperation. In this research also more details of the legal consequences of the cooperation has to be described.

7.3.3. Introduction strategy

The introduction of the system has to be worked out in more detail. In this research the marketing strategy is quite general. In the risk analysis some recommendations are made for a step by step introduction to the market. The system is launched in one country first, before introduction in other European countries.

7.4. Vision on PND's

During this research the awareness grew about the possibility that a Portable Navigation Device can be fully merged into Personal Digital Assistant (PDA). For certain the PDA will become a great competitor of the PND. PDA's are more and more capable for complex applications. Besides that, more and more consumers own a PDA. It is likely that the portable navigation will be integrated in the PDA, especially because route guidance with a PDA is already possible. However the design of the software for a PND doesn't differ very much for the design of it for PDA. Therefore if this expectation is becoming the truth, still this project can be financial feasible. Moreover this can result in higher sales.

One of the respondents of the surveys mentioned that he will not use a navigation system when he has internet access via a laptop or desktop PC, because the screen of a PND is too small, the speed of the system is too slow, etc. The laptops are becoming smaller, faster and lighter to carry. For example the maximum thickness the new MacBook Air of Apple is

only 19 millimetres (minimum 4 millimetres). If this trend continues it is reasonable to ask if the laptop and the PDA are not going to be integrated in each other and becoming one type of product.

The integration of functions can be a necessary step in the development of navigation systems for two reasons. First, the integration of applications in one system is a continuous business. People do not like to take a lot of different systems with them. The second reason is the competition between developers. To be the first in the market, innovation is needed and therefore new applications and functions have to be integrated in one system.

What are the effects of the integration of PND's, PDA's and laptops for the PND developed for holiday purposes? It sounds reasonable that it is not necessary to develop system functions, such as internet access and listening to MP3's on the PND, because when integrated these functions are already present in the system. Already mentioned, the development of the information functions on a PND is still financial feasible, because on PDA's and laptops these functions are not yet (fully) integrated.

Another current development is the use of (or research after) GSM-technology instead of GPS-technology for localisation of cars. For example the cooperation of TomTom and Vodafone in High Definition (HD) traffic project. It is important to take this development into account in order to change from GPS-technology to GSM-technology if GSM turns out to be a more attractive solution.

List of references

Books and reports

- Bierlaire, M. (2003). *BIOGEME: A free package for the estimation of discrete choice models*, Proceedings of the 3rd Swiss Transportation Research Conference, Ascona, Switzerland.
- CODE (1998), Revised User Needs Guidelines (Version 3)
- Donner, E. et al (2004), ADAS: Market Introduction Scenarios and Proper Realisation, *Response 2*
- European Commission, DG XIII (1998), Guidebook for Assessment of Transport Telematics Applications: Updated Version, *Telematics Applications Programme*
- European Commission, DG XIII-B5 (1999), Transport Telematics System Architecture, Constraint analysis, mitigation strategies and recommendations, *Telematics Applications Programme*
- Henscher, D. A., Button, K. J. (2007), *Handbook of Transport Modelling*. Elsevier Amsterdam
- Kim, H., Oh, J., & Jayakrishnan, R. (2006), Agent-based Tour Chaining Model for Advanced Tourist Information and Scheduling Systems, *Paper for the 86th Annual Meeting of the Transportation Research Board, January 2007, Washington, D.C.*
- Kotler, P., Keller, K.L. (2006), *Marketing Management*, 12th edition, Prentice Hall
- Louviere, J.J., Hensher, D.A. & Swait, J.D. (2000), *Stated choice methods: analysis and application*, Cambridge university press, Cambridge, United Kingdom.
- Muizelaar, T. & Arem, B. (2007), *TM_main_report_survey_print.pdf*, University of Twente, the Netherlands
- Zelm, M; Vernadat, F.B. & Kosankc, K (1995), The CIMOSA business modelling process, *Elsevier Computers in Industry 27 (1995)*, pages 123-142
- TomTom (2006), *Driving ahead Annual Report 2006*, Amsterdam

Internet sources

- 511 Deployment Coalition (2002), Deployment Assistance Report #1: Business Models and Cost Considerations, online retrieved on December 6th, 2007 via http://www.its.dot.gov/511/511_Costs.htm
- ANVR (2007), Kerncijfers toerisme & recreatie algemeen, 2007, via http://www.anvr.travel/uploads/publicatie/Rapporten_en_Onderzoeken/NBTC%20Kerncijfers%202007%20A4.pdf
- AT&T (2007), Orthogonal arrays, online retrieved on December 19th, 2007 via <http://www.research.att.com/~njas/oadir/oa.9.4.3.2.txt>

Company Consulting Nederland (2007), online retrieved on December 13th, 2007 via <http://www.companyconsulting.nl/00000195ab0270101/00000195ab0dd8043/index.html>

iSuppli, (2007), online retrieved on December 10th, 2007 via http://www.eetasia.com/ART_8800468554_1034362_NT_4542f584.HTM

NBTC (2007), *Visie op de markt*, 2007, via <http://www.holland.com/corporate/>

Wikipedia (2007), Marketing plan, online retrieved on December 5th 2007, via http://en.wikipedia.org/wiki/Marketing_plan#Marketing_strategies

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Appendix A. Current situation

In order to get an idea of the current prices of PND's a short internet research is done. Besides this, these prices support the estimation of the price levels for the stated preference research. In this appendix more detailed information is given about the current price of navigation systems and the way how add-ons are available for customers.

A.1. Price of navigation systems

Current Practice

A short internet research is done, to get an idea of the current price level of navigation systems. The minimum and maximum prices were stored. There were a number of preferences. The system has to be bought in The Netherlands. It has to be a portable system and it has to cover all Europe (digital card). The website: www.prijsvergelijk.nl is used for this research. The research is done on 10-12-2007.

Price Range:

- TomTom®: €179,- * / €349,- till €739,- *(only West-Europe)
- Nokia®: €302,- till €394,-
- Acer®: €199,- till €365,-
- Vdo® Dayton :€178 till €474,-)
- Lenco®: €169 till €339,- (€169,- is on CD)
- JVC®: €339,- till €529,-
- Pioneer®: €340,- till €449,-
- Viamichelin®: €199,- till €449,-
- Garmin®: €161,- till €999,-

A.2. Current add-ons for navigation systems

Current Practice

A short internet research is done to get an idea of the current price level of the packages. The research focused on the availability of points of interest (POI's). This research is done by using the Dutch websites of the main players on the worldwide navigation market. These are the companies of TomTom, Garmin and Mio(Tech), there market shares are respectively 37, 25 and 20 percent (iSuppli, 2007).

The results:

- J-wire hotspots Europe: €12,95 (1 year subscription) (www.tomtom.com). J-wire uses the technology Wi-Fi to download POI's.
- For the Netherlands (only ANWB-members) for free: fill-up points, beaches, ANWB-shops, ANWB cycling routes, ANWB walking routes and P&R-locations. (www.tomtom.nl)
- Hotspots of KPN and T-mobile for free (www.tomtom.nl)
- Locations of Dunkin' Donuts and Baskin Robbins for free (www.tomtom.nl)
- Garmin POI-loader for free. With the POI-loader you can upload your own points of interest and download other ones. (www.garmin.nl)
- A lot of shareware. For example: <http://www.poiedit.com/> gives the possibility to share for free poi's

The current practice is that a lot of it is shareware. On the internet There is a large community, which members develop software to share points of interest (poi's).

Appendix B. Stakeholder Analyses

B.1. Introduction

This appendix exists of 3 parts. First, an overview is given of stakeholders with their interests and actions. Second, the information exchange between the stakeholders is described. Third, the financial dependencies between the different are described.

The purpose of this appendix is to give an overview of the stakeholders and to give arguments for different kind of cooperation between stakeholders. These arguments are used to support our advice on the type of cooperation to choose.

Overview of the stakeholders

The Converge method (European Commission, DG XIII, 1998) is used to make an overview of the stakeholders, their interests and their actions (see table 5).

Stakeholder	Interest	Actions
The Traveller	<ul style="list-style-type: none"> – Reliable route guidance – To receive a good quality of tourist information – Comfortable driving – Save money – Easier to find the 'perfect' destination to stay or to leisure. – In case of emergency to have the relevant information – Status. 	<ul style="list-style-type: none"> – Decision tot buy or not to buy. – Give response / feedback on the system. – Share information with other users (internet)
The Co-traveller (extra interests beside the interests of traveller)	<ul style="list-style-type: none"> – Entertainment during the travel. – Education during the travel. 	<ul style="list-style-type: none"> – The decision to buy or not to buy the extra system functions/packages – Give response / feedback on the system.
The producer(s) of the navigation system	<ul style="list-style-type: none"> – Make profit – Create new markets – Satisfied users. – Reliability – Liability. 	<ul style="list-style-type: none"> – Research and Development – Cooperation with parties, which are active in the tourist sector. – Marketing – Exclusive cooperation with other stakeholders, such as commercial tourist and travel organizations or travel guide companies.
Commercial Tourist and Travel Organisations. (for example: ANWB and VVV)	<ul style="list-style-type: none"> – A higher level of service to their clients. – To distinguish themselves from possible competitors. – A new market with possibilities for extra profit. – To have influence 	<ul style="list-style-type: none"> – Participate – Share information. – Create awareness by their members. – Put their name on the product

Stakeholder	Interest	Actions
Travel Guide Companies (for example: Lonely Planet)	<ul style="list-style-type: none"> - Make profit - Strategically (Be part of this development. In order to create a future market for their companies). 	<ul style="list-style-type: none"> - Participate - Share information - Put their name (brand) on the product
Government (regional, national and international)	<ul style="list-style-type: none"> - Regional economical development - No more traffic unsafety - Fair competition between the private parties 	<ul style="list-style-type: none"> - To draw up legislation on traffic safety. - Standardization - Enhancement
Other companies in the tourist sector.	<ul style="list-style-type: none"> - Information about the services of their companies is part of the product. - Correct and up to date information - To get more customers (easier to find) 	<ul style="list-style-type: none"> - Share information - Update information - Sponsor the product
Representatives of fuel stations.	<ul style="list-style-type: none"> - Information about the services of their companies is part of the product. - Correct and up to date information - To get more customers (easier to find) 	<ul style="list-style-type: none"> - Share information - Update information - Sponsor the product
Suppliers of ICT components (hardware and software)	<ul style="list-style-type: none"> - Be part of the project (their hardware or software is used) - To increase sales 	<ul style="list-style-type: none"> - Give (online) support - Give discounts
Traffic researchers	<ul style="list-style-type: none"> - To collect information about travel behaviour - A good level of quality of the data. 	<ul style="list-style-type: none"> - Share knowledge - Support the development

table 5: Overview of stakeholders

B.2. Information scheme

In this paragraph the information exchange is described. In the figure below, these exchanges are showed. After that the relations are described in more detail. Describing this, possibilities, remarks and arguments are given for information exchange between the stakeholders.

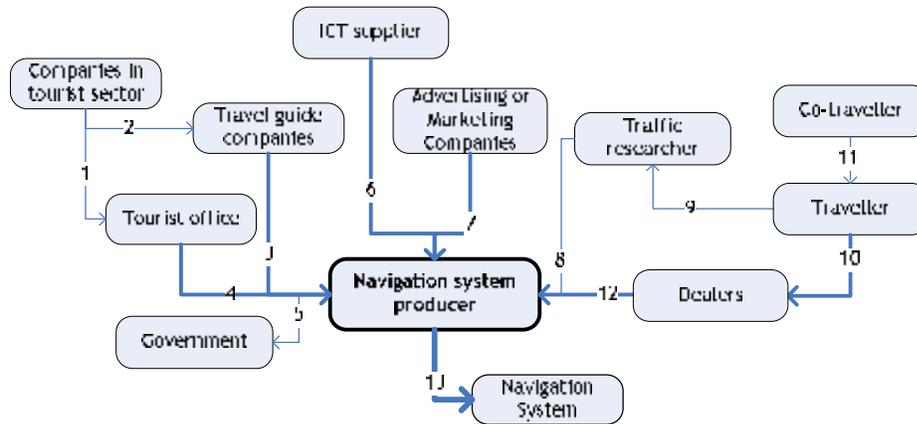


figure 3: Information relations

Relations (numbers refer to the arrows in figure 3):

1. Companies in the tourist sector share information about their services with tourist offices with the purpose to reach the tourist
2. Companies in the tourist sector share information about their services with travel guide companies with the purpose to reach the tourist
3. Travel guide companies have a lot of tourist information at their disposal. Therefore they can be, instead of the entire tourist companies themselves, a good partner in the development of this ITS service. However the question is if they are allowed to share these information with other parties, such as developers of this ITS service
4. Also the tourist and travel organizations can represent the companies in the tourist sector. They also possess most of the tourist information. However the question is still, are they allowed to share this information with other parties, such as the developers of this ITS service.
5. Between the government and navigation system producer there is information exchange in both ways. First, the government draws up the legislation and standardization and needs to enhance them. Second, the producer has to share information about his product to pass control tests, by government organizations. These are compulsory tests.
6. ITC supplier has specific knowledge about the hardware and software for the project. This knowledge is useful to the producer of navigation system. So there is of course need for information sharing between those two companies.
7. The marketing strategy and advertising campaign can be done by the producer himself, but also be contracted out to a specialized company. These companies have the expertise how to make a good marketing strategy or a successful advertising campaign. This expertise can be used during different stages in the development.
8. The traffic researcher can be part of the development team and works for the company, but also an extern adviser towards the project. He has specific knowledge about the effects on the traffic and on the behaviour of the travellers. With this knowledge the ITS service can be more suited to his tasks.
9. The traveller (also the co-traveller) can give feedback of this (test) navigation system towards the traffic researcher. This can be done by a questionnaire or can be measured inside the car.
10. The traveller gives feedback on how the navigation system functions. He also shares information about his wishes of the product with the dealer of it.

11. The co-traveller gives feedback of the features for entertainment and education of the system. This feedback, combined with the feedback on the other functions (traveller), is given towards the dealer of the system.
12. The dealer gives the feedback and the questions of his customers to the producer. Another option is that this feedback is directly given by the customers to the producer. Besides this the dealer gives information about the sales to the producer. This can be combined with feedback about the product from the dealer himself.
13. The producer of the navigation system collects all the information and uses it to make the navigation system.

B.3. Financial relations

In this paragraph the financial relations are described. In the figure below, these relations are shown. After that, these relations are described in more detail. In the descriptions possibilities for financial cooperation are given in combination with arguments therefore.

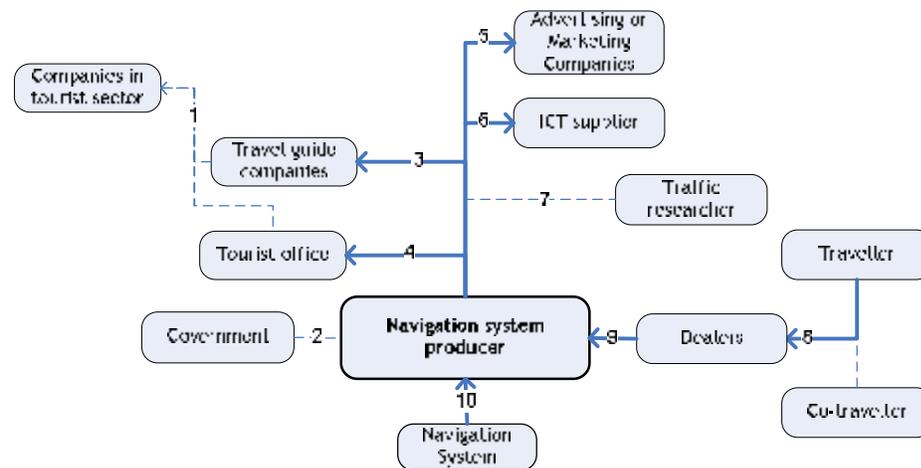


Figure 4: Financial relations

In the scheme the possibility of direct advertising on the navigation system by tourist companies is excluded, because it gives the idea to the users that the information on the system maybe is not complete and that the advertising companies are favoured compared to the other tourist companies. The system can therefore loose too much reliability towards the possible customers.

Relations (numbers refer to the arrows in figure 4):

1. Tourist companies get higher incomes, because of the extra tourists they receive by sharing information with tourist offices and travel guides. Of course negative comments through these companies can result in fewer tourists and therefore lower incomes. Tourist companies are not directly paid for giving information to the tourist offices or travel guide companies.
2. There is a possibility that the government (on regional, on national or on European level) decide to subsidize this project. The reasons for a subsidy can be the expectation that this product results in a higher number of tourists coming to their regions or countries and therefore stimulate the economy. Another reason is that the government stimulates innovation and because this is an innovative product the government decide to give subsidies on the investments. The last reason, mentioned here, is that this product helps to receive government goals on reducing CO2-production or improving traffic safety and therefore the government decide to

- stimulate this project by subsidizing it. Of course the government receives tax-income from the project.
3. There are several possibilities how the travel guide companies can be involved in this project. The first possibility is that they sell their knowledge (information of the tourist sector) to the developers of this product. A second possibility is that they are taking part in the development process and that their brand name(s) is/are used. If they take part in the project than they are responsible for a part of the investment and therefore share in the risks and the profits of the project.
 4. Just as the travel guide companies tourist offices or tourist organisations can share their knowledge to the developers of this product. And if they are allowed they receive payment for it. They also can take part in the development process, especially if they are important players on the tourist market. For example in the Netherlands, the ANWB is important tourist organisation. They have more than 3 million members and therefore cooperation with them opens a big extra sales market. Besides this there brand is strong and the ANWB can be used as a partner, which distributes specific updates of the system. Depending on the kind of chosen cooperation financial flows are there between the producers and the tourist organisations.
 5. Advertising and marketing companies are hired for their expertise in these areas. This can result in a better advertising and marketing campaigns and therefore results in higher sale numbers.
 6. Hardware and (possible software) is bought from suppliers of ICT. Besides this support on hardware or software can contracted out to these companies. This has the advantage that these companies have more technical knowledge and can therefore give better (technical) support. This results in better maintenance and durability of the product.
 7. Traffic researchers are hired for their specific expertise and are paid for this.
 8. The traveller (co-traveller) buys the product.
 9. The product is distributed to the dealers. These are online and offline companies. Different financial structures are possible, depending on agreements, sales or exclusivity
 10. For every navigation system sold, the producers yield profit.

Appendix C. User needs analysis - Questionnaire 1

At the start of the project there was a lack of knowledge about the interests of the potential users. This has led to a first assessment about user needs by a questionnaire. Based on these results the content of the ITS service is designed. This appendix gives a description of the content, sample and main results of the questionnaires.

C.1. General information

The results of this first questionnaire find out which information the user would like to receive using this service. Therefore the respondents are asked which information they prefer on their trip and at their holiday destination, in order to figure out what the difference is between the user needs in these situations. There is also checked whether they should use such information pre-trip. Hereby the differences between subgroups (qua income, age, etc) are examined.

The outcome leads to a classification of the possible information that is provided with this service. It is also the input of the final design of the service and input for the content of the next questionnaire (appendix D). The goal of that second survey is to investigate the WTP of the developed ITS service and the appreciation of four attributes.

The questionnaire is put on the internet in December using the website <http://www.thesistools.com/?qid=39922&ln=ned>. This link was sent to about 150 people. Besides that, the opportunity to make use of visitors of thesistools.com to fill in the questionnaire is seized.

The target group are ideally holidaymakers who drive by car to their European holiday destination, age 25-50 and with a relatively high income (so that they can buy such a luxury good like a navigation system with special functions). Due to the network of the project team, it is hard to find enough people in this specific target group. Together with the knowledge that students are the buyers of the future, it is decided that students are also allowed to fill in the questionnaire, to gain more data.

C.2. Content questionnaire

To achieve all abovementioned goals, there is asked for three sorts of information: general (personal) information, general information about the possession and use of a navigation system and information about the needs of the service with respect to the content. The respondents are asked for the general information at the end of the questionnaire, because that is the least important information¹. The questions are given in (relatively simple) Dutch, to make sure that the respondents understand them.

General (personal) information

The respondents are asked for:

1. Gender
2. Age
3. Income

Possession and use of navigation systems

The respondents are asked:

4. The amount of journeys abroad
5. If they are a navigation system owner
6. How often they use a navigation system

¹ The fact that a man, age 18-25 can cooperate, without any other answers is worthless. Contrary, user needs information without the knowledge whether it is from a man/women, is useable.

User needs - about information functions & system functions

Information functions: The respondents receive a situation, followed by questions: "Suppose, you are going on holiday to a European country by car. You have got a portable navigation system (like TomTom, Garmin, Navman, etcetera.)"

7. To what extent they think that particular information is useful to receive, using a navigation system
 - a. On-trip
 - b. At the holiday destination
 - c. Pre-trip
8. Which other information they like to receive

System functions:

9. Whether they prefer particular system functions in the navigation system itself.
10. Which other system functions they like on their navigation system?

The information and system functions that are put in the user needs analysis in advance are listed below.

Information functions

- Gas stations (incl. actual fuel price)
- 'Help!'-options - route to nearest hospital, police office or garage
- Parking options
- Public transport information
- Hotels and campsite information (price, location, telephone number, facilities - same detail level as campsite guide)
- Restaurants
- Places of interest (POI) - touristic places that are interesting for holidaymakers (incl. price, opening hours, etc)
- Local tourist offices
- Language guide - to look up words in different languages.

System functions

- Mp3 - music listening
- Voice recognition
- Internet access
- Sharing options - to share information with buddies - e.g. POI's, good restaurants
- Photo storage - to empty a storage card of a digital photo camera
- DVD watching
- Listen book
- Computer games
- Language course - to learn a language on the way

C.3. Sample description

In the first survey 99 respondents have answered (a part of) the questions. 90 of them finished the questionnaire. Thus information about gender, age and income is not for all respondents available. The data is cleaned by deleting the respondents that filled in the survey partly. This data cleaning method is chosen so that as many as possible data remains.

Some general information about this sample is shown in table 6: 77.5% of the respondents are male and two third of the respondents are 25 years old or younger².

² This distribution is not surprisingly due to the network of the project team. There is tried to get a representative group to send the link of the questionnaire to older, working people.

Sample - general information

Gender: 89 filled in their gender.

- 69 are male (77.5%)
- 22 are female (22.5%)

Age: 90 filled in their age.

- 62 are between 18 and 25 (68.9%)
- 15 are between 26 and 35 (16.7%)
- 4 are between 36 and 45 (4.4%)
- 6 are between 46 and 55 (6.7%)
- 3 are older than 55 (3.3%).

Income: 73 filled in, 7 filled in 'I do not know', 10 filled in 'I am not willing to answer'

- 37 have an income of 0 - 0.5 times modal (50.7%)
- 6 have an income of 0.5 - 1 times modal (8.2%)
- 16 have an income of 1 - 1.5 times modal (21.9%)
- 5 have an income of 1.5 - 2 times modal (6.8%)
- 9 have an income of more than 2 times modal (12.3%)

Number of trips abroad: 99 filled in the number of trip abroad

- 22 go fewer than once per year abroad (22.2%)
- 44 go once per year abroad (44.4%)
- 24 go once per year abroad (24.2%)
- 2 go once per year abroad (2.0%)
- 7 go fewer than once per year abroad (7.1%)

Navigation system ownership: 99 filled in whether they own a navigation system

- 52 own a navigation system (52.5%)
- 47 does not own a navigation system (47.5%)

Use of navigation system: From those who own a navigation system (52 in total)

- 5 use the navigation system daily (9.6%)
- 12 use the navigation system weekly (23.1%)
- 20 use the navigation system monthly (38.5%)
- 15 use the navigation system rarely (28.8%)

table 6: Sample description

C.4. Results - user needs

The respondents were asked to give the usefulness of a specific function on a 5-points scale. This has led to the classifications in figure 5 and figure 7. It shows the measured usefulness of different functions, as well for information functions as system functions.

First the results of the information functions are shown in §C.4.1, followed by the results of the system functions in §C.4.2. At last the results of the first questionnaire are discussed.

C.4.1. Information functions

In figure 5 the most important results of the user needs analysis are shown. The figure displays the measured usefulness of different functions, as well for 'on trip' and 'at the holiday destination'. Both situations are important by the designing of ITS service, because it will be used on the way to the destination and at the holiday destination itself. Due to that the ranking is based on the average of the 'on trip' and 'at the holiday destination' means of usefulness of the sample. A mean of 0 implies a neutral usefulness; a value of 1 implies that the average respondent thinks that it will be useful; a value of 2 implies that the respondents value the function as very useful. The information functions gas station and help-options score obvious the best on a usefulness scale. They have the highest positive need.

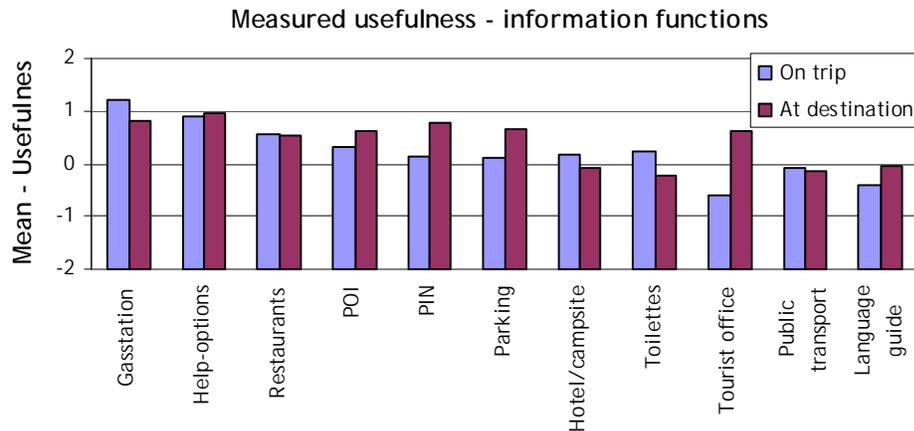


figure 5: Measured usefulness of information functions

Is there a difference between user needs for the situation on the way (on trip) and the situation at the holiday destination (at destination)?

'At destination' the best scoring items are, with the highest user need for it, gas stations and help-options. Other, also good scoring functions are PIN, parking, restaurants, POI and tourist office. The answers are quite clear and they are the same for most subcategories (e.g. high income and low income).

For the 'on trip' the results are not that clear. The best scoring items are gas stations and help-options, like in the 'at destination' situation. For the total sample information about restaurants, POI's and toilets have also a positive user needs, followed by hotel/campsites, pin and parking. However for different subgroups the results differ. For the subgroup with a high income (after gas stations and help) parking, restaurants and POI's score best, followed by hotel/campsites and PIN. For subgroup low income and aged younger than 26 (read: students) (after gas stations and help) the best scoring items are parking and tourist office, followed by hotel/campsite, toilets and restaurant.

So there are differences in user needs for the two situations. At the holiday destination there is a need for information about gas stations, help-options, PIN and parking. On the way there is a need for information about gas stations, help-options, restaurants, POI's and toilets. This is roughly what was expected.

Is there a difference between subgroups?

By analyzing the data there are different subgroups distinguished, men/women, younger/older, navigation system owners/non-owners, high income/low income. For defining significant differences the t-test is used with a confidence level of 95%.

As concluded above, for the 'at destination' situation there is no significant difference between subgroups. These are the main results for on trip information functions:

- Although the navigation system-owners value the functions as less useful (generally, except for on trip information about 'Restaurants'), there is no significant difference found between owners and non-owners
- For on trip information there is no significance difference found between men and women. (Notion: the average women values the help-options, tourist office and language guide as more useful in comparison to men. The average men values only PIN-location information as more useful in comparison to women)
- For on trip information the group of respondents younger than 35 years values the functions lower in terms of usefulness. Notable: the group older then 36 years is not interested in information about public transport, it scores a mean usefulness of -0.9 (-1 = not useful). Besides that, this older group values information about restaurants and POI's significant higher than the younger group.

- Almost the same tendency as by respondents older than 36 years comes into sight when looking at income: the group with a high income (> 1*modal) values information about restaurants and POI's significantly higher than the others. In general the group with an income above modal values the functions as more useful (besides gas station, help-options and not surprisingly: information about PT)

Based on these results there can be concluded that there is only a slight difference in need of information functions on trip between user groups.

Will users presumably use their portable navigation system before they are going on holiday to gather holiday or route information?

The outcome of this part of the survey is shown in figure 6. This question is filled in by 88 respondents. The convincing conclusion of this part of the survey is that respondents do not think that they will use a portable navigation system pre-trip to gain information. They will not use it as an information source in the planning of the holiday trip. Only for the information of hotels/campsites and POI is it presumable that it is used pre-trip.

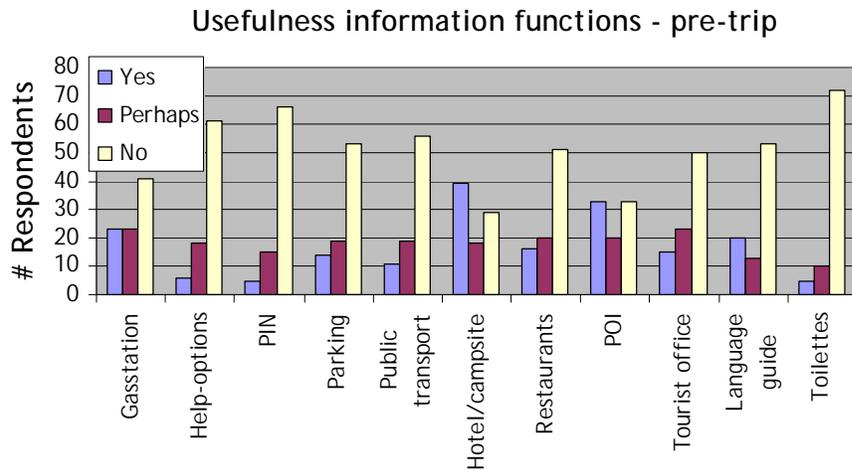


figure 6: Usefulness of information functions before the holiday trip

C.4.2. System functions

What is the need of the users for system functions?

To get an answer on this question the respondents had to scale the given system functions in three categories: yes, no or perhaps. In figure 7 a ranking of the system functions is given. It is notable that a lot of respondent does not seem to be very interested in functions like a language course or the opportunity to listen a book on their navigation system. Other functions like MP3, voice recognition and internet are much more in demand.

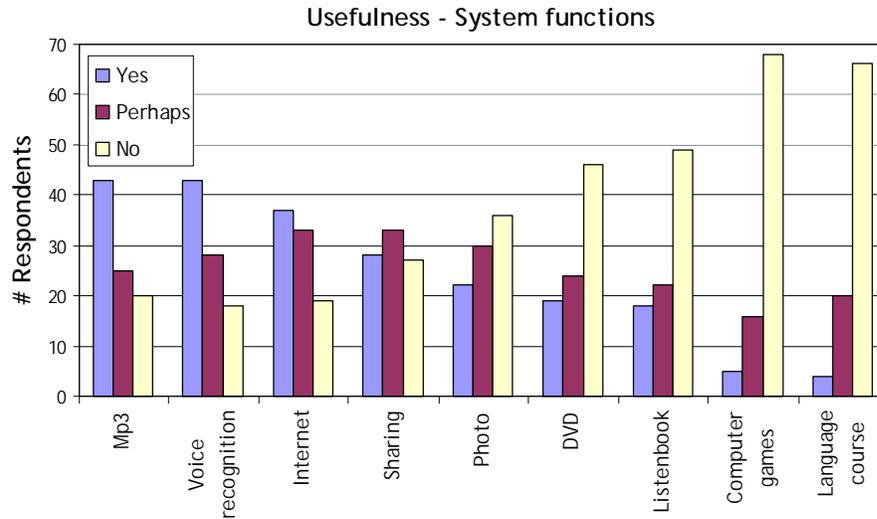


figure 7: Mean usefulness of system functions

The focus is on two subgroups of respondents (young, age 18-25, 61 respondents and elderly, age 26+, 26 respondents) who showed that they have a need for some functions ('yes'-answers in figure 7). The youngest group shows a clear preference for mp3, voice recognition and internet. The elder people however have a preference for respective voice recognition, internet access, sharing options and mp3. Mainly the option to listen mp3-music is valued different.

To make a choice between the functions there is also looked at the people who have a slight positive need for a function ('perhaps'-answers). Than is the combination of for mp3, voice recognition and internet obvious a good choice: relative many respondents aged 26+ are perhaps interested in a mp3-function on the system. These three are the main functions in the service design.

Which functions will be used in the second survey?

In the second survey, the system functions with the highest need are used, except the function voice recognition. This is because this function is more and more available in stand navigation systems. So it is not innovative. Taken along this function will distort the WTP-survey.

C.5. Discussion of results

Unfortunately a couple of respondents mentioned that they hadn't read the on-trip question very good, so that they were a little confused when the holiday question appeared. Luckily the web application of the questionnaire-website could go 'back', so they were able to re-fill the particular question. Due to this confusion the results of the on-trip question are disturbed.

For the second survey, only the functions with the highest score are considered. It is undesirable to use all functions, because it would overload the respondents with information. When the system is developed, it is likely that all functions with a positive usefulness score are implemented in the system.

C.6. Questionnaire 2

To set up the second questionnaire, only the best functions are considered. As mentioned in §C.4.1, the best functions are the help-options, location and information of gas stations and locations of cash machines.

Three high scoring 'holiday' functions are points of interest, restaurants and tourist offices. In an extended system these functions will be added to the basic functions. It is assumed that route guidance is possible on every navigation system.

This result in the following levels for the attribute 'functions':

Level 1: route guidance + 3 functions (gas, help, pin)

Level 2: route guidance + 3 functions (gas, help, pin) + 3 holiday functions (POI, restaurants and tourist office)

The system functions are not taken into account in the stated preference survey. The respondents were later asked in the questionnaire for their willingness to pay for two system functions (internet access and music listening).

Appendix D. Stated preference survey - Questionnaire 2

D.1. Method

There is interest in the willingness to pay (WTP) for this ITS-concept, especially interest in the WTP for the information and system functions. To measure the WTP a stated preference survey is used. In this survey the main attributes are tested on a group of respondents in order to determine their relative importance. Furthermore this results in a relative value of the willingness to pay. To construct this stated preference survey a method existing of three steps is used. This method is described in the 'handbook of transport modelling' (Henscher, D.A., Button, K.J., 2007).

The 3 steps are:

1. Model specification.
2. Experimental design generation.
3. Questionnaire construction.

In the first stage the model and the parameters to be estimated are specified. Therefore a good understanding of the specific choice problem is needed. The analyst needs to determine the number of alternatives, the attributes of each of the alternatives and the attribute levels that are used in this study. In the end the model type used, needs to be described (Type, Utility function, Degrees of freedom, Sampling size, etc)

D.1.1. Specific choice problem

The choice problem exists of two major issues. First, the situation in which the respondents are going to make their choices. Second, the choices they are able to make. It is important to describe the choice situation clearly and in detail. In that way the respondents know and understand the choices they make.

The purpose of this stated preference survey is to define the willingness to pay for a navigation system developed especially for holidays. The willingness to pay is measured relative to the main other attributes. The basis situation and the attributes needs to fulfil the major choices respondents make in practice. In this case the choice situation is realistic towards the respondents. The following situation and attributes are used.

The situation

The respondent is for two weeks on a holiday in Europe. He travels by car with one or more passengers. He is not familiar with the route towards his holiday destination. On his holiday he would like to make some trips in the region.

They have a basic navigation system at their disposal. This system can navigate and has information about the location of gas stations and cash machines. This information cannot be updated.

The main attributes tested are: Type of system, system price, update price and the reliability of the information. These attributes and their levels are discussed in detail later in this chapter (see §D.1.2)

This research focuses on adults with an income higher than 30.000 euro. However, due to the short time for this research and the large sample size needed, every adult (also students) can participate in this research. Besides this, the family status of the respondent is important, because there is an expectation that the choices of a family with children significantly differs from the other respondents without children.

D.1.2. Attributes

For the stated preference survey, seven attributes are defined and described. The attributes are more or less strongly related with each other. Strong relations are there between system type and system price or the reliability of the information and the update price. It is important that the survey is not too long and the choices are not too complex for the respondents. Therefore not all the six attributes are used in the survey. In our opinion the four most relevant are chosen. The finally used attributes are the system type, the system price, the reliability of the information and the update price.

Here below the attributes are described in more detail. First, the 4 attributes used in the survey are described. Second the 3 attributes not used in the survey are described.

System Type

This attribute has two levels. There is a basic system and an extended system. The basic and the extended system are based on the outcomes of the first questionnaire. Out of this survey, the 3 best information functions form the basic system and the extended system has 3 more functions.

1. Basis system. This is standard navigation system with 3 information functions. These functions give information about and the location of fuel stations and cash machines. Besides this the system gives information about emergency services (telephone numbers, routes, etc).
2. Extended System. The extended system is the basic system with some other extra information functions. It gives information about the location and opening hours of Points of Interests (POI's), restaurants and tourist offices

System price

This attribute determines the price customers pay to purchase the system. There are 3 levels. The levels are based on current prices for navigation systems. For a short overview of the current prices, see appendix A.

These price levels are:

- €175,-
- €250,-
- €325,-

The highest price is €325,-. This is realistic, because for all brands it is possible to buy a navigation system, which supports the preferences.

Reliability of the information

This attribute defines the reliability of the information. The question towards the users is: "How reliable has to be the information on the navigation system?" In this research there are three options. The first option is that it is impossible to update the service. The second option is that at the start of the holiday season all information will be updated. This is twice a year (summer and winter season). The third option is that information is kind of 'real time'. On a daily base all information is updated and the users can also download this information on a daily base. The corresponding levels are 0, 1 and 2.

Update price

The update price is linked with the reliability of the information. If the information cannot be updated, than of course the update price is 0 euro. There are 3 levels. To determine the values a short study is made of the current practise. This is already described in appendix A. In general users of navigation system do not pay very often for updates. Mostly, it is shareware or the users pay a small amount of money for a yearly subscription.

Besides this it is hard to have people pay for a service if they can get it elsewhere for free. Therefore in the stated preference research low prices are used for this kind of services.

The prices are:

- for free
- for €7.50 (on yearly base)
- for €15,- (on yearly base)

Package or a new system

This attribute defines if the users can buy a package for their current navigation system or that they have to buy a new navigation system for this service. First option is that they can buy a package with which they can update their navigation system. The second option is that they have to buy a new system.

The update method

This attribute defines the way the service is going to be updated. The update method is also connected with other attributes, such as update price, system type and payment method. The first option is that the service cannot be updated. The second option is that the service can be updated by taking the system out of the car, putting it in a docking station and connect it to the PC/laptop. And then uses the internet or DVD/CD to update the system. The third option is that the system can be updated inside the car (wireless connected to the internet). This last option needs an internet connection, which creates other functions.

The payment method

This attribute defines the way the users are going to pay for this service. The payment method is connected with the attributes: system price, update price and update method. The user can pay the system in an ordinary way, via shops or online. Besides a credit card, users can also use payment methods, such as IDEAL to pay online. If the service is going to be a service that needs regular payment in order to receive updates, payments with a credit card or by mobile phone are the standard options.

D.1.3. Socio-demographic variables

The socio-demographic variables are used to compare the results of the respondents. These can explain the differences in the outcomes of the survey. Besides this, with the socio-demographic variables the target group is picked out. The target group are respondents which have an income higher than average and are between 26 and 45 years old. The expectation is that this group are more interested in this navigation system than the other groups.

However a large sample size is needed to determine significant difference between the groups. Looking to comparative research, sample sizes of at least 500 respondents are needed for reliable outcomes. These numbers of respondents are not realistic for this research. This means that for most of socio-demographic variables comparing is not possible and that the reliability of the conclusions is low.

The socio-demographic variables used in this research are: gender, age, income, type of household and possession of a navigation system.

Three types of households are selected. There is a distinction made between students and not-students, because the expectation is that students are overrepresented in this research. And therefore it is important to be able to separate them. And there is a distinction made between households with kids and households without kids, because the expectation is that due to different life styles these two groups distinct from each other with their opinion on this navigation system for holidays.

D.1.4. Model type

Multi Nominal Logit Model

To estimate the relative willingness to pay between the attributes a Multi Nominal Logit Model is used (MNL-model). The program Biogeme (Bierlaire, 2003) is used to estimate this MNL-model. The estimation is done by maximum likelihood. The MNL-model is a discrete choice model and it is based on the idea that travellers would like to maximize their utility, when making choices. The utility function hereby used is (equation 1):

$$V_{in} = b_{0i} + b_{i1}x_{1in} + b_{i2}x_{2in} + b_{i3}x_{3in} + b_{i4}x_{4in}$$

equation 1: Utility function

V_{in} = Systematic utility for alternative i and individual n.

B_{i0} = Alternative specific constant

B_{ki} = Coefficient (attributes)

x_{kin} = Attributes

The alternative-specific constant represents the net influence of all unobserved, or not explicitly included, characteristics of the individual(s) or the option(s) in its utility function.

With Biogeme the coefficients of the attributes are calculated and their statistical significance. Biogeme determines the adjusted ρ^2 . The adjusted ρ^2 indicates if the model fits the data. If the values of adjusted ρ^2 are between 0.2 and 0.4, the model is indicated to have a very good fit (Louviere et al., 2000), which makes the model reliable.

In Biogeme 4 utility functions are made, because Biogeme cannot cope with 1 utility function. The Beta's in these functions are the same, but the alternative specific constant can vary due to randomness.

Below (equation 2) these functions are presented.

$$ALT1 = ASC1 + b_1 * SL_1 + b_2 * PP_1 + b_3 * NU_1 + b_4 * UP_1$$

$$ALT2 = ASC2 + b_1 * SL_2 + b_2 * PP_2 + b_3 * NU_2 + b_4 * UP_2$$

$$ALT3 = ASC3 + b_1 * SL_3 + b_2 * PP_3 + b_3 * NU_3 + b_4 * UP_3$$

$$ALT4 = ASC4 + b_1 * SL_4 + b_2 * PP_4 + b_3 * NU_4 + b_4 * UP_4$$

equation 2: Utility functions used in Biogeme

With these functions it is expectable that B1 and B3 are positive and B2 and B4 are negative. The system type and reliability are linear with the utility and the costs give an inverse linear with the utility.

The alternative specific constants are variable. It is expected that they are about to be 0, since there is no difference between the utility functions. The difference from 0 is caused by randomness.

D.1.5. The stated preference questions

At this phase it is important to determine the minimum amount of questions needed to estimate the relative willingness to pay (the Beta's). For this the degrees of freedom are calculated. The minimum amount of questions equals the degrees of freedom. In equation 3 the degrees of freedom are calculated.

$$\text{Degrees of Freedom} = (L - 1) * M * A + 1$$

equation 3: Degrees of Freedom

L = The number of attribute levels (3),

M = The number of alternatives (1),

A = The number of attributes (4).

There are maximally 3 attribute levels. The attribute system type has only 2 levels. There is one alternative (there are 4 used, because of Biogeme. However in practise there is only one). There are 4 attributes. This results in 9 degrees of freedom. Therefore 9 questions are needed.

The different levels of attributes have to be distributed in these 9 questions. For this the method of Optimal Orthogonal Choice (OOC) is used. *“The method is designed to maximize the difference between the attribute levels of the design across alternatives and hence maximize the information obtained from respondents in making choices obtained from that design.”* (Henscher, D.A., Button, K.J., 2007)

An orthogonal array from the internet is used here for (AT&T, 2007). Because attribute system level only contains 2 levels, some adjustments are made on the array. Each option is moved two places in order to create different options in one question. With this array all questions are made. In table 7 this array is presented.

Q = question

ST = System Type

SP = System Price

RI = Reliability of the Information

UP = Update Price

Q	ST	SP	RI	UP												
1	0	175	0	0	0	325	2	7.5	1	250	2	0	1	175	2	15
2	0	250	1	15	1	175	1	7.5	1	325	0	0	0	250	0	0
3	0	325	2	7.5	1	250	2	0	0	175	2	15	1	325	1	0
4	1	175	1	7.5	1	325	0	0	1	250	0	0	0	175	0	0
5	1	250	2	0	1	175	2	15	0	325	1	0	0	250	1	15
6	1	325	0	0	0	250	0	0	0	175	0	0	0	325	2	7.5
7	0	175	2	15	1	325	1	0	0	250	1	15	1	175	1	7.5
8	1	250	0	0	0	175	0	0	0	325	2	7.5	1	250	2	0
9	0	325	1	0	0	250	1	15	1	175	1	7.5	1	325	0	0

table 7: Question array

D.2. The questionnaire

D.2.1. The content

The questionnaire exists of three groups of questions.

The first group are the stated preference questions. These are already described in paragraph before.

The second group exists of two questions. The first question is a question, where the respondents get a description of navigation system for a holiday and they are asked: “How much would you pay for this system?” The purpose of this question is to determine an alternative value for the willingness to pay.

Suppose: You see a navigation system, which gives information on fuel stations, cash machines, emergency services, restaurants, points of interest and parking garages. The system can be updated on a daily base and this service costs €7.50 each year.

How much would you pay for it?

- €150
- €200

- €250
- €300
- €350
- Otherwise, namely ...

The second question is to determine the extra money respondents would like to pay for navigation system, which also can be used to play music or to go on the internet. If a respondent fills 20 euro or less, this is understood that he or she doesn't like to have this opportunity.

How much would you like to pay extra for the opportunity to listen to music or go on the internet with your navigation system?

- €0
- €20
- €40
- €60
- €80
- €100 or more

The third group are questions to determine the socio-demographic variables of the respondents. The socio-demographic variables asked for are already described in paragraph D.1.3. These questions are asked at the end, because they are less important in comparison to the other questions. The respondents have the option to not answer this part of the survey

D.3. The outcome

D.3.1. Sample description

In total 67 people started the questionnaire, but only 53 gave useful answers and finished the questionnaire. The data for 14 respondents is deleted, because of the reliability of the information. These 14 people answered only one question or answered all questions with the same answer. The outcomes of these respondents disturb the outcomes.

In total these 53 persons filled in 470 stated preference questions, only 7 were left blank; possibly the respondent forget to answer the question or thought the gave an answer. 3 persons did not give 2 answers and 1 did not give 1 answer. These specific questions are deleted in order to clean up the data for Biogeme.

In 5 stated preference question (questions 2, 4, 7, 8 and 9) 1 option scored more than 70%. In question 3, 5 and 6 scored 1 option more than 50%.

It is likely that the real willingness to pay (WTP) in the questions in which the respondents had to give a price for a given system, is higher. In is not sure how much the difference is between the real value and the given value.

Of the respondents of the questionnaire 79% of the respondent is male, 21% is female and 58% of the respondents is student.

D.3.2. Results

The results of the questionnaire are split in two parts. First part is the Biogeme analysis and the second part is the analysis of the other data.

Biogeme

In Biogeme the output is created. The adjusted ρ^2 has a value of 0.392, a good value. This indicates that the results are acceptable.

Biogeme has estimated the values of the betas. Below the values of the betas are given:

Beta	Attribute	Value
B1	System Level	1.10
B2	Purchase price	-0.0182
B3	Number of updates	1.02
B4	Price of update	-0.0577

All betas score good at the t-test. Also, as expected, B1 and B3 are positive and B2 and B4 are negative.

Biogeme analysis

The survey has to answer some questions about the willingness to pay (WTP). With this discrete choice survey it is only possible to find the relative WTP.

The questions to be answered are:

1. What is the relative WTP in purchase price for the system level?
2. What is the relative WTP in purchase price for increasing a level of updates?
3. What is the relative WTP in update price for increasing a level of updates?

The relative WTP is found by dividing the different betas.

The first question results in a WTP of €60.44. This means that if someone would like to have an extended navigation system, instead of a basic system, he pays about €60 extra.

The second question results in a WTP of €56.04. This means that if someone would like to have a higher level for updating his system he pays about €56 extra per level when purchasing the system.

Question 3 results in a strange answer. The relative WTP would be €17.68, more than the maximum level asked in the questionnaire. Further research in the value of B4 shows that B4 has a high correlation with the other betas, varying from 0.41 till 0.55. This can be one reason for this strange result.

Another reason might be the difficulty of the question. It can be hard to imagine what you would like to pay yearly for updating a navigation system. This can lead to uncertainties in the answers.

Analysis of the other data

- Average price for an extended system, daily updated for €7.50 per year is €206, 95% between €138 and €275
- Average price for extra functions internet and music is €21, 95% between €0 and €61
- The difference in WTP is not very big between students and non-students. For the system the willingness to pay both about €206, and for the additional functions €21.
- The difference in WTP between higher income (>0.5 modal) and lower income (<0.5 modal) is €215 versus €200. For the additional functions this is €21 for the higher incomes and €23 for the lower incomes.
- The difference in WTP between young and elderly people is €208 versus €204. For the additional functions this is €23 versus €17.
- The difference in WTP between men and women is €209 versus €200. For the additional functions this is €21 for men and €22 for women.

Only the averages are calculated, because the number of respondents is too low. Only 53 respondents finished the questionnaire, so statistical analysis is not reliable. For this reason no different datasets are made for Biogeme.

D.4. System types

With the gathered information, different types of systems are possible. In three choice steps a consumer can select his favourite system. The first choice is the choice between a basic system and an extended system. The extended system costs €60 more.

The second choice is about the system functions. If a consumer would like to have those, he pays an additional €20. The third and last choice is about the level of reliability. As a result of the survey, consumers have to pay €56 for an extra level. With three levels, it is possible to pay an additional amount of €56 or €112. Level 0 means that there is not possibility to update the system information, level 1 means that updating is possible twice a year. Level 2 means that updating is daily possible.

In figure 8 an overview of the possible systems is given. The additional costs of the systems are the costs for the extensions.

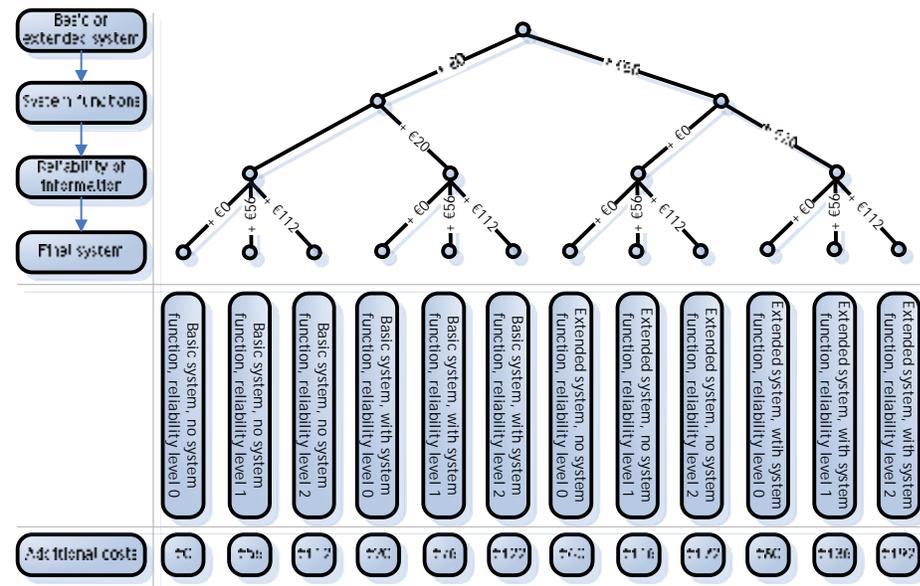


figure 8: Possible systems

Appendix E. Risk Analysis for ITS Development

The risk analysis is based on RAID method. First, the risks are described in short in a table with some explanation below it. After that follow the mitigation strategies.

E.1. Risks

This paragraph describes the threats that may occur within the deployment scenario. The threats are given, together with their consequences. They are categorized in the RAID categories. The probability of occurrence and level of impact are also estimated. Those parameters together are related to a certain risk rating, which varies from a high probability of occurrence with high level of impact (high risk, red) to low probability of occurrence with low level of impact (low risk, blue) and everything between.

1 Framework architecture					
	Threat description	Threat consequences	Prob. of occurrence	Level of impact	Risk scheme
1.1	Add-on, extra service does not fit in architecture	- Lack of harmonisation causes delays in the deployment - Service has to be changed to fit in architecture	Low	Medium	Green
1.2	Current systems does not support add-on	- Complete new system must be developed - User has to buy new system, if he likes the extra service	Low	Medium	Green

1.1 If there is a misfit between the new service and the system architecture, it can cause delay in the deployment of the service. Different stakeholders will probably expect and/or require that the new service will fit in the architecture, e.g. to match with other systems.

1.2 If the current navigation systems do not support this kind of add-ons, than There is no need to develop an add-on. Current navigation system users have to pay again the full price for a new navigation system. Therefore fewer users are going to chance over to this system. Maybe therefore less income is guaranteed. Besides this, the development costs for this service can be higher than expected, because current technology is not suitable.

2 Communication					
	Threat description	Threat consequences	Prob. of occurrence	Level of impact	Risk scheme
2.1	Different way of communication between service provider and info provider	Errors in communication	Low	Medium	Green
2.2	Navigation system does not receive GPS signal	System (temporarily) not useful	Medium	Low	Green
2.3	GPS is not available	System not useful	Low	High	Yellow

2 Communication					
2.4	Overload of information	<ul style="list-style-type: none"> - Users lose view - Frustration - Less attention for the other tasks, such as handling the car → decreased safety - System will be turned off 	Medium	High	Orange
2.5	Extra information hampers route guidance info	<ul style="list-style-type: none"> - Frustration - Longer Travel times 	Low	Medium	Green

2.1 Because the service and information providers (like ANWB, navigation system provider) use different standards, a risk of different ways of communication exists. This may lead to errors in the communication. The probability of occurrence is low, because the stakeholders will make a compromise to use the same standards.

2.2 Because of different reasons the system does not receive a GPS signal. These reasons can be: starting up, too few satellites available, driving in tunnel or driving in a street surrounded with high buildings. This unavailability is mostly for a short time period, therefore the impact is low.

2.3 GPS is managed by the American army. From strategical point of view GPS could be unavailable for certain time periods in certain areas. Or the quality of the signal can be much lower. Effects can be high. However this can change if there are alternatives for GPS on the market, for example Galileo.

2.4 Because of receiving too much information, the driver cannot handle this information correctly. This can result in frustration, more unsafe driving or turning the system of.

2.5 The extra information can hamper the route guidance. Users can therefore miss indications of the route guidance and this leads to frustration and longer travel times. The probability of occurrence will be low, because route guidance is given more than once and not only by using the display.

3 Cost-benefit					
	Threat description	Threat consequences	Prob. of occurrence	Level of impact	Risk scheme
3.1	Economical recession	- Fewer products sold	Medium	Medium	Yellow
3.2	Sale price is too high	<ul style="list-style-type: none"> - Fewer products sold. - Less profit 	Medium	Medium	Yellow
3.3	Low returns on the investment	<ul style="list-style-type: none"> - No investor will be found - Delay of the project 	Low	High	Yellow
3.4	Low benefit for stakeholders	<ul style="list-style-type: none"> - Stakeholders loose interest. - Quality decreases - Cancelling of the project 	Medium	Medium	Yellow
3.5	Demand forecasting risk (over-forecasting)	<ul style="list-style-type: none"> - Pricing pressure → loss of revenues - Increase in finished goods inventory and net working capital. 	Medium	Medium	Yellow

3 Cost-benefit					
3.6	Demand forecasting risk (under-forecasting)	- Shortage of products - Loss of revenues - Damage in reputation - Damage in relations with distributors and retailers	Medium	High	Orange
3.7	Saturated market	- Less grow - Less profit	Low	Medium	Green
3.8	Insolvency of distributors and retailers	- Financial losses	Low	Low	Blue

3.1 The European economy can come into a recession. Because this is a luxury product and therefore it is more sensitive for effects on the economy. Possible users have less money to spend and will save more on holiday products.

3.2 The willingness to pay of the possible customers is overestimated. If the margin between the costs and the sale price is small, than the sale price cannot be adjusted. This can result in serious financial losses.

3.3 If this is the case the chance is high that no investors are found and that the project will come to an end. Because investing money in other projects is more interesting. Only if It is certain that there is a return on the investments, than the chance for investor is higher.

3.4 If the benefits for other stakeholders, which are part of the development team, is low. They will loose interest and are less willing to invest time or money in the project. Therefore the project can be delayed and the quality of the product can decrease. In the end the project can be cancelled. However the impact is only medium, because with a new stakeholder or with new negotiations this problem can be solved.

3.5 Adequate demand forecasting is a difficult business. If the demand is over-forecasted, this results in higher stock-rates. Therefore higher costs and more capital is needed. Beside due to price pressure this can result in lower prices.

3.6 If the demand is under-forecasted the impacts can be higher in comparison to over-forecasting, because of the large damage done to the imago of the company and the risk on quality loss due to rapidly increasing the production capacity. In the end competitors can profit from and the company looses market share.

3.7 The navigation system market is nowadays a booming market. There will be a moment that this market is saturated. However the penetration rate of navigation systems nowadays is not high enough to expect this for the coming years. Beside this the quality of navigation systems is still improving, therefore users are willing to buy new and better navigation systems.

3.8 If distributors are not able to pay for their debts, they can go into bankruptcy and this can result in financial losses. However, if There is a good control procedure on giving credits to customers the probability of occurrence is low. Beside this, there are insurances available, which can cover this threat.

4 Deployment and operation					
	Threat description	Threat consequences	Prob. of occurrence	Level of impact	Risk scheme
4.1	Incomplete data and not all options are given	- Reliability of the system is low; - System is not widely used	Medium	Medium	Yellow
4.2	In case of updating by users: mistaken update	- Reliability of the system is low; - System is not widely used	Low	Medium	Green
4.3	Competitor launches similar product first	Behind competitors	Medium	Medium	Yellow

4.1 There is a risk that the used data (location of hospital, opening hours of POI, telephone numbers, parking options, etcetera) are incomplete. Because of that, not all options are giving by the service. Especially in case of help-options this can be a problem. This results in a lower reliability of the service, and probably the service will be turned off by the consumers.

4.2 Updates must be correctly be interpreted by the system. In this way the reliability remains high and the system is used.

4.3 With a new idea you have to be the first in the market. Otherwise, you loose profit to competitors. If the competitor is a small company, it may be possible to buy the other company, to get the knowledge into your own company.

5 Funding provision					
	Threat description	Threat consequences	Prob. of occurrence	Level of impact	Risk scheme
5.1	No(t) (enough) funding provision is found	- Delay in development - Without funding the system can not be developed	Medium	High	Orange
5.2	User does not want to pay for service or update	- Other stakeholders have to invest - System is not sold	High	Low	Yellow
5.3	Wrong WTP assessment	- Not a correct selling price	Medium	High	Orange
5.4	Interest rate expands	- Negotiate a loan for investments is very unattractive; - Only wealthy stakeholders invest	Low	Medium	Green

5.1 A project like this needs funding. Until enough funding is found, the service can not be brought into market. Beside that, insecure funding can delay the development.

5.2 It is practically sure that the end user would not like to pay for the updates, through which other stakeholders have to invest in deployment of this service. Because other investors will be found, the level of impact of a user that will not pay is low.

5.3 Due to the little sample in the stated preference survey, the willingness to pay is not measured as reliable as it can be.

5.4 If investments are made with the money of someone else, interest rate has to be paid. As a consequence, it is more difficult to find investors.

6 ITS infrastructure					
	Threat description	Threat consequences	Prob. of occurrence	Level of impact	Risk scheme
6.1	Other data transmission turns out to be more favourable than (the chosen) GPS	- No solid basis of the system	Low	Medium	Green
6.2	System is not compatible with GALILEO	- Lower reliability of position	Low	Low	Blue

6.1 When it turns out to be that another communication system like GSM is more attractive in comparison with the chosen GPS, the structure of the system is not solid. On longer term, it is possible that GPS stops.

6.2 With the upcoming of GALILEO, it is preferable that the system is compatible with this positioning system.

7 Legacy					
	Threat description	Threat consequences	Prob. of occurrence	Level of impact	Risk scheme
7.1	No complete legislation for system	System can not come to the market	Low	High	Yellow
7.2	Erroneous data	Claims (in case of hospital)	Low	Medium	Green
7.3	Intellectual property: product already licensed	- Paying other company; - Cancelling the project	Medium	High	Orange
7.4	Intellectual property: own product badly licensed	Competitors will imitate product	Medium	Medium	Yellow
7.5	Intellectual property: project knowledge used for other purposes	- Knowledge to competitors	Low	Medium	Green
7.6	Integrated systems in cars will be prohibited	Product can not be put on the market	Low	High	Yellow

7.1 There is a chance that some parts of the service are not legislated, or the legislation is delayed. The first results in the cancelling of the deployment of this service; the second delays the deployment.

7.2 Wrong data can be (literally) fatal. When people are looking for a hospital, they are in a hurry and information has to be correct.

7.3 When a product is already licensed, the development cost raise enormously. In worst case, the project have to be cancelled.

7.4 Licensing is an important issue. The product can be copied by someone else, so you lose profit. Good licensing is really difficult.

7.5 The knowledge that parties gain in the project do not have to be used for other purposes. Otherwise the knowledge can come to a competitor. How more parties are involved, the greater the risk.

7.6 By distraction of a system, traffic safety can decrease. When a lot of accidents happen, as a consequence of the system, the system can be prohibited by the government.

8	Politics				
	Threat description	Threat consequences	Prob. of occurrence	Level of impact	Risk scheme
8.1	Subsidy loss	- Loss of profit	Low	Low	Blue
8.2	Political problems in supplier's country	- Delays in development - Other suppliers have to be found	Medium	Medium	Yellow

8.1 The government should be convinced to participate in and stimulate the development of the system. When government is against the development, no investments by the government are made. This can slow down the process or even terminates it.

8.2 Due to political problem in supplier's countries, it can be hard to get hardware or software on time. In the worst case new suppliers has to be found, to guarantee the development.

9	Privacy				
	Threat description	Threat consequences	Prob. of occurrence	Level of impact	Risk scheme
9.1	Misuse of personal data (info about (behavioural) choices)	- Apprehension 'Big brother is watching'; - Service will be turned off; - Damage in reputation	Low	High	Yellow

9.1 The society is afraid of misuse of personal data. If there is a slight suspect of misuse of the data, the apprehension of a so called 'Big brother is watching' will raise. A possible consequence is turning off of the service in the car, to be sure that no data is shared with the provider.

10	Safety				
	Threat description	Threat consequences	Prob. of occurrence	Level of impact	Risk scheme
10.1	System is very complex, much more workload for driver	- System is not adopted by users - Decrease of traffic safety	Low	Medium	Green
10.2	Holiday is planned in car	Unsafe situation on the road	Low	Medium	Green
10.3	Longer trips	- Safety decreases	Low	Low	Blue
10.4	Distraction by audio/visual signs	- Safety decreases	Medium	Low	Green

10.1 This service makes the travellers' decisions more complex, because on the road, there is not only the driving task, but also the looking for hotels or camp sites, for instance. The information is probably shown on a screen in the car, or by audio; this may also distract the driver. The combination of this thinking, reading and/or listening raises the workload for the driver. This decreases traffic safety. When traffic safety decreases, the

government do not allow this system. The system should be designed in such a way, that the workload is reduced to a minimum.

10.2 Drivers attention is more focused on the information about camp sites, hotel or POI's than on the road. This

10.3 Drivers drive for a longer time, because workload is lower with a navigation system. This can reduce traffic safety.

11 Stakeholder acceptance					
	Threat description	Threat consequences	Prob. Of occurrence	Level of impact	Risk scheme
11.1	No interest from manufacturer (low benefit)	System can not be developed	Medium	High	Orange
11.2	Conflicting interests (e.g. between tourist info providers)	- Development is slowed down - Cooperation is difficult	Medium	Medium	Yellow
11.3	ANWB requires special rights for their members	- Purchase price of ANWB information raises - System provider can not satisfy ANWB	Medium	Medium	Yellow
11.4	Stakeholders are harmed by higher competition	- Bad commitment of stakeholders	Medium	Medium	Yellow
11.5	Outsourcing risks	Cooperation with other parties can lead to significant delays	Low	Medium	Green

11.1 When the benefits are too low for the manufacturer, he do not participate in the development of the service. Without the participation of the manufacturer development and deployment has to be cancelled.

11.2 Different parties have different interests. For a good cooperation, all parties have to profit from this project. Otherwise, the project team feels a lot of resistance.

11.3 Maybe it is not possible in any case, so that the system provider can not satisfy ANWB. Due to that, the ANWB will not be a partner in information cooperation.

11.4 Companies who have a great market share can loose this, because other companies are easier to find with the navigation system.

11.5 Third-parties have great influence on the proceeding of a project.

12 Standardisation					
	Threat description	Threat consequences	Prob. of occurrence	Level of impact	Risk scheme
12.1	Information is given in different formats by information suppliers (Lonely Planet, ANWB)	Information has to be 'translated' before sending or by the system	Medium	Medium	Yellow

12	Standardisation				
12.2	No standard for system functions	- Use of different memory cards - Not interchangeable	Medium	Medium	Yellow
12.3	Information from different countries	- Delivery times do not ally - Exchange rate	Medium	Medium	Yellow

12.1 Different organisations use different ways of collecting and using the data. When different parties have to work together, a standard has to be formulated and used by all parties. Otherwise, information should be translated.

12.2 When different devices come to the market, a standard should be made. Without a standard, every system works in a different way or works with different standards (like memory cards). This makes integration of different system functions in one navigation system difficult.

12.3 Due to the holiday purpose of the system, information from different countries is used. It is possible that this information can not ally with each other. This leads to a not up to data system.

13	Technology maturity				
	Threat description	Threat consequences	Prob. of occurrence	Level of impact	Risk scheme
13.1	Incorrect information is given (e.g. about hotels)	User does not trust system	Medium	High	Orange
13.2	Internet access in car is not enough developed	- Bad signal receiving	Medium	Low	Green
13.3	Display too small for amount of information	- Low satisfaction of users	Medium	Medium	Yellow
13.4	Bugs	- System break down	Low	Medium	Green
13.5	PDA will become alternative for PND	- Market share of PND's decreases	Medium	Low	Green
13.6	Service works only when PND is turned on	- Less added value	Medium	Medium	Yellow

13.1 Information given by the system about hotels and point of interest should be reliable. When information is incorrect the user will neglect the information next times. In this way the system is worthless.

13.2 Users are not satisfied when they buy a system that doesn't work. The reliability has to be as high as possible.

13.3 The display has to be big enough for the given information. A lot of scrolling is not wanted.

13.4 The system must be 'hufter proof'. Besides that, the system must be free of bugs. The system must not break down by user handlings.

13.5 The coming of PDA's reduce the market share of PND's. Possibly, the holiday functions can be used on a PDA.

13.6 The system must be turned on to use it, otherwise it has no added value.

14 Traveller acceptance					
	Threat description	Threat consequences	Prob. of occurrence	Level of impact	Risk scheme
14.1	User does not want to buy this system	System will not be used	Medium	High	Orange
14.2	Lack of awareness of the public	System will not be used	Low	High	Yellow
14.3	Not orderly and suitable HMI	- Distributed information is not clear - User-friendliness decreases	Low	Low	Blue
14.4	Insufficient information	Lack of info to choose (temporal) destination	Medium	Medium	Yellow
14.5	Wrong info/system functions chosen by project team	- Target groups not interested in PND	Medium	Medium	Yellow

14.1 The system is not used when the user doesn't like it or when the system gives useless information. He won't buy it or won't use it by turning the system off. In such a case the system has no added value.

14.2 When the marketing is bad, the user do not know of the existence of the system. In such a case users won't buy a system.

14.3 The given information should be clear. When information is, for instance, not readable the user can not use the system.

14.4 The given information (exactly) should be the information the user would like to have. Maybe he would like to have information about hotels or camp sites. This information has to be correct, to ensure the use of the system. Insufficient information will lead to a non-use of the system.

14.5 Due to an incomplete user needs analysis, a wrong system can be build. It must be sure that the right information is displayed at the right moment. In this analysis only 100 respondents, mostly Dutch male students, filled in the questionnaire.

15 Organisation and institutional issues					
	Threat description	Threat consequences	Prob. of occurrence	Level of impact	Risk scheme
15.1	Improper cooperation	- Delay - Bureaucracy	Medium	Medium	Yellow
15.2	Not the best ITS solution due to different interests of parties (compromising)	- Benefit not optimal - Bad fit with interests of target group	Medium	Low	Green

15.1 Many involved stakeholders lead to a difficult cooperation. For the development of this system different private partners have to cooperate. The differences between them can cause delays or bureaucracy, mainly through communication errors.

15.2 Stakeholders have different interests, so compromises have to be made. This can cause a non-optimal service, so not maximum social benefit is gained, but maximum financial benefit.

E.2. Mitigation Strategies

In this step of the RAID-analysis mitigation strategies are described to tackle the main risks. Main risks are the risks, which in previous phase scored orange or red. In this case, six risks scored yellow and none scored red. The aim of the mitigation strategy is to avoid the risks or to control the impact of the risks. For each risk there are a number of different mitigation strategies.

In table 8 an overview is given of all the risks, which scored orange or red.

Risk	Description	Consequences	Prob. of occurrence	Level of impact	Scheme
2.4	Overload of information	- Users lose overview - Frustration - Less attention for the other tasks, such as handling the car - System is turned off	Medium	High	Orange
3.6	Demand forecasting risk (under-forecasting)	- Shortage of products - Loss of revenues - Damage in reputation - Damage in relations with distributors and retailers	Medium	High	Orange
5.1	No(t) (enough) funding provision is found	- Delay in development - Without funding the system can not be developed	Medium	High	Orange
7.3	Intellectual property: product already licensed	- Paying other company; - Cancelling or delay of the project	Medium	High	Orange
11.1	No interest from manufacturer (low benefit)	System can not be developed	Medium	High	Orange
13.1	Incorrect information is given (e.g. about hotels)	User does not trust system	Medium	High	Orange
14.1	Users do not buy this system	System is be used	Medium	High	Orange

table 8: Major risks

Overload of information (2.4):

- Set up a practice test with a prototype and measure the (extra) workload of this PND. This practice test has to be done for different scenarios. For example different road types, different amounts of traffic, different number of occupants inside the car, etc. Use the results of this test to adapt the PND.
- Make the user aware that he or she can tune, which information he or she would like to receive and that it is preferable to do this before trip. This can be written down in the manual and can be stressed on in the marketing campaign, that the driver is in control.
- Present the information in a user-friendly way. Not with flashing messages, but more neutral. Give an advice on where to place the PND in the car.
- Make the user aware that it is mainly a task for the other occupants of the car to operate the PND and that the driver only has to follow the instructions of the PND. This can also be written down in the manual and can be stressed on in the marketing campaign.

Demand forecasting risk (under-forecasting) (3.6):

- This risk is the result of uncertainty in forecasting the number of PND's sold. So a(n) (extended) market research has to be done to give a better forecasting of the market shares.
- The production process of the PND has to be flexible. This means that on short term the capacity can be adjusted to the current demands. This can be done by short supply chains (in time), a lot of standardised units in the PND's and by making agreements about this with the suppliers.

No(t) (enough) funding provision is found (5.1);

No interest from manufacturer (low benefit) (11.1):

These are two risks, which have similar background. The benefits and the necessity of the project are questioned.

- If there is still doubt about this, the first strategy should be to reduce the uncertainties in the project. There are two major uncertainties. First, uncertainty about the profitability of the project and second, (part of that) about the user acceptance of the product. To reduce these uncertainties on a larger scale (than in this research) a costs and benefits analysis has to be done. Besides that, also on a larger scale a user acceptance research. On a larger scale, means more respondents than in the current research and the research has to be done in different countries.
- The idea behind this project is that more stakeholders share responsibilities about the funding of the project. Thus not only the manufacturer has to be convinced about the necessity of the project, but also the other participants. For this, it is important that in detail appointments are made of the responsibilities of each of the participants. Furthermore, all the participants are aware of the benefits of the project for each participant. Of course the mitigation strategy mentioned above can help to convince them.
- The last mitigation strategy (maybe not a true mitigation strategy) is that if this project is considered to be part of the major trend in the development of PND's than this project doesn't need to pay itself back in the coming years. The project is considered to be vital to stay competitive towards other producers of PND's and to stay an important player on the market of PND's. If the CEO's consider this to be the case than this risk is less important.

Intellectual property: product already licensed (7.3):

- The first mitigation strategy for this is to raise the awareness of the importance of registration the intellectual property of the product. This awareness needs to be raised for all the participants in the project It is important that experts about intellectual property are part in the development of the product. They can give their advice and they can take care of an early registration of the product or parts of the product. Besides this, It is important to stress the secrecy of the project in order to prevent that important information gets to the competitors and that they register the intellectual property earlier than the your own company does. This means that not all members of the project have access to all information. All information is intellectual property of the company and therefore can not be used without permission in other projects outside the company. The company has to prevent (to a certain extent) that employees change jobs to a competitor.
- In order to protect the intellectual property of the product and to prevent that the product is copied by other companies, it is better that the PND's are produced in countries which protect intellectual property strictly.

Incorrect information is given (e.g. about hotels) (13.1):

- A first strategy is to update the information in the system often, for example on daily base. With this strategy the information is adjusted quickly to changes, such as a closing of a particular hotel. Beside this, wrong adjustments are also quickly corrected again.
- A second strategy is to develop a control mechanism on who is allowed to update information in the database. This strategy can be combined with the first strategy. The purpose of the control mechanism is to prevent that wrong adjustments are made. Questions hereby are: Who is allowed to update which information or when becomes an adjustment part of the update of the information? For example is a hotel owner allowed to update information about his hotel or even the information about a hotel of competitor? IP-addresses can be used to make a black list of persons, who are not allowed to make adjustments.
- Users of the product can choose which kind of updates they would like to receive. The updates can be classified in levels. For example only updates with adjustments, which are confirmed by more than 10 different users. Or only updates which are confirmed by a particular group, for example by employees of this company. Or they can decide that they would like to receive an update on all the adjustments made from all the users. With this strategy the user himself chooses which kind of updates he would like to receive. And therefore he becomes (partly) responsible for the reliability of the information he chooses.

Users do not buy this system (14.1):

- The first strategy is to prevent that this will happen. Therefore on a larger scale a user acceptance research has to be done. This research has to be done in different countries. The aim of this is reduce the uncertainty of the user acceptance of the product.
- A step by step introduction of the product can help to reduce this risk, because introduction of problems occur on a smaller scale. Solutions for these problems can be found and these solutions can be used for the next introduction phase. This can result in higher consumer's satisfaction.
- A good advertisement campaign can convince the users of the benefits of the product and create a higher user acceptance. It is important to underline why the consumers have to buy this PND.

Appendix F. Planning

This planning gives an overview of the activities of the project. It shows (in table 9) the week targets in time and activities. In the last column an overview of activities per team member is shown (A = Anthonie, L = Lieuwe, M = Margreet)

Overall, the work is checked by at least one other group member. More important issues, like the assessments and the conclusions are checked by everyone.

In general all group members have spent about the same time to the project.

Activities	Week						52	1						Who
	46	47	48	49	50	51			2	3	4	5		
Project plan	■	■	■										ALM	
Present technology and systems		■	■	■	■	■							M	
Stakeholder analysis		■	■	■	■	■							A	
User needs assessment		■	■	■	■	■			■	■			LM	
Questionnaire 1 design		■	■	■	■	■							M	
Questionnaire 1 online/open			■	■	■	■							M	
SPSS analysis					■	■							M	
Define attributes				■	■	■							A	
Questionnaire 2 design				■	■	■							ALM	
Questionnaire 2 open						■							L	
Biogeme analysis									■	■			L	
Definition of new system				■	■	■			■	■			M	
Risk analysis										■	■		A	
Business model			■	■	■	■			■	■	■		L	
Structure			■	■	■	■							L	
Financial assessment / plan					■	■			■	■			L	
Marketing plan						■			■	■	■		AL	
Conclusions and recommendations										■	■		ALM	
Presentation 1				■									L	
Presentation 2						■							A	
Presentation 3									■	■			M	
Survey 1			■	■	■	■							ALM	
Survey 2				■	■	■							ALM	
Lay-out report										■	■		L	
Presentation											■		AM	

table 9: Overview activities of the project