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Abbreviations

Abbreviation	Definition
EC	European Commission
ESC	Electronic stability control
EU	European Union
ISA	Intelligent speed adaptation
ITS	Intelligent transport systems
PCB	Perceived behavioural control
RTTI	Real-time traffic information
TPB	Theory of planned behaviour
TPMS	Tyre pressure monitoring system
TRA	Theory of reasoned action
UTAUT	Unified theory of acceptance and use of technology

Executive summary

Road transportation accounts for a lot of CO_2 emissions and they are still increasing. Intelligent transport systems can effectively reduce emissions from vehicles, and the European Commission launched a directive in 2010 to speed up the deployment of these systems. User acceptance and demand are important factors for the deployment process and can be measured in different ways.

The purpose of this study was to study users' awareness, experience, attitude, demand and willingness to pay for advanced driver support systems. The data was collected through a questionnaire administered in five European countries and analysed depending on gender and age. Systems included in the study were: speed alert, emergency braking, eco-driving assistance, real-time traffic information, start-stop assistance and a tyre pressure monitoring system. Awareness of the selected systems varied a little, but in general around 60% of the respondents had read about, heard of or tried the systems. The actual usage was low, 5-19% depending on the system. Respondents who had tried the systems were asked how often they used it, revealing that most systems were not used regularly. The respondents also had to evaluate the perceived usefulness of the systems on different road types (urban environments, highways and rural roads) and the perceived importance of the systems' benefits. All the systems were seen as useful on at least one road type. Depending on the system, different benefits were included, but at least one benefit for every system was viewed to be important. Around 50% of the respondents wanted to have the systems in their next car and around 60% would be willing to pay something for the systems, usually less than € 200.

Another purpose of this study was to determine the users' acceptance, early adoption and unawareness of the systems. The analyses were done using logistic regression. Variables included in the acceptance, early adoption and unawareness analyses were determined based on the literature review of previous user acceptance studies. For the acceptance analysis statistically significant variables increasing the respondents' acceptance were: buying their next car as new, frequent usage, high perceived usefulness, and benefits of the systems. For early adoption these were household income, vehicle mileage and the price of their next car. For unawareness they were gender, vehicle mileage and price of their next car.

1. Introduction

1.1 Background

Road transportation accounts for a large proportion of carbon dioxide (CO_2) emissions. In the European Union (EU), 20% of CO_2 emissions in 2011 were derived from this mode of transport alone. The growth rate has also been alarming; from 1990 to 2011, emissions from road transportation increased by around 19%, whereas emissions from other major sectors (waste, industrial processes, energy, agriculture and other consumption) decreased during the same period. (Eurostat 2013) Since CO_2 emissions are still expected to rise, policies and strategies have been implemented to reduce them. The goal set in 2007 was that by the year 2015 all new cars should not emit more than 130 g CO_2/km and by 2021 no more than 95 g CO_2/km. (European Commission 2007).

Making driving more efficient can help reduce emissions. With lower speeds, shorter travel routes, less accelerations and better utilization of the traffic network, less fuel is used and therefore less emission is caused (Vreeswijk et al. 2010). "Intelligent Transport Systems or 'ITS' means systems in which information and communication technologies are applied in the field of transport, including infrastructure, vehicles and users, and in traffic management and mobility management, as well as for interfaces with other modes of transport" (European Parliament, Council of the European Union 2010). ITS include applications that help drivers drive more efficiently and eco-friendly, and may also increase the safety of driving. There is a wide range of ITS, from receiving local travel conditions to systems that control the car. Greater usage of ITS is a way to reduce emissions from road traffic and to achieve the goals set by the European Commission (EC) (European Commission 2007). Even if the benefits are clear, the deployment of many of these systems has taken place slowly; the actual deployment of many systems in the EU27 is still less than 1% (Öörni 2014). The users' willingness to adopt the systems is a key factor in the deployment process. To speed up the deployment of ITS, the EC announced an Action Plan in 2008, and a new Directive with practical measures in 2010. As a result the EC has funded various projects and working groups to raise awareness and increase the usage of ITS (European Parliament, Council of the European Union 2010).

iMobility Challenge is a project that strives to increase the usage and to promote ITS. The project is partly financed by the EC's Directorate General for Communications, Networks, Contents and Technology. The project began in October 2012 and is set to continue until the end of 2014. Objectives within the project are to support and speed up the deployment of ITS in cars. (Ertico) Systems that make road transportation more eco-friendly and efficient are the focus of the project, but safety systems are also included. Increasing awareness of these systems among both policy makers and the public is one objective. Different support studies form another part of the project, and aim to study the current usage, impacts and user awareness of the systems. (Öörni, Schirokoff 2013) A mapping of the systems, a mapping of services and products and a study about users' awareness and demand for iMobility technologies have been carried out so far (Öörni, Schirokoff 2013, Konstantinopoulou 2013, Öörni, Penttinen 2014).

User acceptance is an important pillar for the deployment of ITS; if people do not want the systems or see them as useful it is difficult to realize the full potential of ITS. There is no universal definition for user acceptance and there are also many ways to model and predict it. User awareness, attitudes, intentions and willingness to pay, and similar definitions, have been used to measure acceptance of a system (Adell, Várhelyi 2008, eSafety Challenge 2009, eSafety Challenge 2011, Höltl, Trommer 2013, Karlsson et al. 2013, Öörni, Penttinen 2014, Trommer, Höltl 2012, Vlassenroot et al. 2008, Vlassenroot, De Mol 2007, Vlassenroot et al. 2010, Vlassenroot, Brookhuis 2014). Adell (2009) suggests a common definition of driver acceptance: "Acceptance is the degree to which an individual incorporates the system to his/her driving, or, if the system is not available, intends to use it." The motivation for this definition is that the important aspect is the driver and it focuses on the actual usage of the system or the intention to use it. Stating that a system is useful or beneficial is not the same as actual using it when possible. Regardless of which definition or model is chosen for user acceptance, user awareness/attitudes and their willingness to pay are important factors for successful deployment of the systems. The acceptance and adoption trends of the systems have to be identified so that the implementation strategies can be improved.

The systems identified for promotion to customers in the iMobility Challenge were included in the user aspect questionnaire, since mainly these systems are available on the market (Öörni, Schirokoff 2013). In addition, speed alert and emergency braking were also included, given that they have been studied previously on a European level, improve safety, and are common among users (Öörni, Penttinen 2014). The final six systems to be included were speed alert, emergency braking, eco-driving assistance, real-time traffic information (RTTI), start-stop assistance and a tyre pressure monitoring system (TPMS).

1.2 Objectives

This is one support study of the iMobility Challenge; concerning user awareness and demand for iMobility systems. Information on user awareness, experience and demand for these systems was collected by a questionnaire in five EU countries. The answers to the questionnaire are the base for this study where the results are studied and analysed. This study analyses the questionnaire data further than the previous study by Öörni and Penttinen (2014) which included only basic results and a comparison between the countries.

The primary purpose of the study was to analyse the answers to all the questions relating to the demographic variables of age and gender. Getting information on user acceptance of the systems was the principle aim, as well as pinpointing which factors influence this acceptance. Another purpose was to identify early adopters of the systems, and whether there are any explanatory factors for early adoption. Finally, the profile of respondents who were unfamiliar with the systems was examined.

The research questions for the study were the following:

1. What were the respondent's awareness, experience, attitude, demand and willingness to pay for the iMobility systems depending on demographic variables?
2. What was the profile for user acceptance of the iMobility systems?
3. What was the profile of early adopters of the iMobility systems?
4. What was the profile of respondents unaware of the iMobility systems?

Earlier research was examined to give a better understanding and background to the subject (Chapter 2). There are many models and definitions for user acceptance; these are presented in the literature study. Previous studies on user acceptance for each selected system are presented separately, starting with a brief presentation and description of the system's impact. In Chapter 3 the method and data for the study are described, including the respondents' demographics. Chapter 4 gives the results for all the research questions, covering each system separately. Responses concerning respondents’ awareness, experience, attitudes, willingness to have and willingness to pay for the systems are presented first, followed by the results for acceptance, early adopters and unawareness of the systems. The discussion (Chapter 5) gives an analysis of the results and looks at connections to previous studies. The conclusions and recommendations for further research bring the study to a close in Chapter 6.

2. Related research

2.1 Diffusion of innovation

Rogers (2003) introduced the diffusion of innovations theory, which describes the process of how technology is adopted by users. Diffusion is seen as how a new invention is spread in a society over time. People have a different willingness to adopt an innovation; Rogers has identified five different groups depending on their adoption rate; innovators, early adopters, early majority, late majority and laggards (Figure *1*). (Rogers 2003)

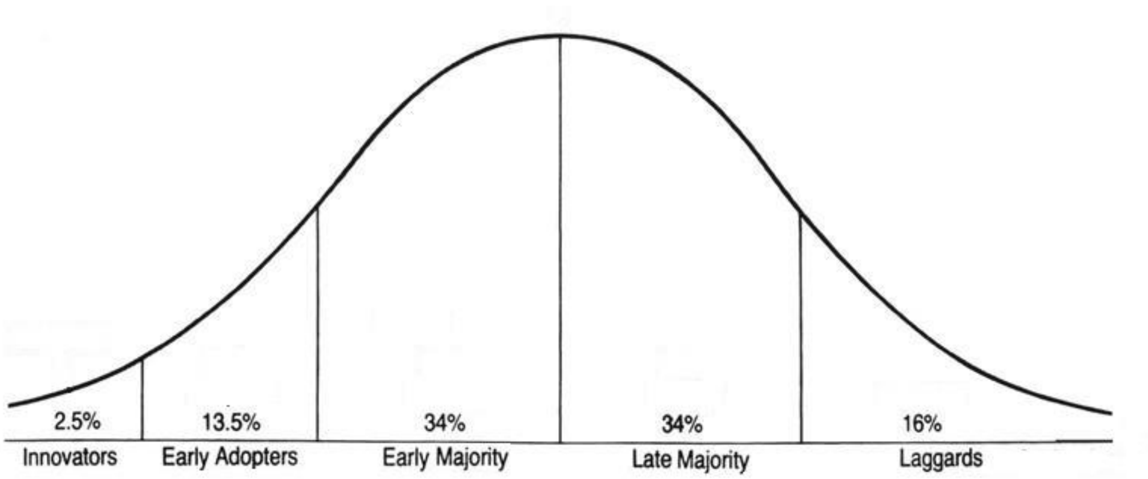

Figure 1. Adoption categories according of their rate of adoption (Rogers 2003)

Rogers (2003) assessed that there are five factors affecting the rate of adoption of an innovation: how much better the innovation is compared to previous technology, how compatible the innovation is with the users’ values and previous experience, how difficult it is to understand and use the innovation, the possibilities to try the innovation and how available the outcomes of the innovation are. (Rogers 2003)

Rogers (2003) has identified some characteristics among the adoption categories:

- Innovators
    - They are usually not afraid of risks and are constantly willing to adopt and finance new technologies.
    - They are not ruined by failure since they have the financial means to survive. Innovators are not a part of the local society, but introduce the society with new technologies, and if it is successful the adoption process continues.
- Early adopters
    - They are part of the local society; they also strongly influence the society in terms of opinion and customs.
    - The early adopters’ role is to make the innovation popular by adopting it themselves and spreading the advantages to the public, who will eventually follow.

2.2 Models for measuring user acceptance of technology

2.2.1 Theory of reasoned action

The theory of reasoned action (TRA) is a model (Figure *2*) developed by Icek Ajzen and Martin Fishbein (1975, 1980). The model suggests that behavioural intention is the reason for behaviour. Behavioural intention is influenced by the user's attitude towards the behaviour and the subjective norms concerning the behaviour. The attitude towards the behaviour is made up of the user's beliefs and experience of the behaviour. The subjective norm is the society's or people's pressure on the user to perform the behaviour.

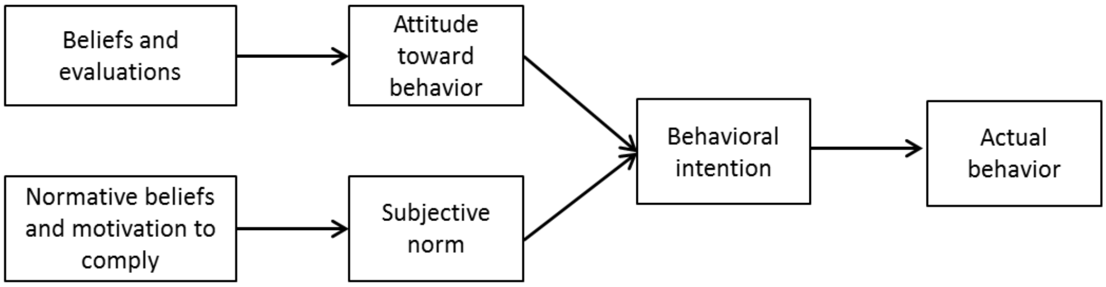

Figure 2. Theory of reasoned action (Davis et al. 1989)

2.2.2 Theory of planned behaviour

The theory of planned behaviour (TPB) (

Figure *3*) was developed by Icek Ajzen (1985, 1991). It is a model that tries to explain the connection between the user's beliefs towards a system and their performed behaviour with the system, or the user's psychological process when using a product or a system. It is an extension of his and Martin Fishbein's theory of reasoned actions (Fishbein, Ajzen 1975, Ajzen, Fishbein 1980). According to the TPB a person's behaviour is based on the person's intention to perform the behaviour, which in turn is influenced by the person's attitude, subjective norm and perceived behavioural control (PBC). The behaviour is directly influenced by the intention to do something. The PBC is the person's opinion on how easy or hard it is to do the behaviour. Subjective norms and attitude towards the behaviour is the same as in the TRA. (Ajzen 1991)

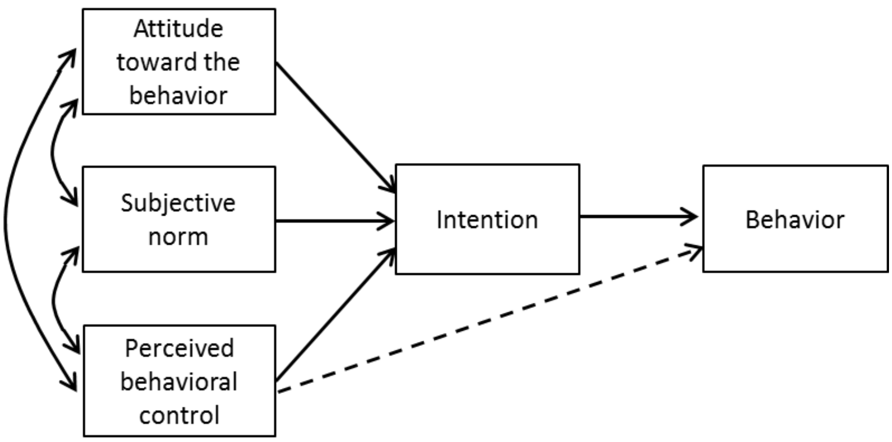

Figure 3. Theory of planned behaviour (Ajzen 1991)

2.2.3 Technology acceptance model

The technology acceptance model (TAM) is another model built on the TRA proposed by Fred Davis (1985). With TAM it is possible to model user acceptance and adoption of computer and information systems. According to Davis (1989), two variables affect whether or not a person will accept and use a technology: the perceived usefulness (U) obtained from using the product and the perceived ease-of-use (E), i.e. how easy the product is to use. The actual usage of the system is influenced by the intention to use it. The model was developed in several stages. In the first stage (Figure 4), the intention to use was influenced by the perceived usefulness and attitude towards using it (which in turn was influenced by perceived usefulness and perceived ease-of-use). The original model was further developed, because in previous studies it was found that both the perceived usefulness and perceived ease of use directly influenced behavioural intention. Therefore the attitude towards using the system was eliminated. The final TAM is shown in

Figure ***5*** (Venkatesh, Davis 1996).

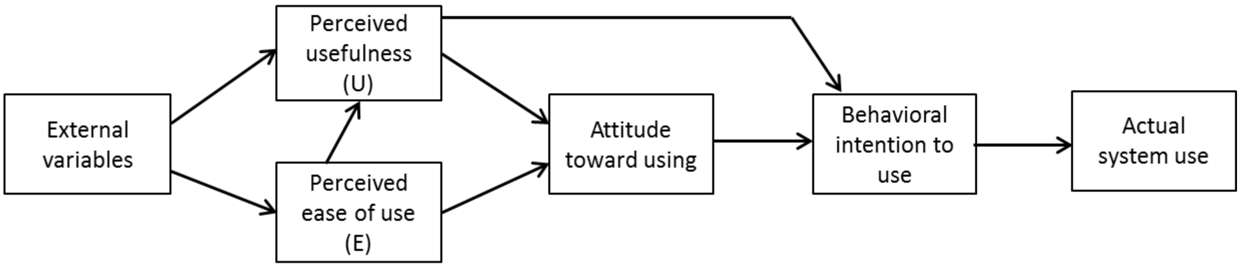

Figure 4. Technology acceptance model (Davis 1989)

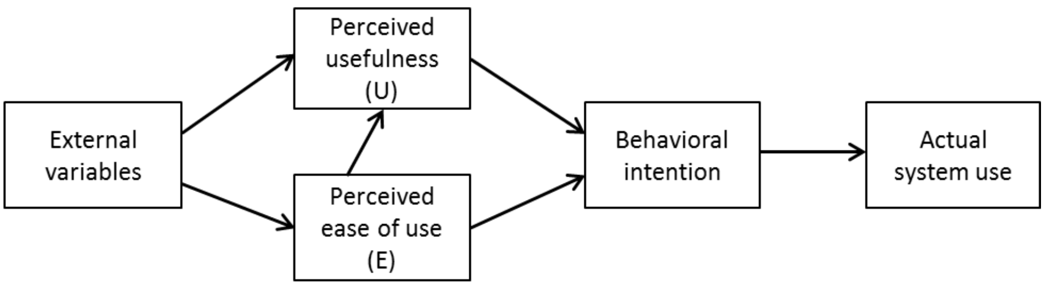

Figure 5. Final version of the technology acceptance model (Venkatesh, Davis 1996)

2.2.4 The unified theory of acceptance and use of technology

The unified theory of acceptance and use of technology (UTAUT) strives to unify all the theories of user acceptance. It is based on three main factors that build up the user's intention to use a system and then turn into actual usage of the system. The factors are "performance expectancy", "effort expectancy" and "social influence" (

Figure *6*). Performance expectancy is how the user sees the gains from using the system. The perceived expectancy is similar to Davis' perceived usefulness (1989). Effort expectancy is how easy the user sees the system is to use, similar to Davis' (1989) perceived ease of use. Social influence is the pressure from other people to use the system, similar to the subjective norm in TRA (Fishbein, Ajzen 1975, 1980). In addition to the intention, the actual behaviour is also directly influenced by facilitating conditions; by supporting the users in different ways it gets easier for them to use it. The four factors are also influenced by the respondent's age, gender, experience of the system and voluntariness to use the system. (Venkatesh et al. 2003)

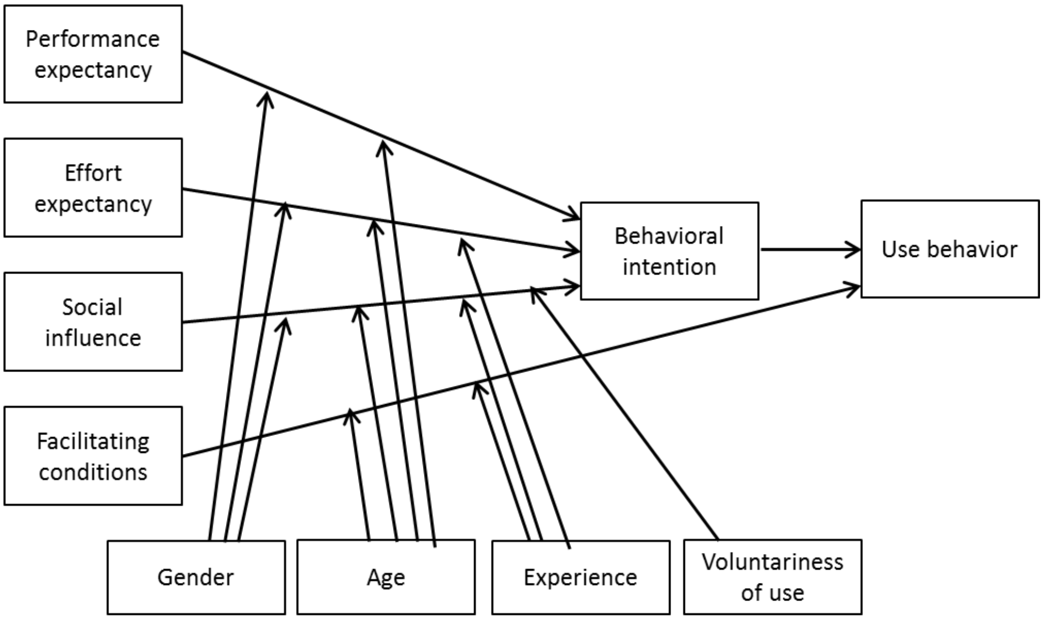

Figure 6. The unified theory of acceptance and use of technology (Venkatesh et al. 2003)

2.2.5 Willingness to pay

Willingness to pay has also been used to measure demand for a product. It is the maximum price a person is willing to pay for a service or product. It has traditionally been measured by proposing different figures to respondents and letting them choose how much they are willing to pay. Willingness to pay as a measure has some problems; it is not the same as buying the product. In addition, respondents might overstate their willingness to pay to impress others or comply with the society's standards. (Breidert et al. 2006)

2.2.6 Summary on models for measuring user acceptance

Despite the range of different models for user acceptance, there are some common factors. Liking a system does not automatically convert to usage; rather, it is the intention to use that will turn into actual usage, as the driver has to be willing to use the system and see the benefits from using it. Nor does willingness to buy a system turn into actual usage, but it is an important pillar for deployment. The user's intention to use has been identified as the deciding factor for actually using the system in many of the acceptance models (Fishbein, Ajzen 1975, Ajzen, Fishbein 1980, Davis 1985, Ajzen 1985, Davis 1989, Ajzen 1991, Davis 1993, Venkatesh, Davis 1996, Venkatesh et al. 2003).

2.3 User acceptance of driver support systems

2.3.1 Speed alert

Speed alert systems help drivers to drive within the allowed speed limit, giving a warning when it is exceeded. The system can warn the driver with a sign, sound or motion, usually a bump on the gas pedal. The system communicates with the surrounding infra-structure and can receive the local speed limit from traffic signs that communicate directly with it, through a camera in the car that recognises traffic signs or from a database. (Kulmala, Öörni 2012) Speed alert reduces the number of accidents caused by speeding. It is estimated that in the future it could reduce 3-16% of the fatalities and up to 9% of the injuries, depending on the deployment (Schulze et al. 2014). The system may either reduce or increase fuel consumption and emissions (Kulmala, Öörni 2012).

Vlassenroot, Brookhuis, Marchau and Wilcox presented a model for the acceptance of intelligent speed adaptation (ISA) in 2008. They reviewed the previous research in the field, both practical trials of the system and general models for acceptance. They identified 14 different factors that influence the acceptance of ISA, divided into two *groups (*

Figure 7). The first group is "general indicators" that relate to user awareness of ISA. The other group is "system specific indicators" that concern the system itself. Both groups influence each other and the acceptance of ISA. (Vlassenroot et al. 2008)

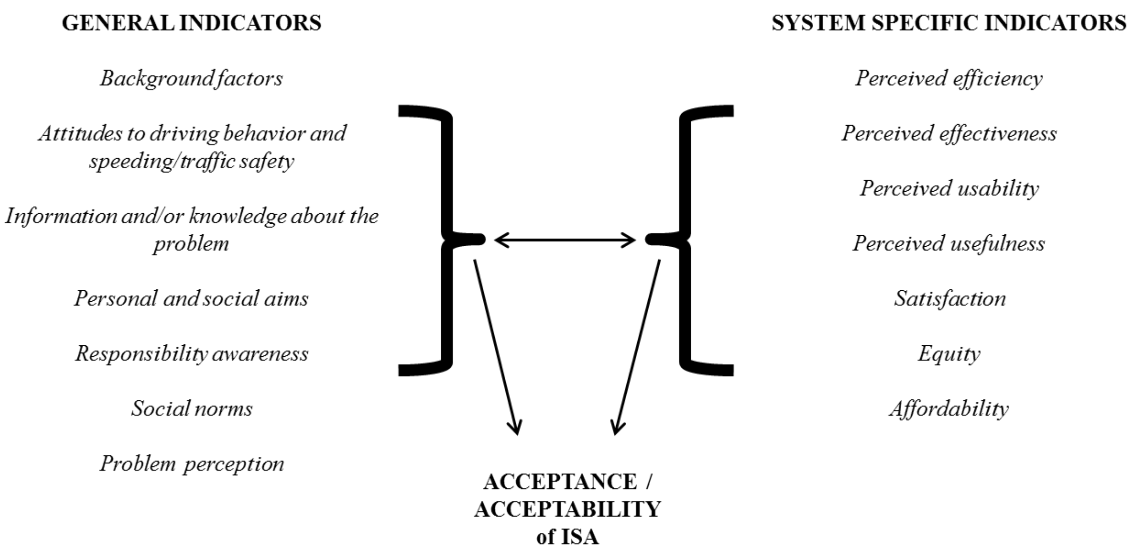

Figure 7. Factors influencing user acceptance of ISA (Vlassenroot et al. 2008)

Vlassenroot et al. (2008) turned these 14 indicators into the actual acceptance model (

Figure *8*). In the model, demographic variables form the basis for travel behaviour and habits. Travel behaviour will consequently influence the knowledge and experience of the system. These three factors determine both directly and indirectly two groups of beliefs; general beliefs and system specific beliefs. The former group consists of personal and social aims, responsibility awareness, problem perception and social norms. It concerns the part of why the system is and should be used, i.e. speeding. The latter concerns the system's characteristics. It consists of perceived efficiency, perceived effectiveness, usability, usefulness, satisfaction, equity and affordability. The two beliefs both influence each other and define the users' acceptance of ISA. (Vlassenroot et al. 2008)

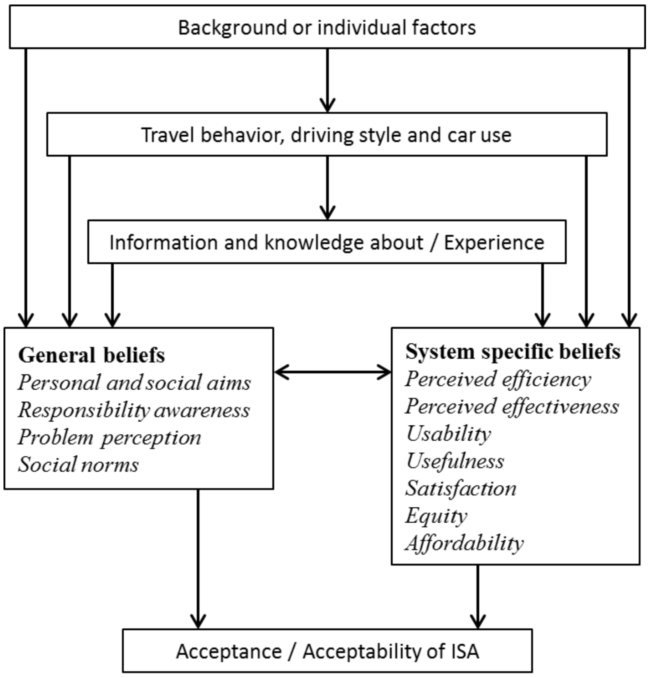

Figure 8. Model for measuring acceptance of ISA (Vlassenroot et al. 2008)

In 2010, Vlassenroot et al. developed their model further (Figure 9). They conducted a deeper analysis of the influences the 14 identified variables had on users' acceptability of ISA (Vlassenroot et al. 2010). They rearranged the variables in the model and divided them into three new groups: background factors (demographics and driving background), general "contextual" indicators (the environment and situation where the system is used) and specific "device indicators" (experience and attitudes about the system). With structural equation modelling (SEM) they identified four factors influencing ISA acceptance the most: the effectiveness of the system, equity, effectiveness of ITS and personal and social aims. (Vlassenroot et al. 2011)

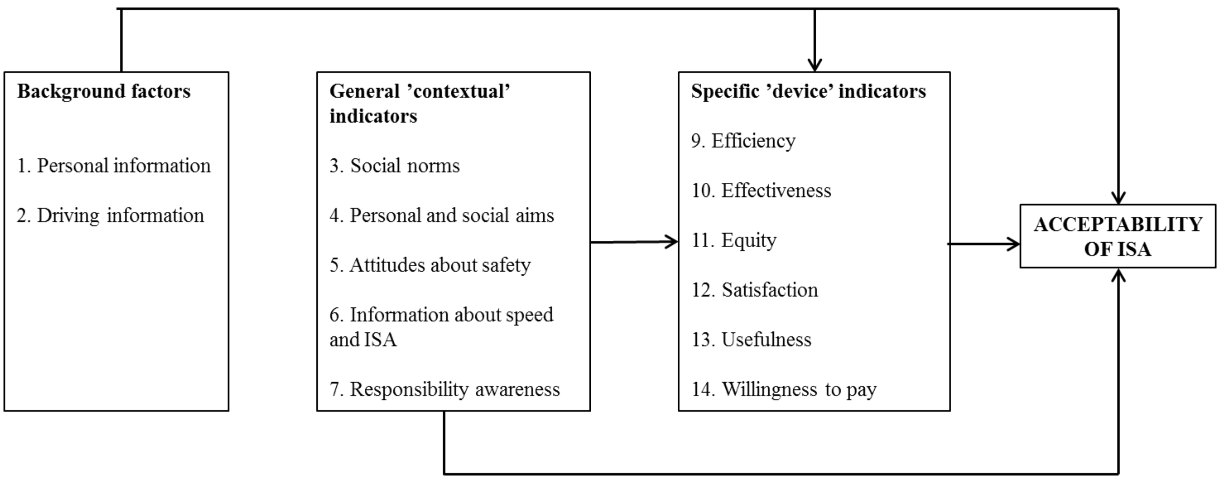

Figure 9. Developed model for variables influencing acceptance of ISA (Vlassenroot et al. 2011)

The eSafety Challenge included two studies on user awareness, demand and willingness to pay for intelligent vehicle safety systems conducted in 2009 and 2011. The total sample size in 2009 was 1 000 respondents who were asked about their awareness, willingness to demand, willingness to pay, and how much they were willing to pay for the systems. In all, 56% of the respondents were aware of the speed alert system, the highest awareness compared to other systems studied in the same project: emergency braking, blind spot monitoring, lane support system and electronic stability control (ESC). Men were more familiar with the system than women, with 63% and 49% respectively having heard of it. Among the respondents 38% wanted the system in their next car and 29% would be willing to pay something for it. Willingness to have the system differed, between persons familiar with the system and those who were not; 45% of those who were familiar with the system would want it in their next car compared with 28% of those who were not. Respondents who said that they would be willing to pay for the system (n=291/1 000) were asked about the amount they would be willing to pay. Most of them gave a figure of €100-300 (51%), 25% would pay €300-500 and 11% were willing to go over €500. Men and women had equal willingness to pay for the system, but 10% more men than women would pay €300-500 and 5% more women than men would pay €500-1 000. (eSafety Challenge 2009)

In the eSafety Challenge study in 2011, 5 000 respondents were asked about their awareness, willingness to have and pay extra for the systems. In all, 64% of the respondents in the questionnaire were aware of the speed alert system, including 70% of the men and 57% of the women. The age groups (18-24, 25-34, 35-49 and 50+) did not differ in terms of awareness. Rating the systems' importance on a scale of 1 (very important) to 6 (very unimportant), speed alert got the rating 3.37, which was lower than for the other systems (advanced emergency braking, blind spot monitoring, lane support system, ESC and adaptive headlights). Of the respondents, 33% were willing to pay additionally for speed alert compared to 29% in the eSafety Challenge in 2009. Men and women were almost equally willing to pay extra for the system (34% and 32% respectively). The age group 35-49 years had the lowest willingness to pay with 29% willing to pay extra for speed alert whereas 38% of those aged 50+ were willing to pay extra. (eSafety Challenge 2011)

The TeleFOT project studied different nomadic and aftermarket in-vehicle devices through long-term large-scale field operation tests. For user acceptance the data was collected from questionnaires completed while the respondents were using and after they used the systems. The respondents were asked to evaluate different statements on a 5-point Likert scale from 1 (no, definitely not) to 5 (yes, definitely). The original model for user uptake or user acceptance was developed from the results. The final model is shown in

Figure *10*. User uptake or acceptance is influenced by willingness to keep and willingness to pay. Willingness to keep is in turn strongly influenced by familiarity with the system, perceived usefulness, design of user interface and trust in the system. Weak influences on willingness to keep were problem perception and the design of the device. Willingness to pay was strongly influenced by perceived usefulness, design of the user interface, and trust in the system. A weak influence on willingness to pay was the design of the device. (Karlsson et al. 2013)

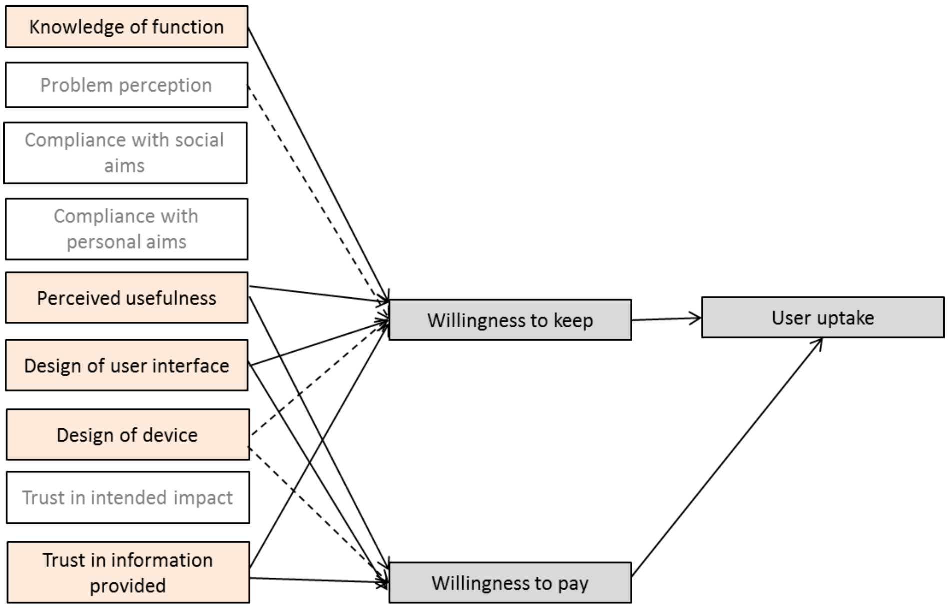

Figure 10. Developed model for measuring user acceptance in the TeleFOT project (Karlsson et al. 2013)

For speed alert, willingness to keep was 35-76% in TeleFOT, depending on the country and application. When comparing the influence of background factors, only frequent usage of the system had any influence on willingness to keep, the other factors had none. The willingness to pay for the system was 2-29% depending on the country, and 95% of the respondents would consider €1-10/month. Non-frequent users were also less likely to be willing to pay; awareness of the system did not have any impact on their willingness to pay. There was a strong correlation between perceived usefulness and willingness to keep in most of the countries, and a strong correlation between perceived usefulness and willingness to pay in all countries. (Karlsson et al. 2013)

To summarize the results on user acceptance of speed alert, more than half of the respondents were aware of the system in previous studies, men had more than women. Roughly one third of the respondents were willing to keep and pay for the system, men and women did not differ in their willingness to pay. Frequent usage and awareness of the system led to higher willingness to have, keep and pay. ISA acceptance was mostly influenced by users' perceived effectiveness of the system, equity, effectiveness of ITS and by personal and social aims. The perceived usefulness of the system correlated with users' willingness to keep and pay.

2.3.2 Emergency braking

An emergency braking system helps drivers avoid collisions by warning them of obstacles and dangerous situations. If a collision is unavoidable, the system brakes automatically and may also start preparing for the collision, for example by pre-tensioning the seatbelts (Kulmala, Öörni 2012). The use of an emergency braking system can improve the safety on roads; and could reduce all injuries and fatalities by 7% in the EU (Wilmink et al. 2008). Use of the system is estimated to slightly reduce congestion costs by 0.27-0.69% (Kulmala, Öörni 2012).

Emergency braking was studied as part of the eSafety Challenge project in 2009 and 2011. In the eSafety Challenge 2009, the braking system was defined as a "warning and emergency braking system". The total awareness of the system was 45%, with men being more aware than women (56%

of the men and 34% of the women had heard about the system). The system had the second highest willingness to have compared to the other systems, speed alert, blind spot monitoring, lane support system and ESC. Of the respondents who were familiar with the system, 63% wished to have the system in their next car, which was almost as high as the highest willingness to have in the study (64% for ESC). Of the respondents who were unaware, 43% wished to have it in their next car. The emergency braking system also had one of the highest levels of willingness to pay compared to the other systems. Of the respondents familiar with the system, 52% were willing to pay something; ESC had the highest willingness to pay with 53%. Of the respondents unfamiliar with the system, 37% were willing to pay something. Respondents stating that they would pay extra (n=436) were asked about how much they would pay; 32% would pay €100-300, 31% €300-500, 18% over €500 and 19% did not know. Men had a slightly higher willingness to pay than women; 11% of the men and 4% of the women would pay more than €1 000 for the system. (eSafety Challenge 2009)

In the eSafety Challenge 2011 the system was defined as an "advanced emergency braking system". Total awareness of the system was 57%; compared to the study in 2009 awareness had increased by 12% points. Men had higher awareness than women, 69% of the men and 44% of the women having heard about the system. Among the age groups, 35-39 year olds had the highest awareness, 59% being familiar with the system. Emergency braking got the second highest score compared to the other systems when rating importance (2.44). The total willingness to pay was 56%, 10% points more than in 2009. Women had a slightly higher willingness to pay compared to men; 58% of the women and 54% of the men were prepared to pay something for the system. There were no significant differences between age groups in willingness to pay; the 50+ group had a slightly higher percentage of people prepared to pay more and a slightly smaller percentage not wanting to pay anything, compared to the other age groups. (eSafety Challenge 2011)

To summarize the results on user acceptance of the emergency braking system, around half of the respondents were aware of the system in the previous studies, men having a higher awareness than women. The awareness increased over time. The total willingness to have and pay for the system was high compared to other systems in the studies, and respondents aware of the systems had a higher willingness to have and pay compared to those unaware of the system. The willingness to pay also increased over time.

2.3.3 Eco-driving assistance

With eco-driving assistance it is easier to drive more eco-friendly. The system instructs the driver how to drive in the most energy efficient way, the system may display e.g. how much fuel and energy is being used. It may also instruct the driver to use the right gear to minimize emissions. The system might also warn the driver to keep to the limit, i.e. with a speed alert system. Some applications also have an "eco-drive indicator" that indicates when the driving is consuming less fuel and is eco-friendly. (Kulmala, Öörni 2012) The system can reduce fuel usage and emissions by 3-11% (Öörni, Mäurer 2012).

Trommer and Höltl (2012) carried out a study as part of the eCoMove project (Castermans et al. 2010) about users' perceived usefulness and acceptance of the systems. They collected 5807 answers from 11 countries in the EU. The systems studied were: eCoTripPlanning, eCoDrivingSupport and eCoPost TripAnalysis. They found that the respondents viewed the systems to be useful. The only variable the respondents disagreed with was willingness to pay, as none of the systems were thought to be worth paying for. Background factors considered in the correlation between the perceived usefulness of the systems were: country, age, driving experience, annual vehicle mileage and experience of using navigation applications. However, they found no significant connection between the respondents' background and their opinions of the system. (Trommer, Höltl 2012)

The green driving application in the TeleFOT project is comparable to the eco-driving assistance in the iMobility Challenge. Depending on the country, 41-65% of the respondents, wished to keep the green driving application. There was no difference in willingness to keep between frequent and non-frequent users. The other background factors did not have any influence either on the willingness to keep. Depending on the country an application, 4-17% of the respondents were prepared to pay for green driving, 80-95% of these selecting to pay €1-10/month. The background factors did not have any impact on willingness to pay, except in one country where frequent users had a higher willingness to pay than non-frequent users. The correlation between the perceived benefits and willingness to keep and pay was significant in all countries. (Karlsson et al. 2013)

To summarise the results on user acceptance of eco-driving assistance systems, there was no connection between the respondents' background variables and opinions of the system in the previous studies. The perceived benefits of the system did, however, influence the willingness to keep and pay. The respondents did not consider the system worth paying for, or were only prepared to part with a small amount every month.

2.3.4 Real-time traffic information

Real-time traffic information helps the driver take the best route depending on the surrounding weather conditions and congestion by suggesting the most efficient and safest alternative. Thus, it also improves the safety of driving and helps the driver avoid congestion and consequent pile-ups. By waning of dangerous conditions like slippery roads, the system further enhances safety; it is estimated that the use of real-time traffic information can reduce accidents related to slipperiness by 5-15%. The effect on fuel consumption and emission can either be positive or negative. (Kulmala, Öörni 2012)

The traffic information application in the TeleFOT project was comparable to real-time traffic information in the iMobility Challenge. Willingness to keep the system was 35-76%, depending on the country and application. Frequent users had a higher willingness to keep compared to non-frequent users. The other background factors had no influence on willingness to keep. Willingness to pay for the system was 3-23%, depending on the country and application, 90% of whom were prepared to pay €1-10/month. The correlation between perceived benefit and willingness to keep and pay was significant in all countries. (Karlsson et al. 2013)

To summarise the results on user acceptance of real-time traffic information, there was only a connection between frequent usage of the systems and willingness to keep, the other background factors having no influence. The perceived benefits also significantly correlated with willingness to keep and pay.

2.3.5 Start-stop assistance

With a start-stop assistance system, the engine shuts down when the car stands still. It starts again when pressing the clutch (manual transmission) or when releasing the brake (automatic transmission). The purpose is to reduce idling time in traffic and thus decrease emissions. (Katirtzidis 2011) Start-stop assistance can reduce total CO_2 emissions by 4-6% from traffic; the effects are greater in urban areas and especially on congested roads; in areas with a lot of congestion CO_2 emissions can be cut by as much as 15-25% (Klunder et al. 2009). No results were found on user acceptance of start-stop assistance in the current literature

2.3.6 Tyre pressure monitoring system

The tyre pressure monitoring system gives a warning when the air pressure of the tyres is too low. A flat tyre increases fuel consumption and the tyre wears more quickly. The system gives two warnings, the first to alert the driver that the pressure is getting low, and if the tyre is not inflated the second warning alerts that the pressure is dangerously low. Using tyre pressure monitoring system could reduce CO_2 emissions by 1.2% in the EU (Klunder et al. 2009). No results were found on user acceptance of tyre pressure monitoring systems in the current literature.

3. Method

3.1 Data collection and questionnaire

To collect data, an Internet survey was carried out in five countries: the Czech Republic, Finland, Germany, the Netherlands and Spain. The total sample size was 5 051, almost equally distributed between the countries; over 1 000 responses was collected from each country. TNS Gallup was in charge of the local market research companies collecting the data in each country. The survey was done in February 2014.

The survey targeted active car users driving more than 1 500 km per year between the ages of 18 and 74. Respondents driving less were excluded from the study.

In the questionnaire (Appendix 1) the respondents were first asked about:

- Their driving background
- How many kilometres they drive annually
- How often they usually drive on different road types (urban environment, highways in urban areas, highways in rural areas and rural roads)
- Whether they use weekly any other modes of transportation (bicycle, motorcycle or public transport).

Next the respondents were asked about their car ownership and purchase patterns:

- Whether they have a car
- Whether it is their own or whether they share it with someone
- What brand, model, type and age the car is
- Whether they bought their car as new or pre-owned
- How often they usually change cars.

They were then asked about their next car:

- Whether they plan to buy their own or get a company car
- If the former, whether the car will be pre-owned or new

Following this the respondents were asked to estimate how much they would spend on their next car, and to choose from a list of 12 the three most important features of a new car, such as engine, appearance, safety, consumption and CO_2 emissions.

Once the background information was collected the questionnaire moved on to cover all six systems. The following factors had been identified to be of importance in the user aspect study and were included in the questionnaire:

- Awareness of the systems
- Experience of the systems
- Attitudes toward the systems
- Perceived usefulness of the systems
- Perceived benefits of the systems
- Willingness to have the systems
- Willingness to pay for the systems

For each system the respondents were asked about these seven factors. The systems were covered separately and when moving to a new system the respondents were first given a short description of it. These were:

"Speed alert alerts the driver with audio, visual and/or haptic (driver needs to apply more pressure on the acceleration pedal) feedback when the speed exceeds a limit set by the driver or the legal fixed speed limit. "

"Advanced Emergency Braking Systems warn you about the danger of potential collisions and when there is no reaction to the warning, activate the brakes together with the systems such as seatbelt pre-tension to avoid mitigate a crash."

"*Eco-driving assistance assists and encourages eco-driving by providing information to the driver about the current fuel consumption, energy use efficiency and appropriate gear selection taking into account engine and transmission efficiency, vehicle speed and rate of acceleration etc."*

"Real-time traffic information is information to the driver on traffic (congestion) and weather conditions for choosing the most effective route or for preparing to cope with a foreseeable situation ahead."

"Start-and stop systems automatically shut down and restart a vehicle's internal combustion engine to reduce the engine's idling time: when the vehicle comes to a stop, the engine is automatically switched off. In the case of manual transmission, this will take place once the gear level is in neutral and the clutch pedal has been released."

"A tyre pressure monitoring system alerts the driver when the vehicle's tyres are below their ideal pressure."

First the respondents were asked about their familiarity with the system, whether they had heard or read about the system, tried the system, or did not know of the system. If the respondents did not know of the system in question they moved on to the next system. If the respondents had tried the system they were asked about how often they used it, and depending on the system they were given different alternatives. For speed alert, eco-driving assistance and start-stop assistance these were:

- I have tried it a few times
- I am using it occasionally
- I am using it regularly
- I am using it all the time when I can

For the emergency braking and tyre pressure monitoring systems the response alternatives were:

- Never
- Less than five times
- Six up to ten times
- More often
- I do not remember

For real-time traffic information the response alternatives for mapping the usage of the system were:

- Daily
- Weekly
- Monthly
- Less often

The respondents who were aware of the system were then asked more detailed questions. First they had to rate the usefulness of the systems on different road types (urban streets, rural roads and highways) on a scale of 1 (not useful at all) to 7 (very useful). Next they were asked to rate the benefits of each system on a similar scale of 1 (not important at all) to 7 (very important). The benefits of each system were formulated as statements. Depending on the system the respondents were asked to evaluate different benefits, ranging from three to six statements. Common benefits for all the systems were:

- It improves the safety of driving
- It improves the comfort of driving
- It reduces fuel consumption

After the perceived usefulness and benefits of the systems the respondents were asked about their willingness to have the system in their next car. The response alternatives available were:

- Definitely not
- Most probably not
- Do not know yet
- Most probably yes
- Definitely yes

And for willingness to pay:

- Nothing
- Up to 100 €
- 101 – 200 €
- 201 – 300 €
- 301 – 400 €
- 401 – 500 €
- 501 – 600 €
- 601 – 1 000 €
- I do not know

Lastly the respondents were asked about their socio-economic background.

- Country of residence
- Gender

- Year of birth
- Size of household
- Household's gross monthly income.

3.2 Models

In this study the factor "willingness to use the system" was considered as the factor "intention to use". A regression analysis was carried out to see which factors influence the users' willingness to use the system. The user's perceived usefulness, ease of use of the system, demographic variables and social context were included in many of the acceptance models described in Chapter 2. In this study the factors included for user acceptance were the respondents' socio-economic background, background related to driving and car purchasing, knowledge about the system in question, perceived usefulness and perceived benefits of the system (

Figure *11*).

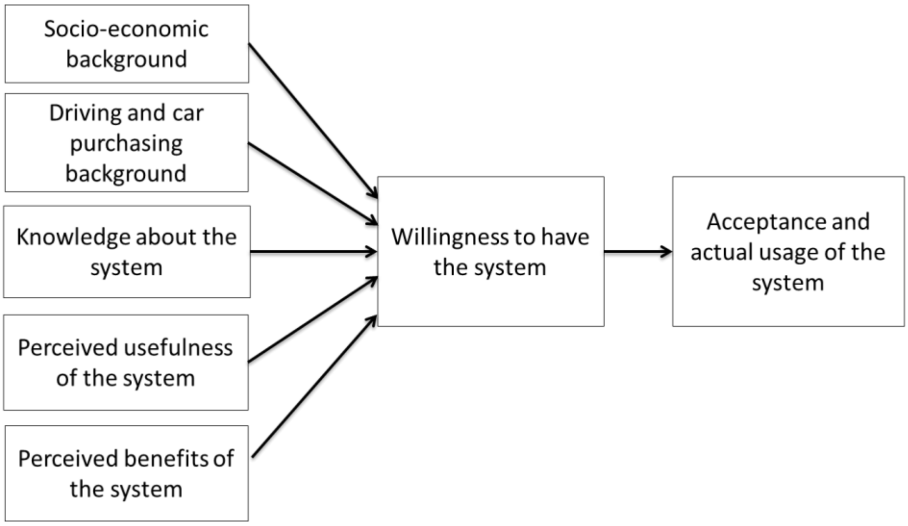

Figure 11. Model for measuring users' acceptance of the systems

The same principle was used for description of the early adopters of the systems. An early adopter was considered to be someone who was using the systems regularly. A regression analysis was carried out to see which factors influence early adoption of the systems. Factors included in the analysis were the respondents' socio-economic background, background related to driving and car purchasing, perceived usefulness and perceived benefits of the systems (

Figure *12*).

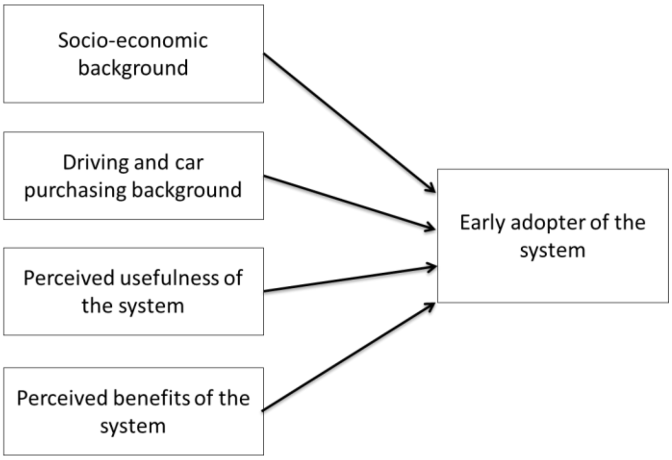

Figure 12. Model for identifying early adopters of the systems

The same method was also used to identify the profile of respondents unaware of the systems. A regression analysis was carried out to see which factors influence this unawareness. Since respondents who stated that they were unaware of the system were not asked any further questions about the system, factors included in the analysis were only their socio-economic background and their background related to driving and car purchasing (

Figure *13*).

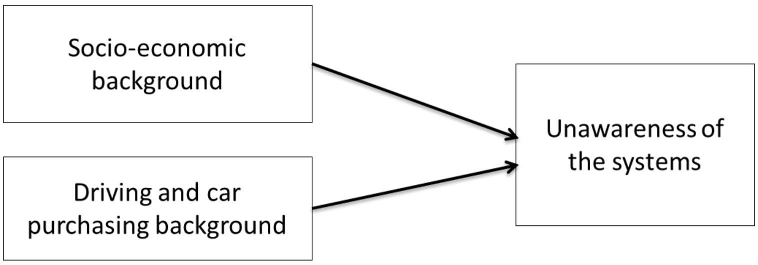

Figure 13. Model for identifying respondents unaware of the systems

3.3 Statistical methods

To find out what likely contributes to acceptance, early adoption and unawareness of the systems a regression analysis was done; since the variables were categorical, a logarithmic regression analysis was chosen. A multinomial logarithmic regression model (Equation 1) predicts the probability of a value belonging to a certain class (Nummenmaa 2004).

$$\ln \frac{P}{1-P} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k \quad (1)$$

Where P is the categorised value

β_0 is a constant term

$\beta_{1\ldots k}$ are regression coefficients

$x_{1\ldots k}$ are x-variable values (independent variables)

The analysis was done as a multinomial regression analysis with SPSS software. A logistic regression model is first evaluated for suitability to the data, after which the variables included in the model are studied. The suitability of the model is evaluated with chi-square tests (X^2-test) for the model fitting information and the goodness of fit and with a pseudo R-square. The model fitting information test first creates a model with only the constant term β_0, then a model with all the independent variables, and the two models are compared using a chi-square test. If the two models do not differ, the constant term can itself explain the variation in the dependent variable, since adding the independent variables does not improve the result, i.e. the model does not fit the data. Small p-values (significance level ≤ 0.05) related to this chi-square test indicate a good model. (Nummenmaa 2004).

The goodness of fit is also based on a chi-square test. However, the test compares the expected frequencies to the observed frequencies, i.e. how well the model categorises the observations compared to the expected categorisation (Equation 2**)**. If these two categorisations do not differ, the model fits the data, i.e. large p-values (significance level > 0.05) related to the chi-square test indicate a good model. (Nummenmaa 2004).

$$\boldsymbol{X}^2 = \sum \frac{(f_0 - f_e)^2}{f_e} \qquad (2)$$

Where f_0 is the observed frequencies

f_e is the expected frequencies

The Nagelkerke pseudo R-square is similar to the R-square in linear regression; it estimates how much of the variation in the dependent variable the model can predict. However, the pseudo R-square is not as determining in logistic as in linear regression analysis.

To see whether the independent variables are statistically significantly influencing the model, a likelihood-ratio test is done. $\beta_{1\ldots k}$ are the regression constants for each independent variable $x_{1\ldots k}$ in the model. If the regression constant is zero, the related variable is not significant for the model. The variable's suitability is tested with a t-test, and the variables are viewed as statistically important at a significance level of 0.05. (Nummenmaa 2004)

Depending on the analysis (acceptance, early adopters or unawareness of the systems), different variables were included (

Figure *11*,

Figure *12* and

Figure *13*). The socio-economic background included the respondents' age and household income. The background related to driving and car purchasing included annual vehicle mileage, the estimated price of their next car and whether their next car would be used or new. Their knowledge about the system included whether the respondent was a frequent user of the system or not. The perceived usefulness of the system was the mean value of how useful the respondents viewed the system to be on all three road types. The perceived benefit of the system was the mean value of how important the respondents viewed all the system's benefits. To facilitate the analysis the categorical variables were converted to binary variables (Table 1).

Table 1. Conversion of categorical variables to binary variables

	0	**1**
Gender	Male	Female
Age group	18-44 year olds	45-74 year olds
Household income	< €5 000/month	> €5 000/month
Kilometres	1 500 - 10 000 km/ year	> 10 000 km/year
Price of next car	< €20 000	> €20 000
Next car new/used	Most probably or definitely used	Most probably or definitely new
Frequent usage	Never or occasionally	Regularly or often
Perceived usefulness	Mean value < 3.5	Mean value ≥ 3.5
Perceived benefits	Mean value < 3.5	Mean value ≥ 3.5

3.4 Respondents

The respondents were divided into groups based on their age (Figure *14*). First, the following age groups were used: 18-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69 and 70-74. These groups were then compared based on their driving behaviour, car ownership and demographic background. The following variables were compared: annual vehicle mileage, whether they had their own car, whether their next vehicle would be new, the price of their next vehicle, monthly household income, and family size. These answers were used to combine preliminary age groups (above) into less but still homogeneous groups. Finally new age groups were formed: 18-29, 30-39, 40-54, 55-64 and 65-74 (Table 2). The age groups were not of the same size, the 18-29 and 65-74 groups being smaller. However, they were important to keep as their own groups to show the differences between young and old drivers.

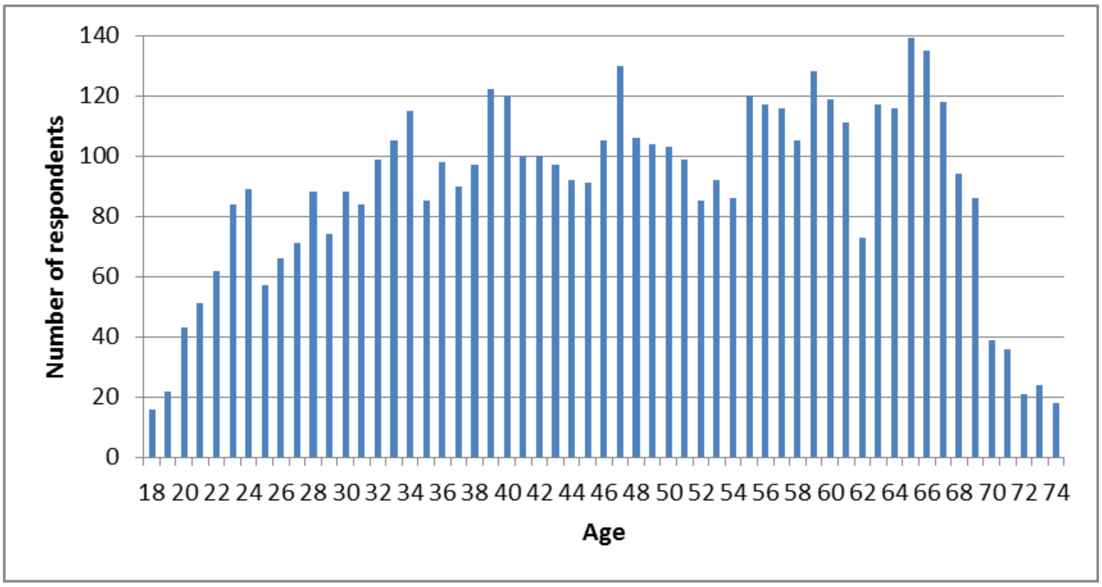

Figure 14. Age distribution of respondents

Table 2. Selected age groups and sizes

Age groups	N	Percentage
18-29	662	14%
30-39	936	20%
40-54	1535	30%
55-64	1100	22%
65-74	787	14%
Total	5020	100%

The average age of the respondents was 47 years and the number of male respondents (56%) slightly higher than that of female respondents (44%). Age group 18-29 was the least representative regarding gender distribution. Age group 18-29 had more female than male respondents and age group 30-39 was equally divided between the genders; the remaining age groups had a majority of male respondents (Figure *15*).

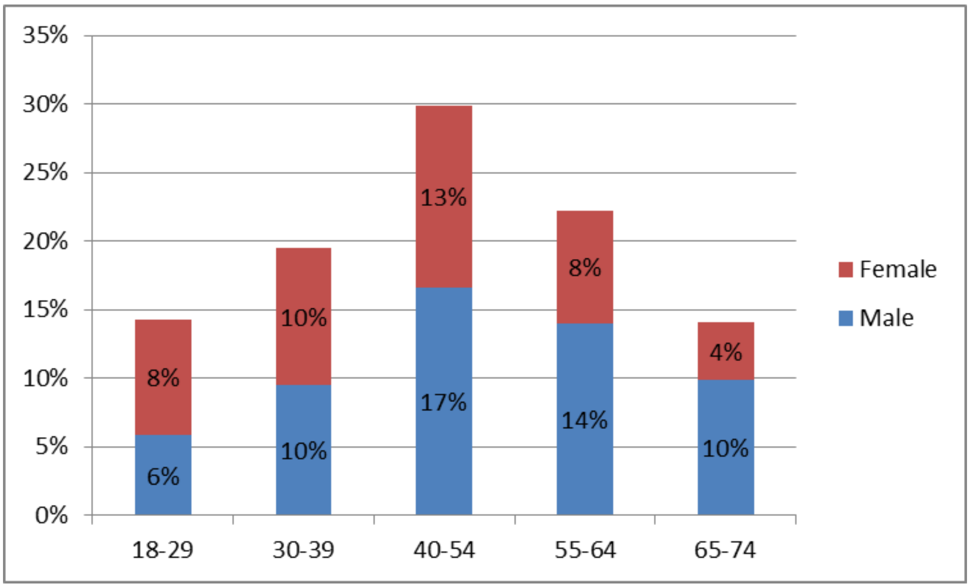

Figure 15. Selected age groups and their gender distribution

Most of the respondents lived in a household of two persons. The total distribution of households was: 15% living alone, 41% with two persons, 20% with three persons, 18% with four, and 6% with five persons (Figure *16*). Women's and men's family relations did not differ substantially, but the men lived to some extent more often in two person and women in three or four person households. Age group 65-74 had the largest difference compared to the other age groups; 73% of them lived in a household with two persons and the proportion of larger families with three or more people was only 10%, which is natural. Age group 55-64 also had a higher number of two person households, at 56%. Age groups 30-39 and 40-54 had the largest families, 58% or more living in three person households, but the 18-29 age group had the highest number of households (12%) with five persons or more.

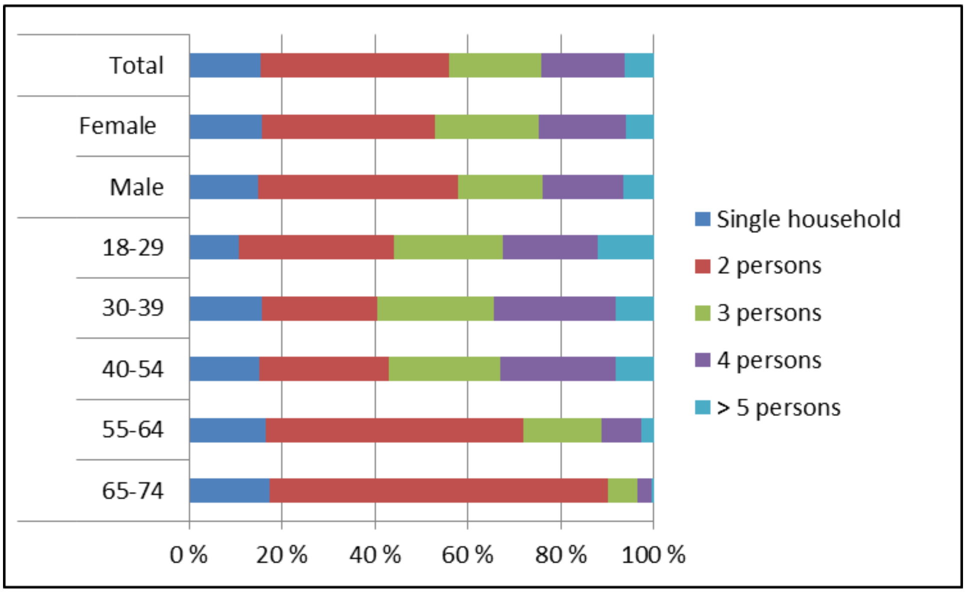

Figure 16. Respondents' household sizes

Of the respondents' households, 42% had a monthly oncome of less than €3 000, 27% earned €3 001-5 000, 11% earned €5 001-7 500, 4% earned €7 501-10 000, 3% earned more than €10 000, and 14% did not know (

Figure *17*). Comparison of monthly incomes between men's and women's households, showed a higher percentage of men's households earning €3 001 – 10 000 but more women answering "I don't know". Of the age groups, 40-54 and 55-64 year olds had the highest household monthly income and 18-29 year olds the lowest.

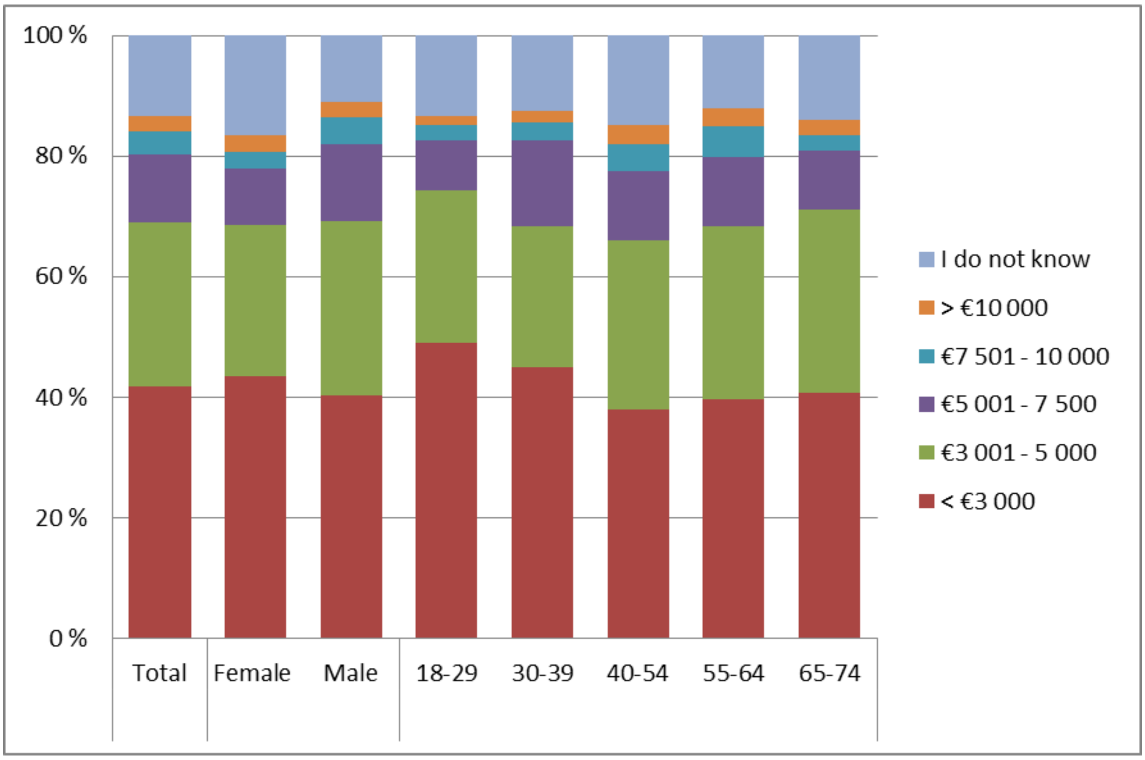

Figure 17. Gross monthly income of respondents' households

4 Results

All the results concerning the respondents' background related to driving, car purchasing, awareness, experience, attitudes, and willingness to have and pay for the systems are presented below by gender and age group. For identifying acceptance, early adopters and unawareness of the systems results from the regression analysis will be presented.

4.1 Background variables

To determine the connection between the different background variables a correlation analysis was performed (

*Table **3***). The connection was statistically important if the p-value was less than 0.05. A strong correlation (p-value less than 0.01) was found between the respondents' household income and age, household income and intention to buy a pre-owned or new next car, and household size and how often they changed cars.

Table 3. Statistically significant correlations between the background variables; X is p<0.05 and XX p<0.01

	Country	Gender	Age	Kilometres/ year	Car ownership	Car type	Car age	Car changing time	Next car new/ pre-owned	Price of next car	Household income	Household size
Country												
Gender												
Age	x	x										
Kilometres/year	x	x										
Car ownership	x	x	x	x								
Car type		x	x	x	x							
Car age	x		x	x	x	x						
Car changing time	x	x	x	x	x	x	x					
Next car new/pre-owned	x	x	x	x	x		x	x				
Price of next car	x	x	x	x		x	x	x	x			
Household income	x	x	**xx**	x		x	x	x	**xx**	x		
Household size	x		x	x	x	x		**xx**		x	x	

4.2 Background related to driving

The most common (35% of participants) annual vehicle mileage was 10 – 20 000 km; the second most common (26% of participants) was 5-10 000 km (Figure *18*). Men drove in general more than women; 45% of the women drove more than 10 000 km per year and 15% more than 20 000 km, the respective percentages for men being 67% and 28%. The 18-29 year olds drove the least among the age groups and only 45% of them drove more than 10 000 km annually and 15% more than 20 000 km. The 40-54 age group drove the most, 65% covering more than 10 000 km and 29% more than 20 000 km annually.

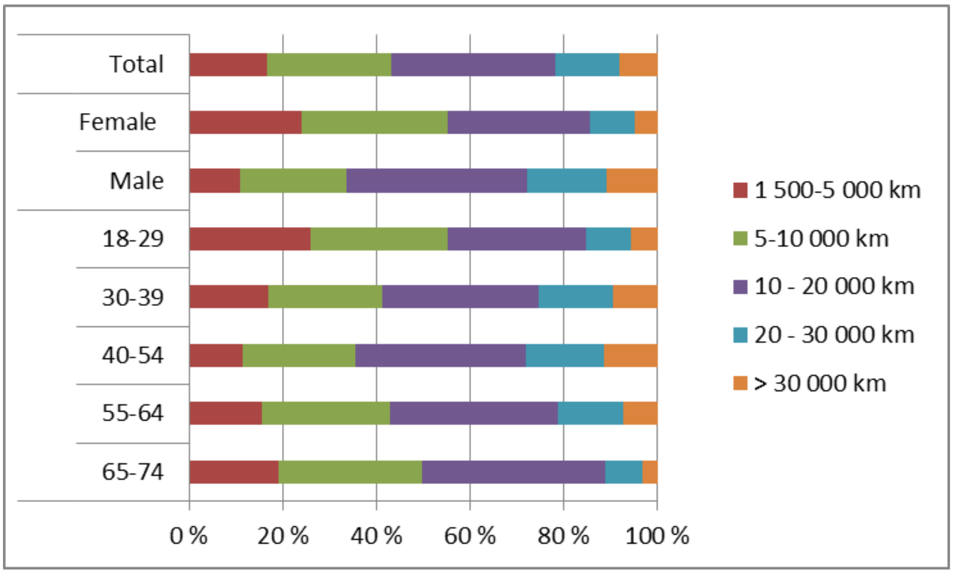

Figure 18. Kilometres driven annually

The most common road type used by the respondents was urban environment; 89% drove in urban environments at least weekly and 52% daily (Figure *19*). The daily usage of highways in urban areas and rural roads was almost equal, being around 20%, but the other driving habits varied, highways in urban areas had a higher percentage of people driving weekly and monthly compared to rural roads. Rural roads had the highest share of “never” responses, 10%, as opposed to the other driving environments, where it was less than 2%.

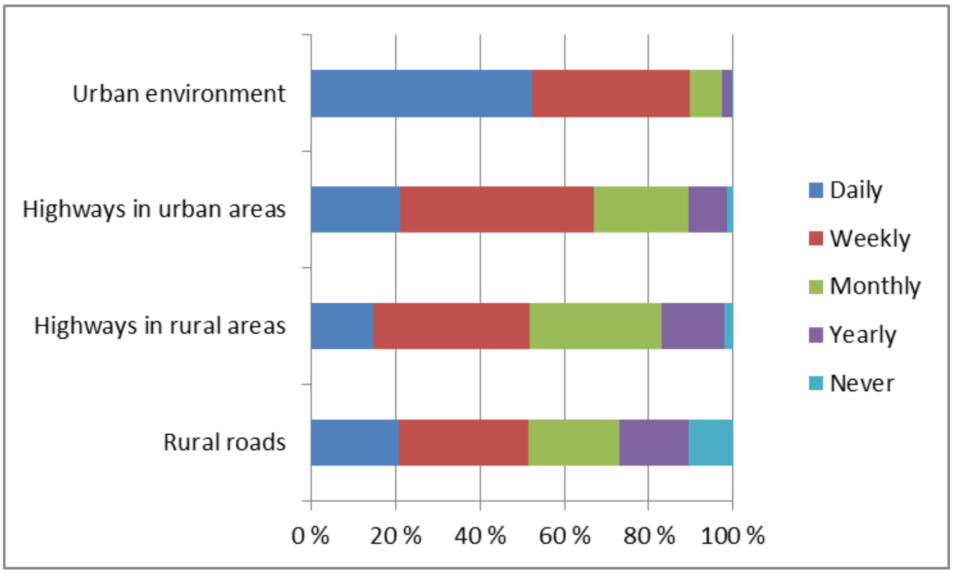

Figure 19. Respondents’ driving habits on different road types

As mentioned above, urban environment was the most common driving environment in the survey; 52% drove daily and 89% at least weekly in urban environments. Male respondents drove more in urban environments compared to females (Figure *20*). Age groups 30-39 and 40-54 drove most often in urban environments compared to the other age groups; nearly 60% drove daily in urban environments. Age group 65-74 drove least often in urban environments compared to the other age groups; less than 40% drove daily in urban environments.

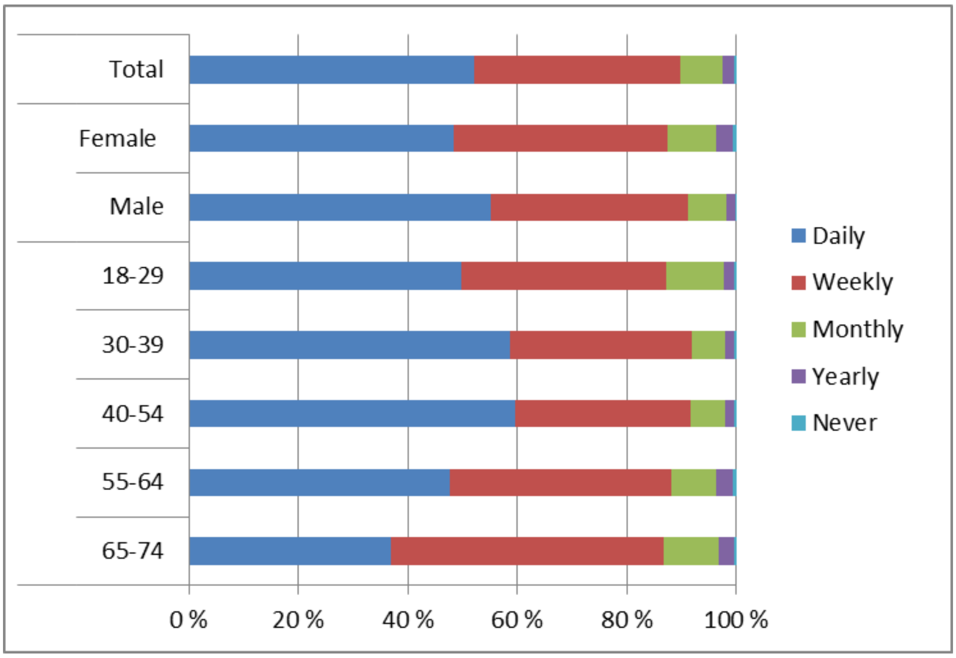

Figure 20. Respondents' driving frequency in urban environments

Highways in urban areas were the second most common road type among the respondents, of which 21% drove daily and 46% weekly on highways in urban areas (Figure *21*). Men drove more often on highways in urban areas than women did; 72% of the men and 61% of the women drove weekly or more often on urban highways. Age groups 30-30 and 40-54 drove most on this road type compared to the other age groups.

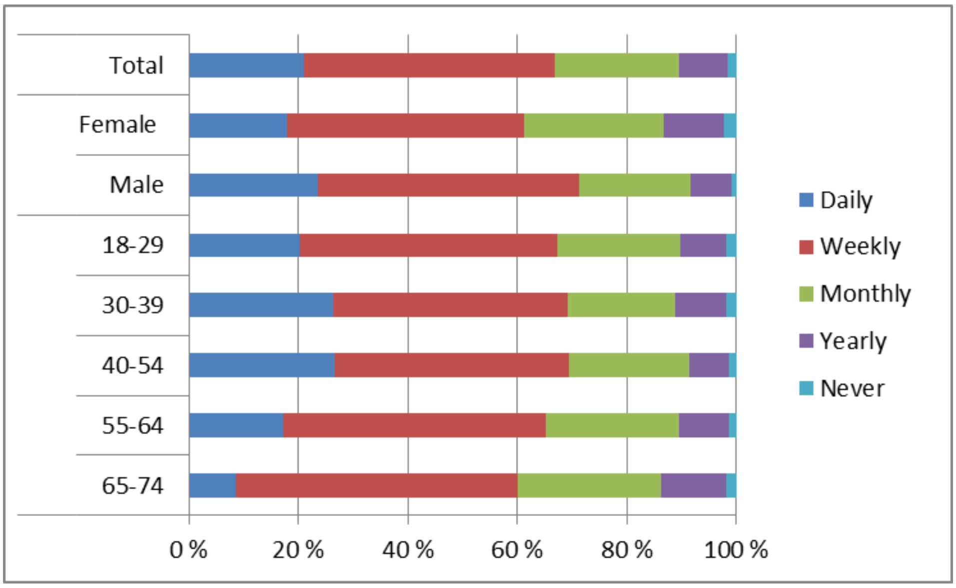

Figure 21. Respondents' driving frequency on highways in urban areas

Of the respondents, 15% drove daily on highways in rural areas and 37% weekly (Figure *22*). The weekly usage was higher for men (40%) than for women (33%), and the yearly and never shares were smaller. Daily usage was the smallest for age group 65-74 (7%). Age group 40-54 had the highest usage of highways in rural areas.

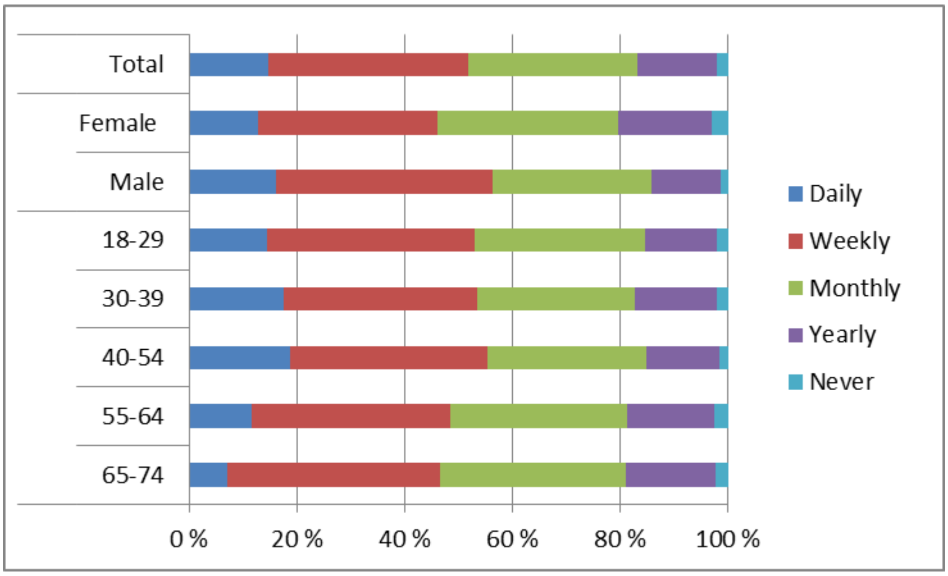

Figure 22. Respondents' driving frequency on highways in rural areas

Rural roads were the least frequent driving environment among the respondents. The daily and weekly usage was the same as for highways in rural areas, at around 20%, but the share of non-users was much higher for rural roads (Figure *23*); 10% of the respondents never drove on rural roads, as opposed to 2% for highways in rural areas. Men drove slightly more often on rural roads compared to women; 54% of the men and 48% of the women drove at least weekly on rural roads. Age group 30-39 had the highest usage of rural roads; 56% drove at least weekly on rural roads, and only 6% never drove on rural roads. Age group 65-74 had the lowest usage of rural roads compared to the other age groups; 15% drove daily and 16% never on rural roads.

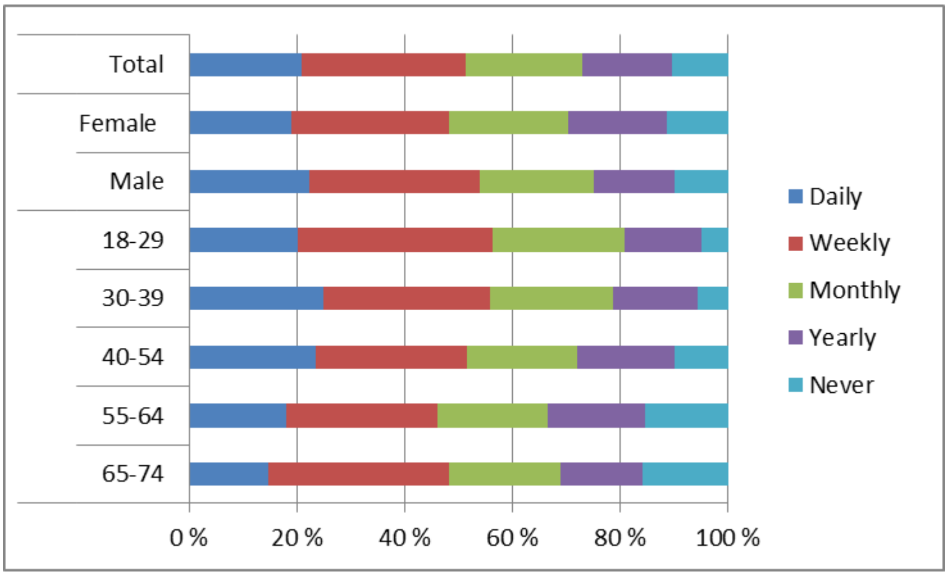

Figure 23. Respondents' driving frequency on rural roads

4.3 Car purchasing

According to the respondents, consumption and safety were the two most important features when buying a new car; around 50% of the respondents viewed them as important (Figure *24*). The least important feature was CO_2 emissions; 4% viewed it as important and less than 10% viewed resale value and transmission as important factors.

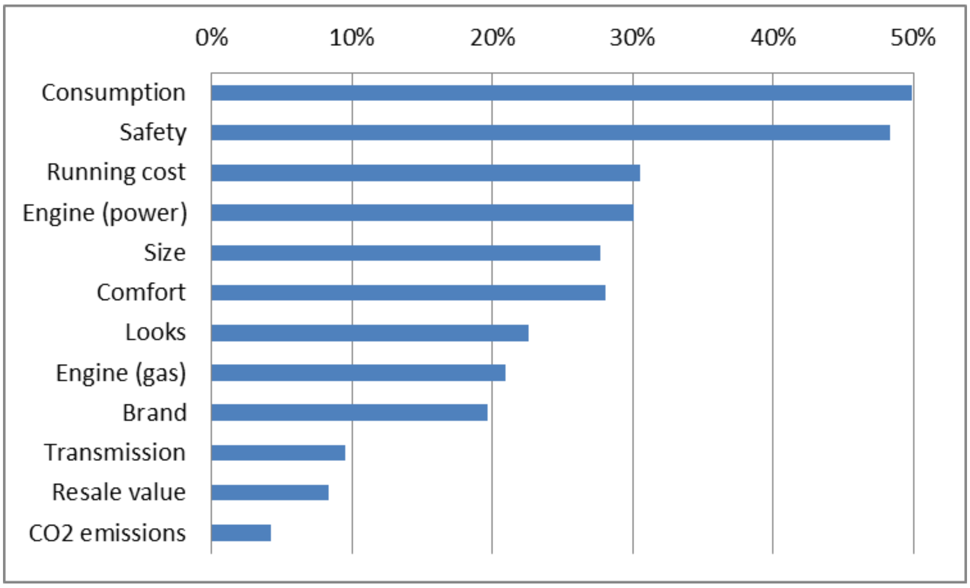

Figure 24. The most important features when buying a new car (Öörni, Penttinen 2014)

Comparison of the age groups' views of important features of new cars revealed some differences between them (Figure *25*). All age groups viewed consumption as an important feature, but safety was not the second most important feature for all age groups. Age groups 55-64 and 65-74 considered safety to be the most important and consumption the second most important feature, while age groups 30-39 and 40-54 put safety in the second place. Among 18-29 year olds 13% viewed safety as the most important feature, making it third most important feature, whereas 19% of 65-74 year olds viewed it as most important making it the most important feature on their list. Age group 18-29 considered looks to be the second most important feature, whereas for older age groups this was only ninth on the list.

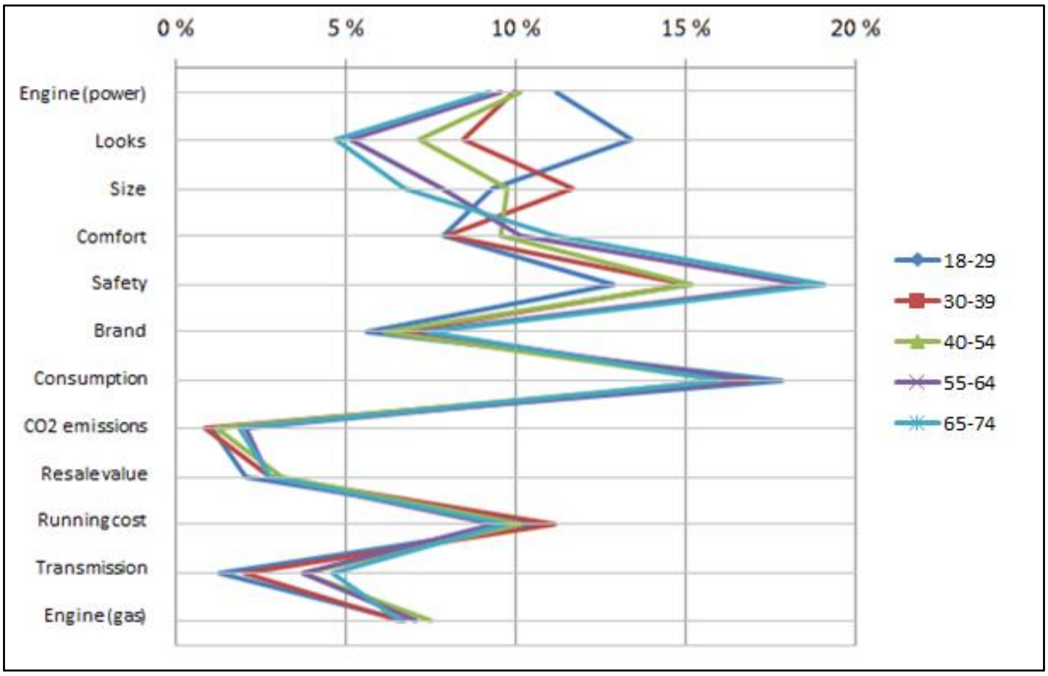

Figure 25. Important features of a new car by age group

4.4 Awareness of the systems

The awareness included respondents who had either heard or used the system (Figure *26*). Most were people who had heard of or read about it; actual usage was low, ranging from 5% (emergency braking) to 19% (eco-driving and start-stop assistance). The lowest awareness was in relation to the tyre pressure monitoring system (54%) and the highest regarding start-stop assistance (69%).

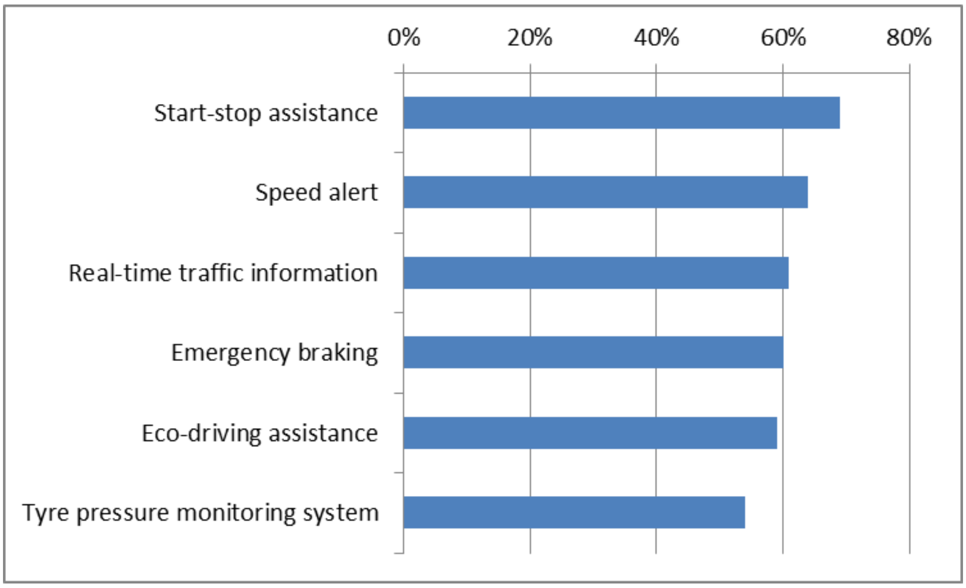

Figure 26. Total awareness of the systems

Start-stop assistance had the highest awareness compared to the other systems, and together with eco-driving assistance the highest actual usage; 19% had used it and 50% had read or heard about it and, giving a total awareness of 69% (*Figure 27*). Men had a higher awareness of the system compared to women; 55% of the men and 44% of the women had heard or read about it and 23% of the men and 16% of the women had used it. Age group 40-54 had the highest awareness (72%) compared to the others. Age group 18-29 had the highest number of respondents who did not know the system (34%), and age group 65-74 the lowest share of respondents who had tried the system (15%).

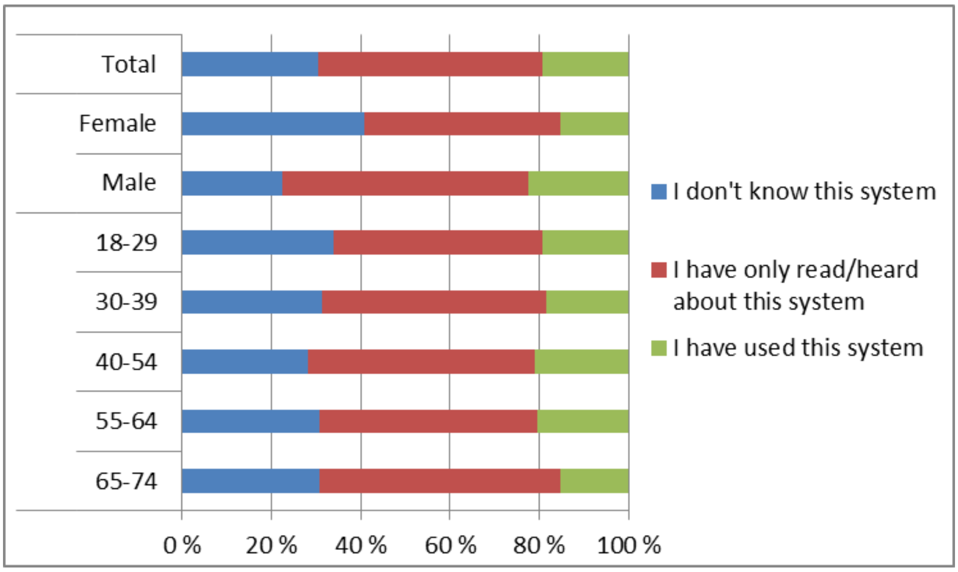

Figure 27. Awareness of start-stop assistance

The total awareness of speed alert was 64% (Figure *28*), 49% having only read or heard about it and 15% having used it. Men had greater awareness of the system than women; 43% of the women did not know the system compared to 31% of the men. Only 11% of the women had tried the system, compared to 18% of the men. The age groups had almost the same awareness of speed alert, around 36%. The 18-29 age group had the lowest unawareness but also the lowest actual usage. Age groups 55-64 and 65-74 had the highest percentage of using the system (17%).

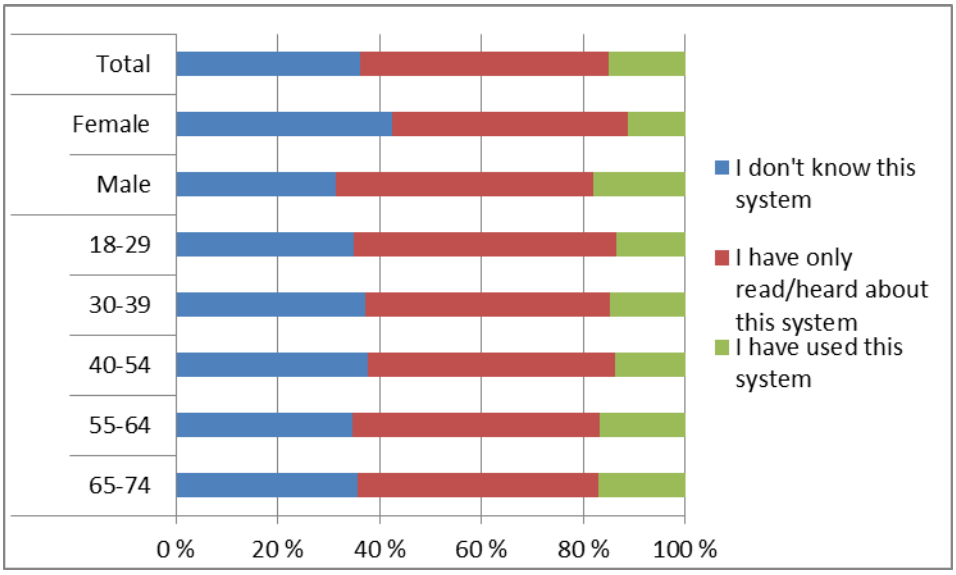

Figure 28. Awareness of speed alert

The total awareness of real-time traffic information was 61%, 48% having read or heard about the system and 13% having tried it (Figure *29*). Men were more aware of the system than women; their total awareness was 69% and women's 50%. Age group 55-64 had the highest awareness of the systems compared to other age groups; they had the highest usage (15%) and were the least unaware (34%) of the system. Age group 18-29 had the lowest awareness (56%) and usage (11%) of the system compared to the other age groups.

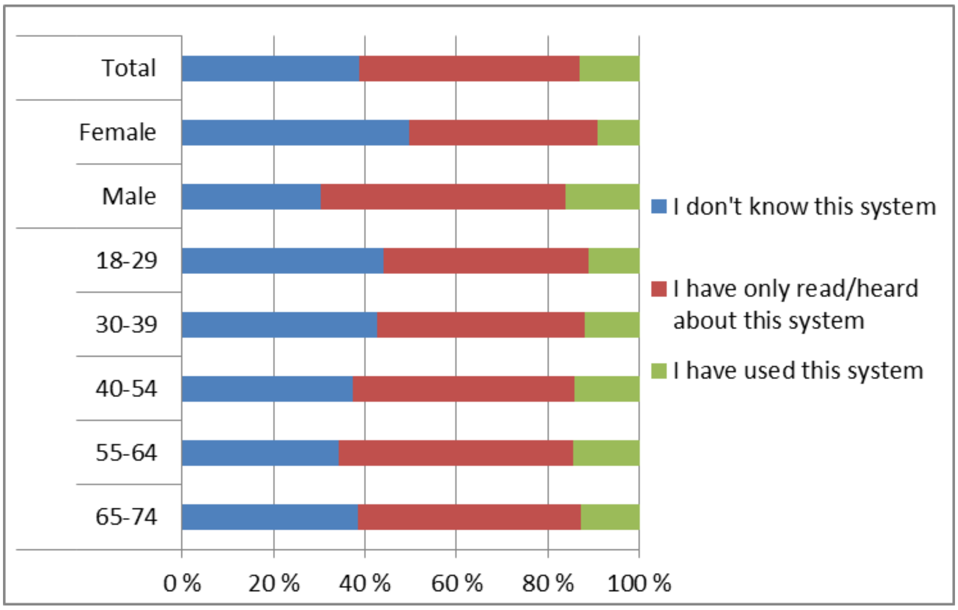

Figure 29. Awareness of real-time traffic information

Emergency braking had the lowest percentage of actual usage compared to the other systems, only 5% had tried the system (Figure *30*) but 55% had heard about it, thus the total awareness was 60%. Women had a lower awareness of emergency braking compared to men; 52% of the women and 31% of the men did not know the system. Age group 18-29 had used the system the most, 7% compared to 3% of 65-74 year olds who had tried system the least. Age groups 18-29 and 40-54 had the fewest "I don't know this system" answers (39%).

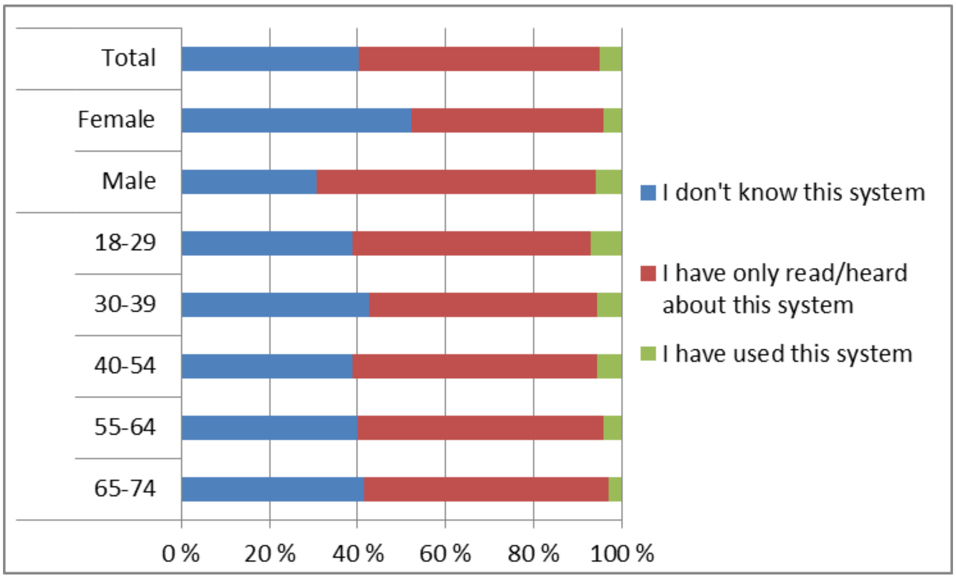

Figure 30. Awareness of emergency braking

Eco-driving assistance, in addition to start-stop assistance, had the highest actual usage compared to the other systems (19%) and 40% of the respondents had read or heard about it (Figure *31*). The total awareness of the system was 59%. Men were more aware of the system compared to women; 43% of the men and 37% of the women had read or heard about it and 22% of the men and 15% of the women had used it. Age group 55-64 had the highest usage among the age groups, and also the lowest percentage of "I do not know this system" answers. Age group 18-29 had the lowest awareness and experience of the system compared to the other age groups.

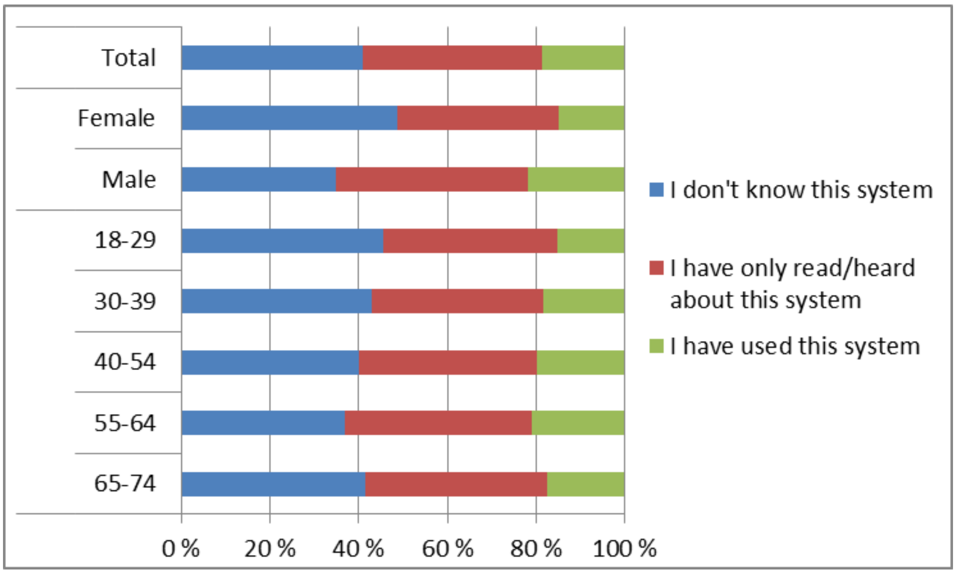

Figure 31. Awareness of eco-driving assistance

The tyre pressure monitoring system had the lowest total awareness compared to other systems; only 54% of the respondents had heard of, read about or tried the system (Figure *32*). Men had a higher awareness of the system compared to women; 49% of the men and 31% of the women had read or heard about the system and 17% of the men and 8% of the women had tried it. Age group 65-74 had the highest awareness of the system (57%) and age group 18-29 the lowest (47%).

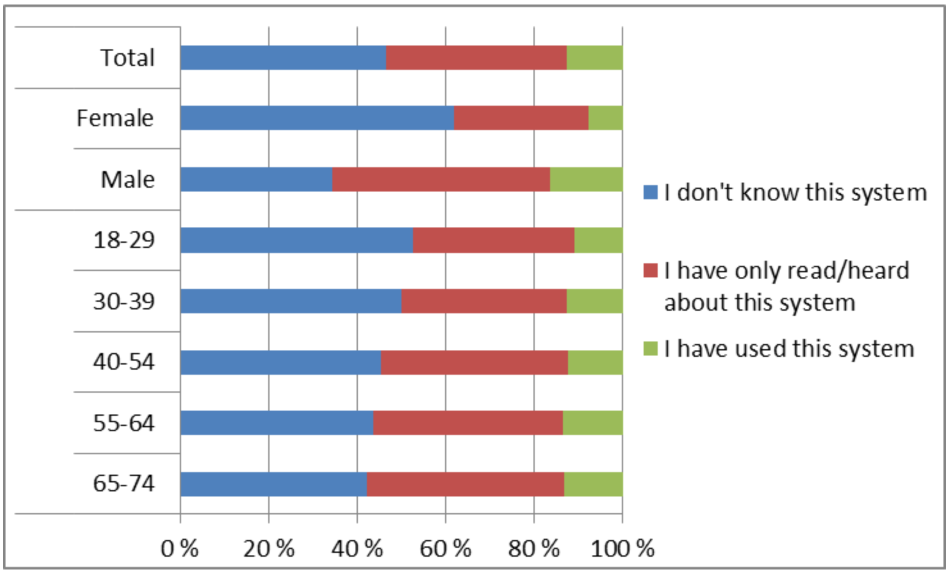

Figure 32. Awareness of the tyre pressure monitoring system

Summarising the results for awareness of the systems, start-stop assistance had the highest total awareness (69%) compared to the other systems (54-69%) and the tyre pressure monitoring system the lowest. Start-stop assistance also had the highest total usage together with eco-driving assistance (19%) compared to the other systems (5-19%), whereas emergency braking had the lowest actual usage (5%). Men had a higher total awareness of all the systems (43-69%) compared to women (31-57%); they also had a higher actual usage of all the systems (6-23%) compared to women (5-15%). There were no consistent differences in awareness between the age groups; 18-29 year olds usually had the highest percentage of respondents unaware of the systems and the lowest percentage of respondents having tried them.

4.5 Experience of the systems

Respondents answering that they had used a system were asked about their experience of the system, i.e. how often they had used it. Depending on the system there were different response alternatives. Respondents who were not aware of the system moved on to the next system and those who had only read or heard about it moved to the question on attitudes towards the system. Eco-driving assistance and real-time traffic information had the highest regular usage compared to the other systems (Figure 33).

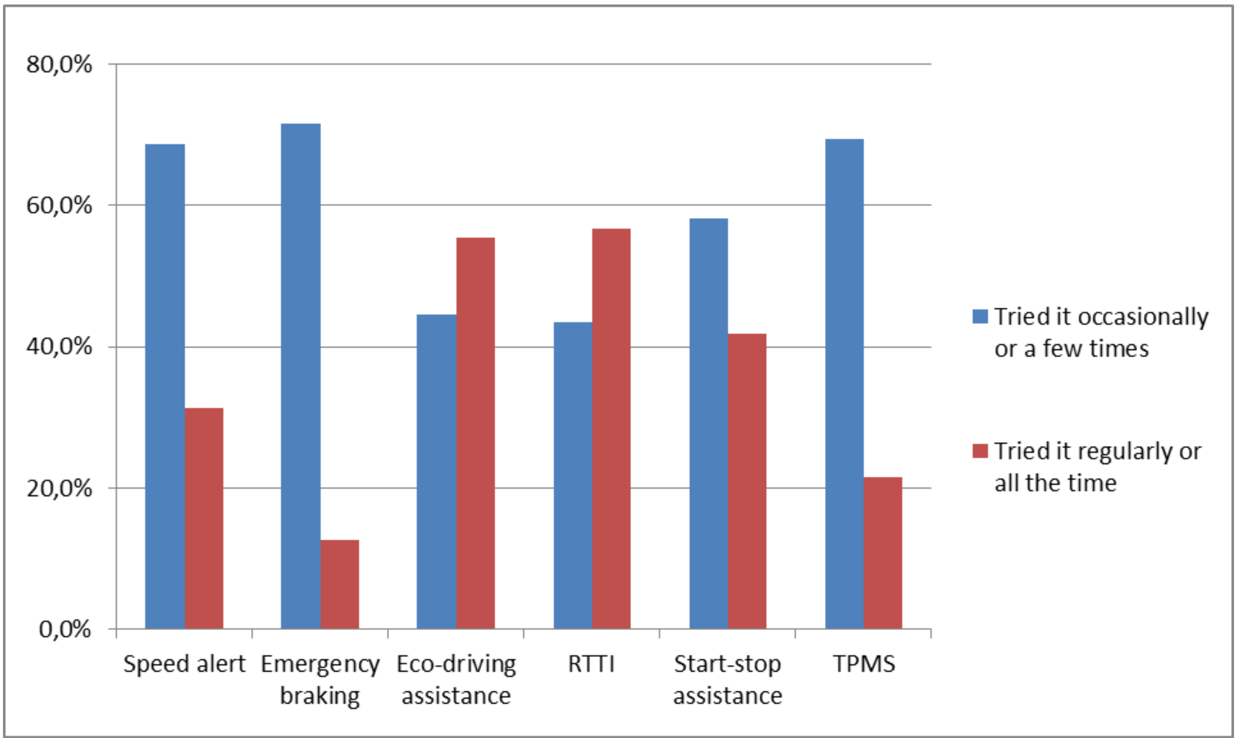

Figure 33. Experience of the systems

Of all the respondents, 44% were using real-time traffic information weekly or daily and 23% were using it monthly (Figure *34*). Women were using it slightly less often compared to men, 27% men and 22% women using it daily. Age group 65-74 were using the system the most compared to other age groups; 32% were using it daily and 13% weekly. Age group 30-39 were using it the least; 25% were using it monthly and 38% less often.

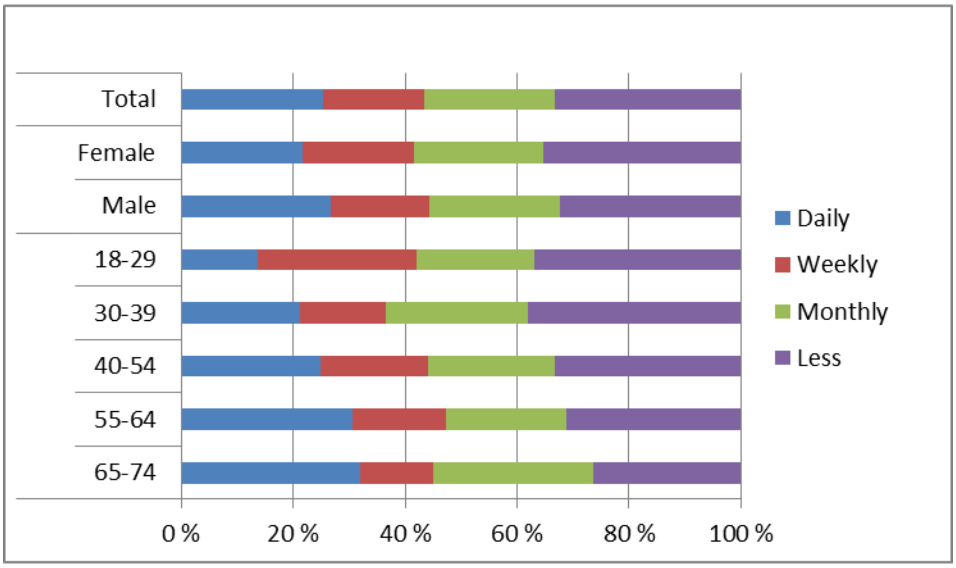

Figure 34. Experience of real-time traffic information

For eco-driving assistance 45% of all the respondents had used it occasionally or only a few times and 55% regularly or all the time (Figure *35*). Men were using the system more frequently than women; 57% of the men and 52% of the women used it regularly or more often. Age group 55-64 had the highest experience compared to other age groups, when comparing how many use it regularly or more often. Age groups 18-29 had the highest share of respondents who had tried the system only a few times (35%).

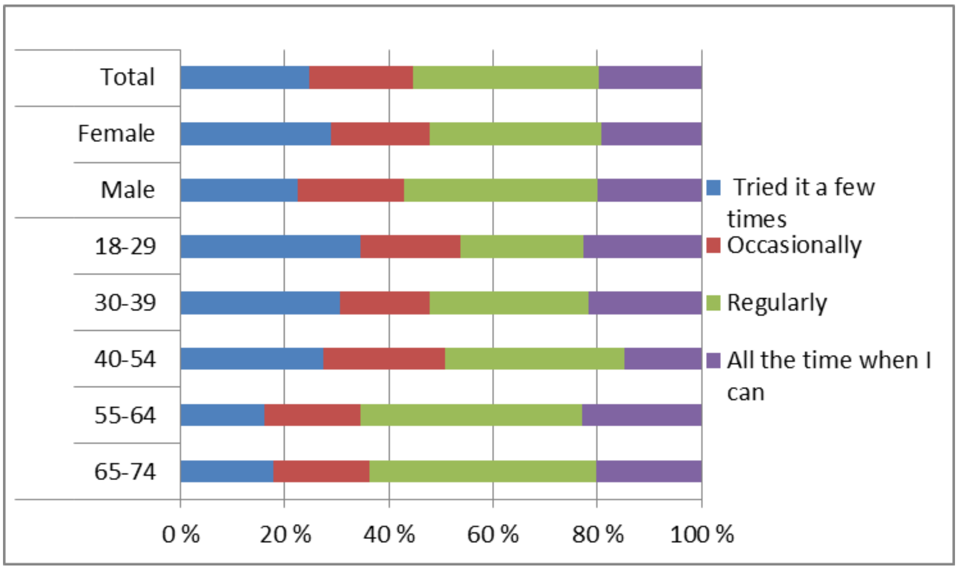

Figure 35. Experience of eco-driving assistance

Of all the respondents, 58% had only tried start-stop assistance a few times and 42% were using it regularly or all the time (Figure *36*). Men and women had almost the same experience of the system; the only difference was that women had a slightly higher percentage of regular users and men a slightly higher percentage of respondents using it all the time. Age group 65-74 had the highest usage of the system; 54% used it regularly or all the time and only 34% had only tried it a few times. Age group 18-29 had the lowest experience of the system; 53% had used it only a few times.

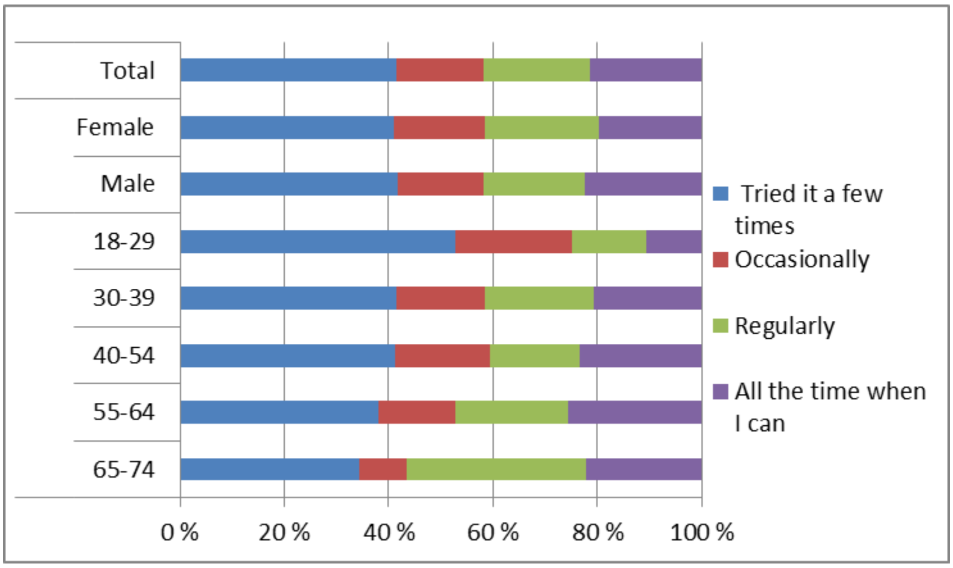

Figure 36. Experience of start-stop assistance

Of all the respondents, 32% were using speed alert regularly or all the time and 68% occasionally or less often (Figure *37*). Women were using speed alert more occasionally or had only tried it a few times compared to men (71% for women and 68% for men). Age group 65-74 had the most experience of speed alert compared to other age groups, 43% using it regularly or more often. Age groups 18-29 and 30-39 had the least experience of the system, 22% using it regularly or all the time.

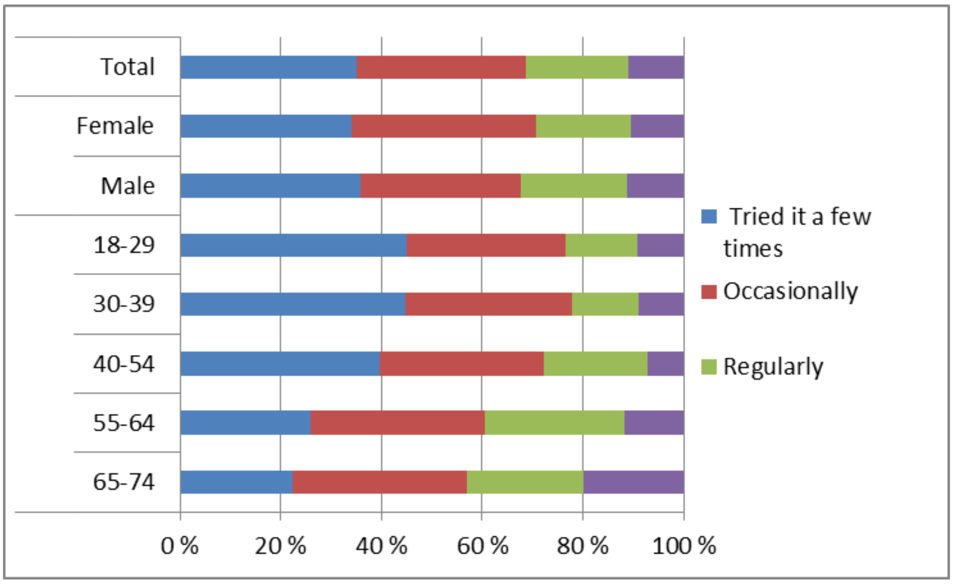

Figure 37. Experience of speed alert

Of all the respondents, 70% had experienced the tyre pressure monitoring system five times or less and 21% more than that (Figure *38*); 22% of the men and 17% of the women had never experienced it, but 17% of the men and 12% women had experienced it more than 10 times. The women also had a slightly higher rate of “I do not know” answers. Age group 65-74 had the least experience of the system, 30% never having tried a tyre pressure monitoring system. Age group 30-39 had the most experience, 25% having experienced it more than six times.

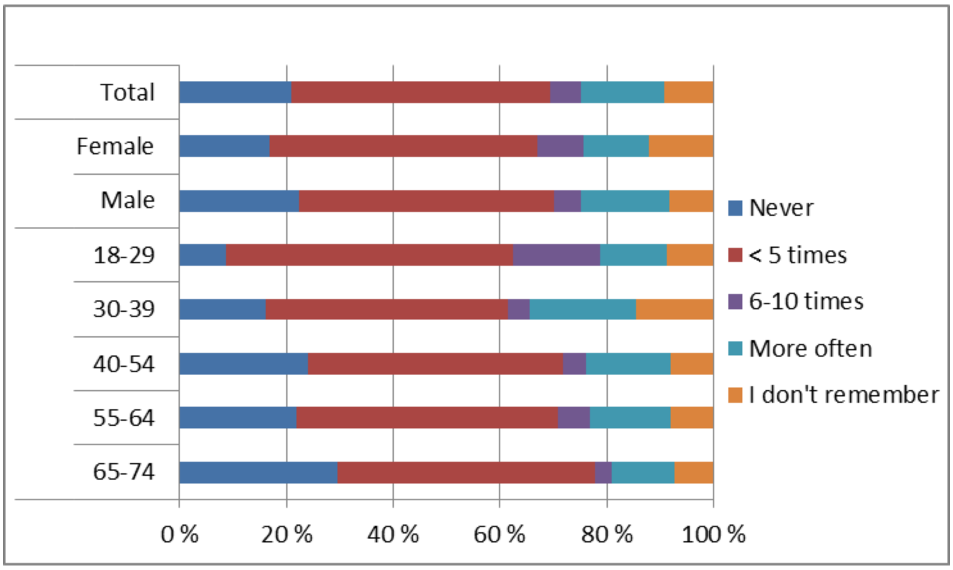

Figure 38. Experience of the tyre pressure monitoring system

Most of the respondents (71%) had experienced emergency braking five times or less and 13% more than that (Figure 39). Men had a higher percentage of "never" answers compared to women, but women answered more frequently "I do not remember." Men also had a higher number of respondents having experienced it six times or more compared to women; 7% of the men and 2% of the women had experienced it six to 10 times, and 10% of the men and 4% of the women more often. Age group 65-74 had the most experience compared to other age groups; 19% had experienced it more often than six times. Age group 55-64 had the highest percentage of "never" answers (35%).

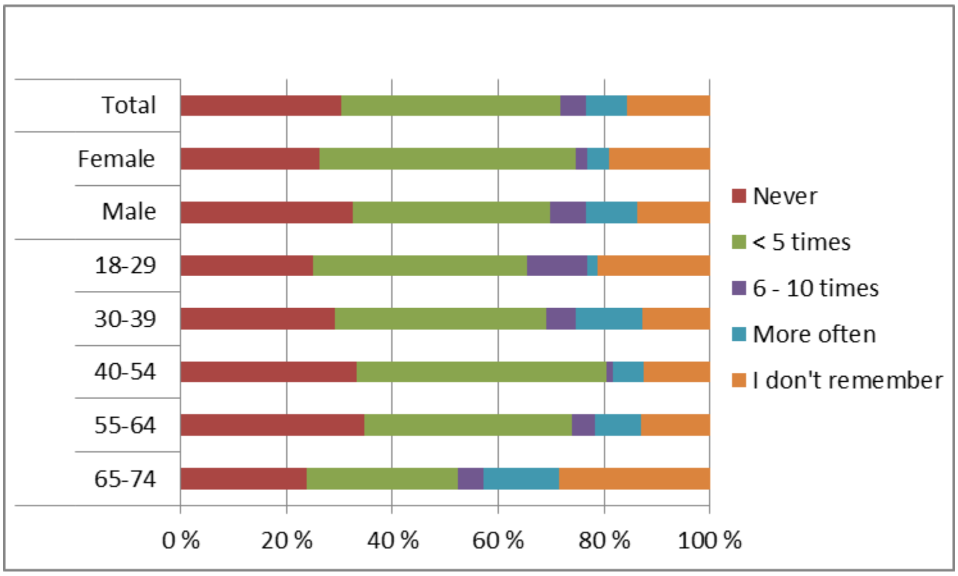

Figure 39. Experience of emergency braking

Summarising the results for experience of the systems, participants were least experienced with the tyre pressure monitoring system and emergency braking systems, which had the least usage compared to the other systems; 70% of the respondents had experienced them less than five times. This is to be expected considering the nature of these systems, they only interact with the driver in special circumstances. Eco-driving assistance was the most used system, with 55% of the respondents using it regularly or all the time. Real-time traffic information had different response alternatives but it was also popular among the respondents, with 43% using it weekly or daily. Men had higher usage of all systems compared to women, but the difference for some systems was minimal. The older age groups (55-64 and 65-74) usually had higher usage of the systems compared to the younger age groups (18-29 and 30-39), except for the tyre pressure monitoring system where it was the other way around.

4.6 Attitudes towards the systems

First the respondents were asked to evaluate the usefulness of the systems on three different road types – urban streets, rural roads and highways – on a scale of 1 (not useful at all) to 7 (very useful). They were then asked to evaluate the importance of different benefits on a scale of 1 (not important at all) to 7 (very important). The benefits differed depending on the system and more benefits were included for some systems in addition to the three common ones "It improves safety," "It improves comfort," and "It reduces fuel consumption."

4.6.1 Usefulness of the systems

On urban streets, emergency braking was viewed as the most useful system (Figure *40*). The tyre pressure monitoring system was considered the most useful system on rural roads and on highways real-time traffic information was the most useful.

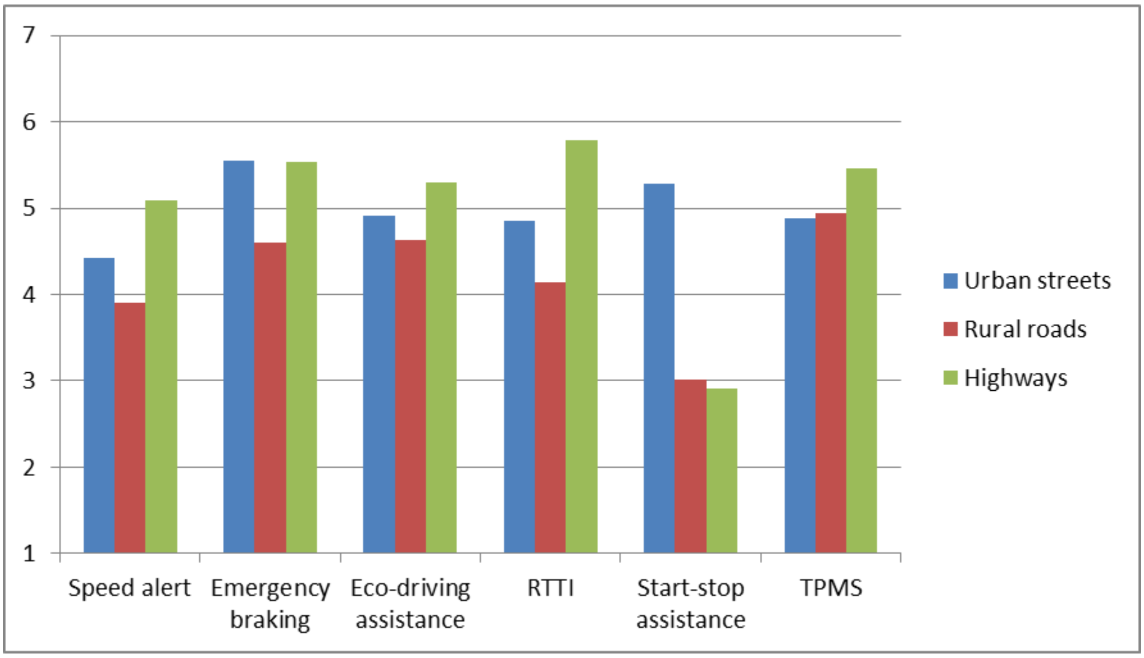

Figure 40. Usefulness of the systems on a scale of 1 (not useful at all) to 7 (very useful)

The total usefulness of emergency braking was slightly higher on urban streets (5.6) than on highways (5.5) and emergency braking was viewed as the least useful on rural roads (4.6) (Figure *41*). Women viewed emergency braking as the most useful on highways and men on urban streets, but the differences between genders for these road types were not large, ratings being around 5.4-5.7. Men viewed the system as less useful on rural roads than did women, the mean usefulness for men being 4.5 and for women 4.8. All age groups viewed the system as slightly more useful on urban streets than on highways, except for 65-74 year olds, and as least useful on rural roads. Age group 18-29 rated the system almost equally useful on all road types. Age group 65-74 had the highest and lowest ratings of the system, 4.4 on rural roads and 5.9 on highways.

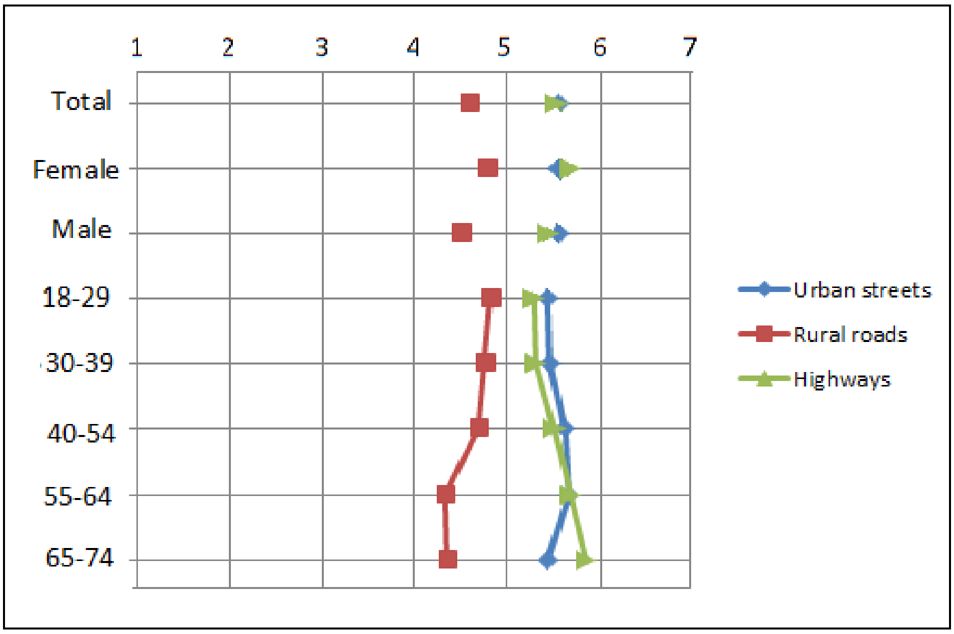

Figure 41. Usefulness of emergency braking on a scale of 1 (not useful at all) to 7 (very useful)

The respondents considered the tyre pressure monitoring system to be most useful on highways Figure 42). The usefulness on urban streets and rural roads was almost the same for every group, being 4.9 for both road types. The ratings for the different road types were similar within the different demographic groups. Nevertheless, women viewed the system as more useful on all road types compared to men. Age group 55-64 viewed the system as most useful on all road types (5.0-5.7) compared to the other age groups (4.7-5.5). Age group 65-74 considered the system to be least useful on both urban streets (4.7) and rural roads (4.7) compared to the other age groups (4.8-5.0 and 4.9-5.0, respectively).

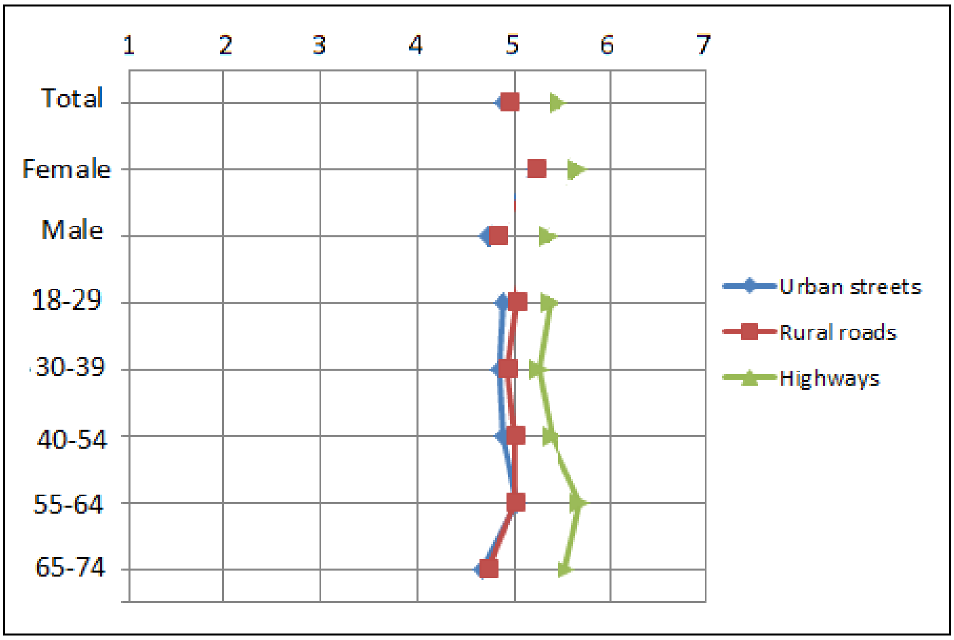

Figure 42. Usefulness of the tyre pressure monitoring system on a scale of 1 (not useful at all) to 7 (very useful)

The usefulness of eco-driving assistance did not differ substantially on the different road types Figure 43). The overall opinion was that it is most useful on highways (5.3), secondly on urban streets

(4.9) and least useful on rural roads (4.7). Women viewed the system as slightly more useful on all road types compared to men. The 18-29 year olds found the system almost equally useful on all road types, the mean value being between 5.0-5.1 for all road types. Age groups 55-64 and 65-74 had both the lowest and the highest ratings for the usefulness of eco-driving assistance; the usefulness on rural roads was 4.4 for both age groups and on urban streets 5.5 (55-64) and 5.4 (65-74).

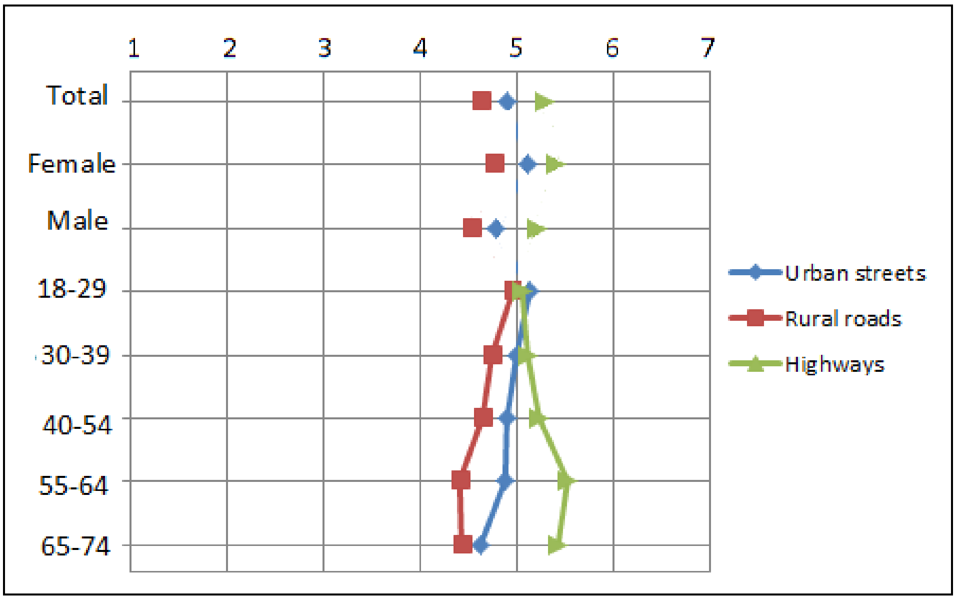

Figure 43. Usefulness of eco-driving assistance on a scale of 1 (not useful at all) to 7 (very useful)

There were rather large differences in the respondents' views of the usefulness of real-time traffic information on different road types (Figure 44). All demographic groups found it to be most useful on highways and least useful on rural roads. The total usefulness on highways was 5.8, on urban streets 4.9 and on rural roads 4.1. Women gave a slightly higher rating to the system on all road types compared to men. The system's usefulness on highways was almost the same for all age groups, but varied slightly on urban streets and rural roads. The younger age groups (18-29 and 30-44) viewed the system to be more useful on urban streets and rural roads compared to the older groups.

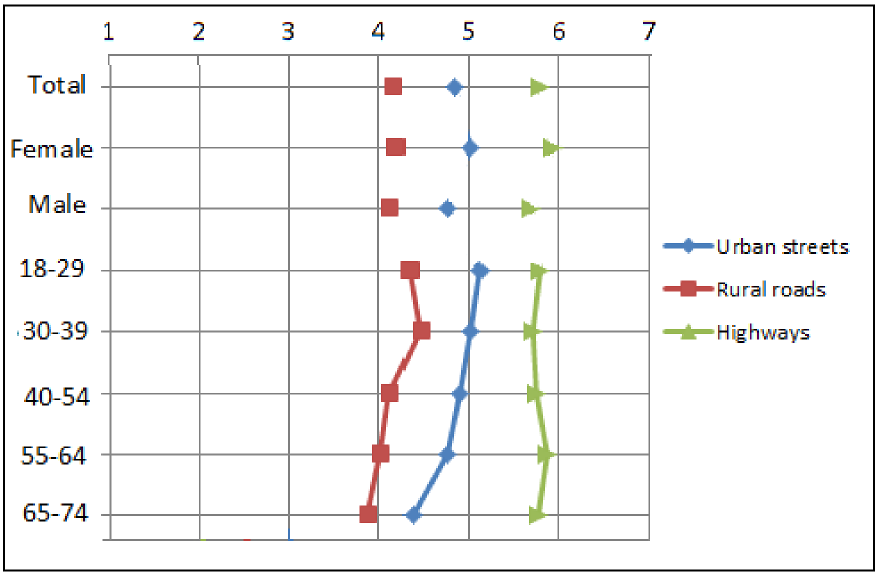

Figure 44. Usefulness of real-time traffic information on a scale of 1 (not useful at all) to 7 (very useful)

Speed alert was considered to be most useful on highways and least useful on rural roads by both genders and all age groups. The total usefulness on rural roads was 3.9, on urban streets 4.4 and on highways 5.1 (Figure 45). Women viewed speed alert to be more useful on all road types than did men. The highest usefulness was found to be on highways by women (5.3) and age groups 55-64 (5.4) and 65-74 (5.4). Age group 18-29 did not find the usefulness to differ substantially between urban streets and highways, compared to other age groups. Among the age groups, 18-29 year olds gave the highest score to the usefulness on urban streets (4.5).

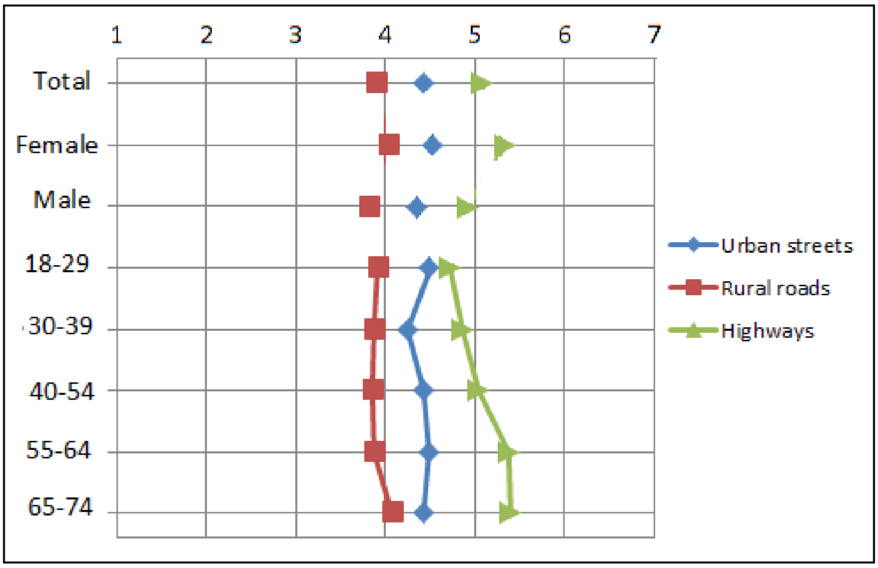

Figure 45. Usefulness of speed alert on a scale of 1 (not useful at all) to 7 (very useful)

Start-stop assistance was considered by all groups to be clearly more useful on urban streets (5.3) than on rural roads (3.0) or highways (2.9) (Figure *46*). The usefulness on rural roads and highways received similar responses within the different demographic groups. The usefulness on urban streets did not vary much between the groups, being between 5.1-5.4. Women viewed the system as more useful on rural roads and highways than did men; on urban streets both genders assigned the same rating. Age group 18-29 rated start-stop assistance on rural roads as more useful (3.4) compared to other age groups (3.0). On highways, 30-39 year olds found the system to be least useful (2.7) compared to other age groups (around 3.0).

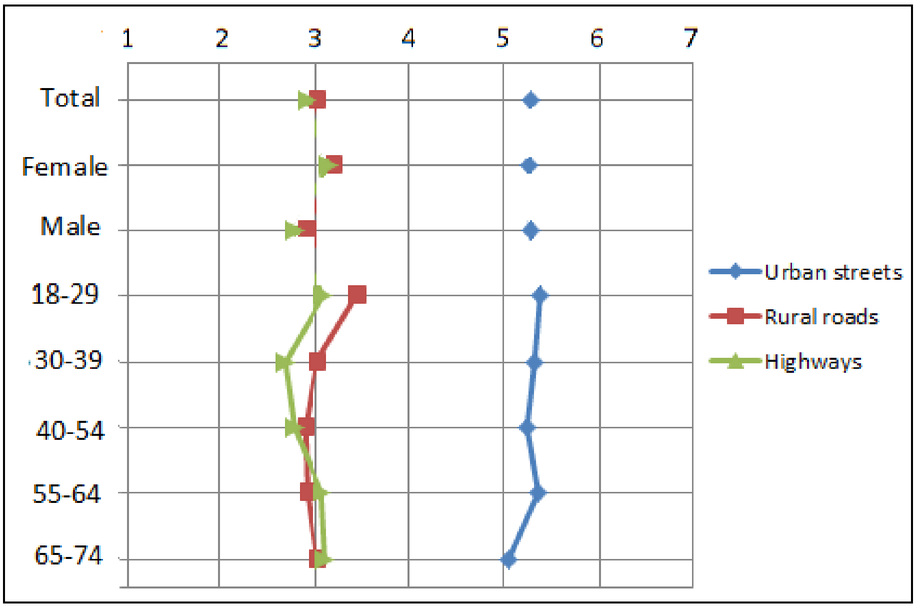

Figure 46. Usefulness of start-stop assistance on a scale of 1 (not useful at all) to 7 (very useful)

4.6.2 Benefits of the systems

The respondents were asked about the importance of different benefits, three benefits being common to all functions: "It improves safety," "It improves comfort," and "It reduces fuel consumption." The importance of improving safety was highest for emergency braking (Figure *47*). For improving the comfort of driving, the tyre pressure monitoring system got the highest score. The importance of reducing fuel consumption was the highest for eco-driving assistance. The tyre pressure monitoring system got the highest importance for all three benefits compared to the other systems.

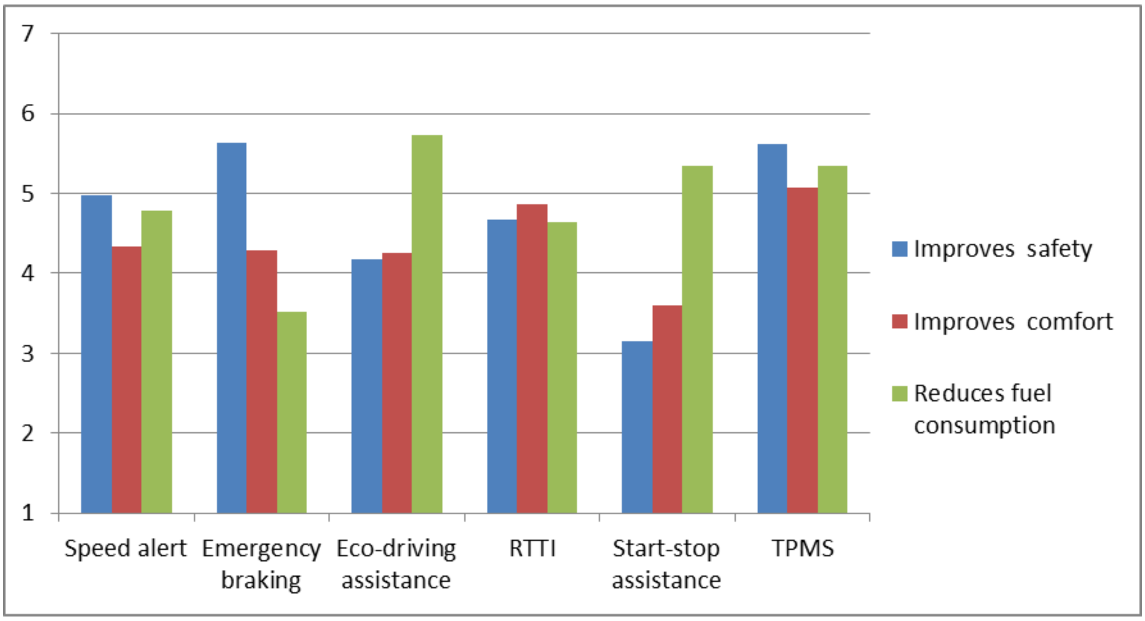

Figure 47. Benefits of the systems on a scale of 1 (not important at all) to 7 (very important)

For the tyre pressure monitoring system, only the importance of the three common benefits was asked about. The importance of all three benefits was high for all demographic groups (Figure *48*). The most important benefit was the improvement of safety (5.6), followed by reduction of fuel consumption (5.3) and finally improvement of driving comfort (5.1). Women viewed the system's benefits to be of greater importance than did men (5.4-5.9 vs. 4.9-5.5). Age group 55-64 gave the highest rating of the benefits' importance (5.2-5.8) compared to the other age groups (4.9-5.6) and age group 65-74 gave the lowest rating (4.9-5.4) of all the age groups.

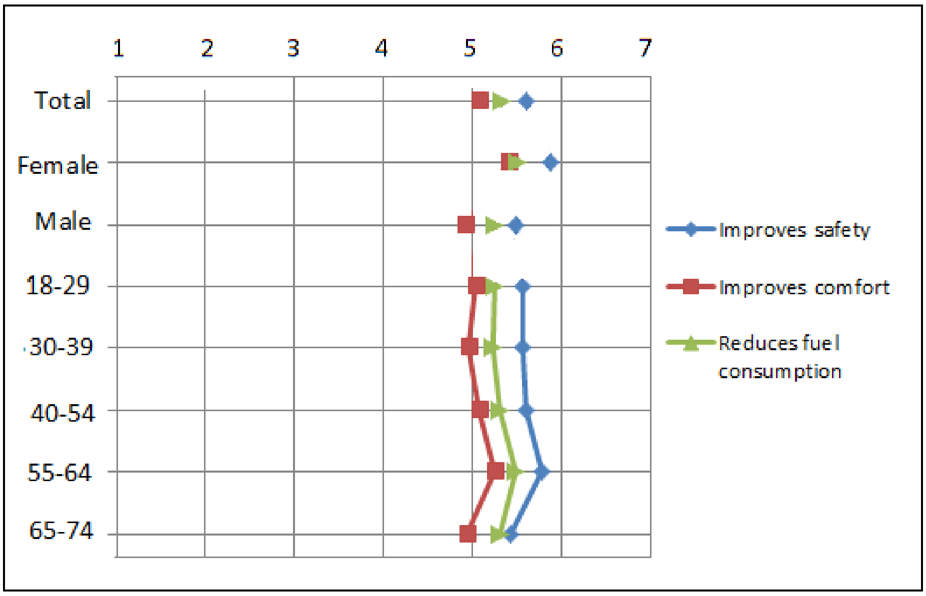

Figure 48. Benefits of the tyre pressure monitoring system on a scale of 1 (not important at all) to 7 (very important)

For real-time traffic information, in addition to the three common benefits the following were included: "It helps me choose the best route," "It helps me choose best the departure time," and "It helps me estimate my time of arrival." The most important benefit was choosing the best route (5.7) and the least important the fuel consumption reduction (4.6) (Figure *49*). Women viewed the benefits of the system to be of higher importance than did men (4.7-5.9 vs. 4.5-5.6). Age group 55-64 had the highest values for the benefits of the system (4.8-5.8), except for estimation of arrival time (5.1), where age group 18-29 gave the highest score for importance (5.4).

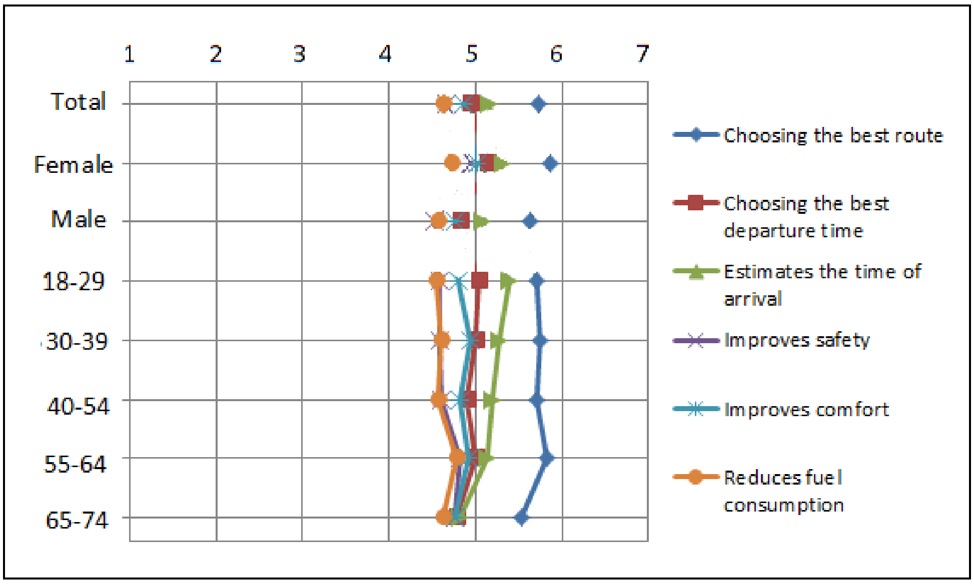

Figure 49. Benefits of real-time traffic information on a scale of 1 (not important at all) to 7 (very important)

For speed alert, in addition to the three common benefits, the respondents were asked the importance of the following: "It helps to control speed" and "It helps to reduce speeding." The benefit of controlling speed was viewed as the most important (5.2) and the impact of improving comfort as the least important benefit (4.3) of speed alert by all demographic groups (Figure *50*). Women ascribed greater importance to the benefits than did men. Among the age groups, 55-64 year olds rated the benefits the highest.

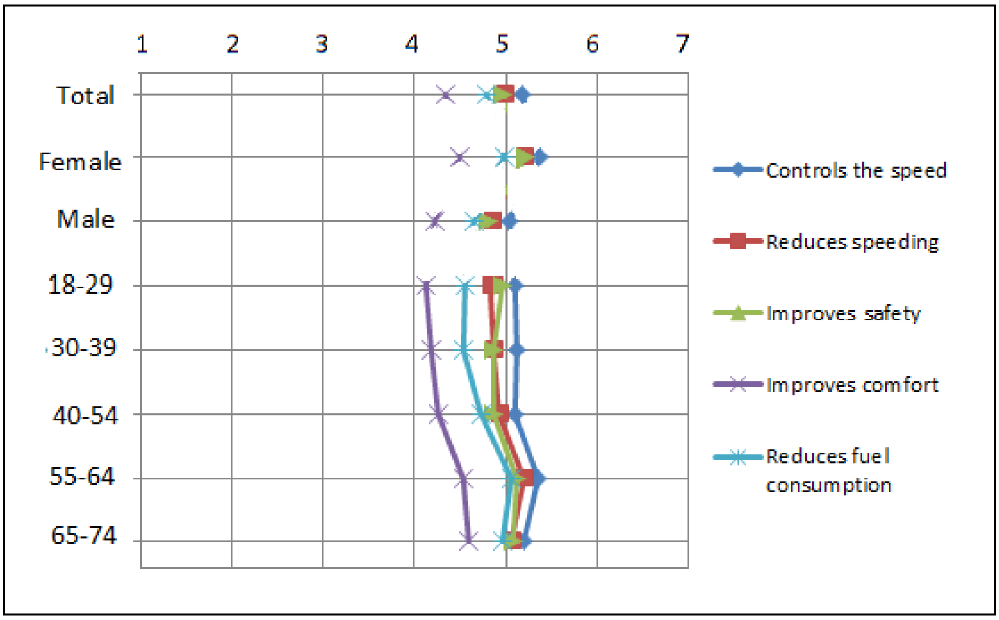

Figure 50. Benefits of speed alert on a scale of 1 (not important at all) to 7 (very important)

The benefits asked about were the same for emergency braking as for speed alert. Clearly most important benefit was the way this system improves safety (Figure *51*). Reducing the fuel consumption was viewed as the least important benefit by all demographic groups. The importance of improving safety was almost the same for all the groups, varying within 5.6-5.7. Regarding the other benefits of emergency braking, women rated their importance more highly than did men (4.0-4.6 vs. 3.2-4.1). The age groups had similar views on the importance of different benefits, except for the reduction of speeding, where 18-29 year olds rated the benefit more highly (4.3) than did the other age groups (3.8-3.9).

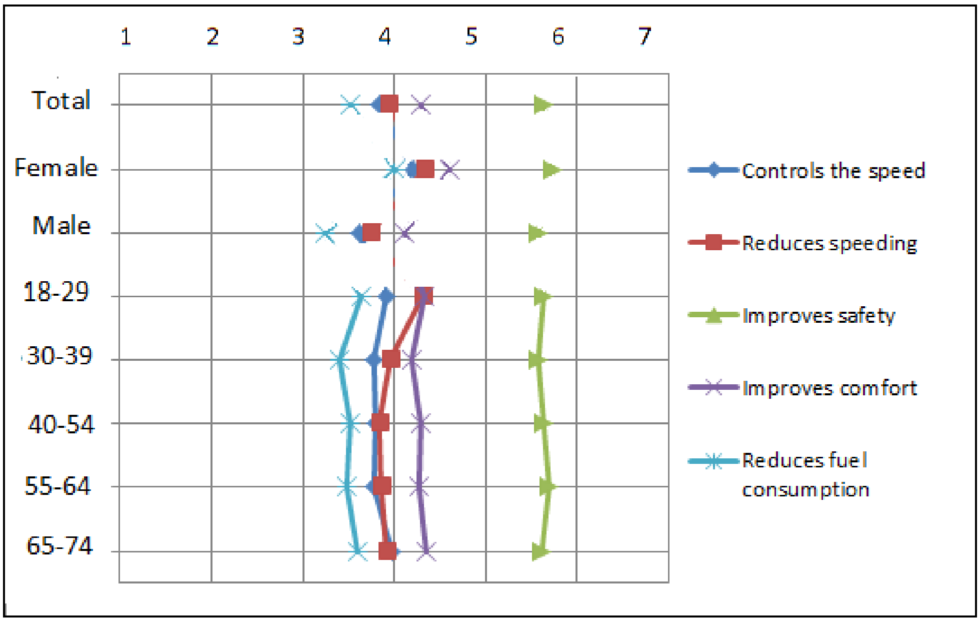

Figure 51. Benefits of emergency braking on a scale of 1 (not important at all) to 7 (very important)

The benefits of eco-driving assistance included making driving smoother, in addition to those listed for speed alert and emergency braking. Reduction in fuel consumption was considered the most important feature (5.6-5.8 for all groups), followed by smoother driving (5.0-5.3). The remainder were thought to be of almost equal importance, although there were differences between demographic groups (Figure *52*). Women viewed all the benefits to be more important than did men (4.5-5.8 vs. 4.0-5.7). Age group 55-64 had the highest rating for the importance of the different benefits (4.3-5.8) compared to the other age groups (4.0-5.7).

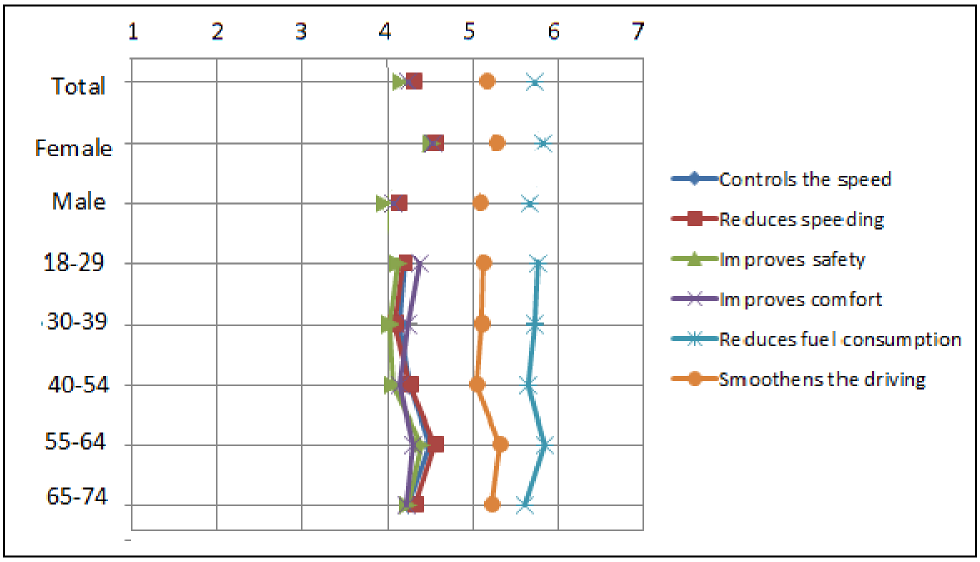

Figure 52. Benefits of eco-driving assistance on a scale of 1 (not important at all) to 7 (very important)

When evaluating the benefits of start-stop assistance, only the three common impacts were included. Reduction of fuel consumption was viewed as most important benefit (5.3) (Figure 53). Improvement of safety was the least important benefit for all groups (2.9-3.5). Women viewed the benefits to be of greater importance than did men (3.5-5.4 vs. 2.9-5.3). Age group 18-29 gave the benefits higher importance (3.4-5.5) than did the other age groups (3.0-5.4).

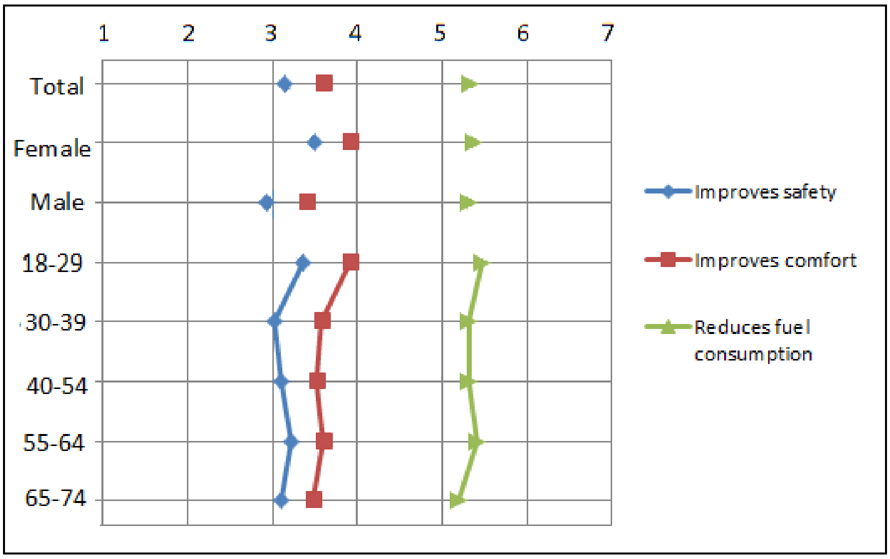

Figure 53. Benefits of start-stop assistance on a scale of 1 (not important at all) to 7 (very important)

4.6.3 Summary of attitudes towards the systems

Summarising the results regarding attitudes towards the systems, all the systems were viewed as useful on urban roads, the most useful on these roads being emergency braking (5.6). On highways the most important system was real-time traffic information (5.8) and the least useful start-stop assistance (2.9). On rural roads the most useful system was the tyre pressure monitoring system (4.9) and the least important start-stop assistance (3.0). Women viewed the systems to be more useful on all the road types than did men. There was no clear trend among the age groups; for some road types the system was rated more highly by the older groups, and for other road types by the younger ones. However, for the road type for which the system was viewed to be most important, the older groups gave higher scores than did the younger ones.

The benefits given the highest scores were improvements in driving safety with emergency braking and tyre pressure monitoring (5.6 for both), reduction of fuel consumption with eco-driving assistance (5.7), and optimal route selection with real-time traffic information (5.7). This is to be expected, as they were the main functions of the respective systems. The least important benefits were improvements in safety with start-stop assistance (3.1) and reduction of fuel consumption with emergency braking (3.5); this also makes sense given that these systems were not designed specifically for those benefits. Women rated the benefits more highly than did men, and the older age groups more highly than the younger ones.

4.7 Willingness to have the systems

After mapping the attitudes and experience of participants towards each system, the respondents were asked about their willingness to have it in their car. Respondents answering “most probably yes” and “definitely yes” were viewed as being positive towards having the system in their next car. The tyre pressure monitoring system and real-time traffic information were the two most popular systems given by the respondents (Figure 54), 60% of them being positive towards having the system. The least popular was start-stop assistance, 40% of the respondents wishing to have it in their next car. Men were slightly more positive towards having the systems in their next vehicle compared to women (42-60% vs. 36-56%), except for the tyre pressure monitoring system where women were more positive (60% vs. 62%). Thus the difference was about 3-4% for every system, except for start-stop assistance where men were 6% more positive than women towards having the system in their next vehicle.

The 55-64 year olds were the most positive age group towards having speed alert, eco-driving assistance, start-stop assistance and tyre pressure monitoring in their next car, while 18-29 year olds were the most positive towards having real-time traffic information and emergency braking. The 65-74 year olds were least positive (36-56%) towards having any of the systems in their next car compared to the other age groups (38-64%), except for speed alert where the 40-54 year olds were the least favourable (44% vs 45-54%).

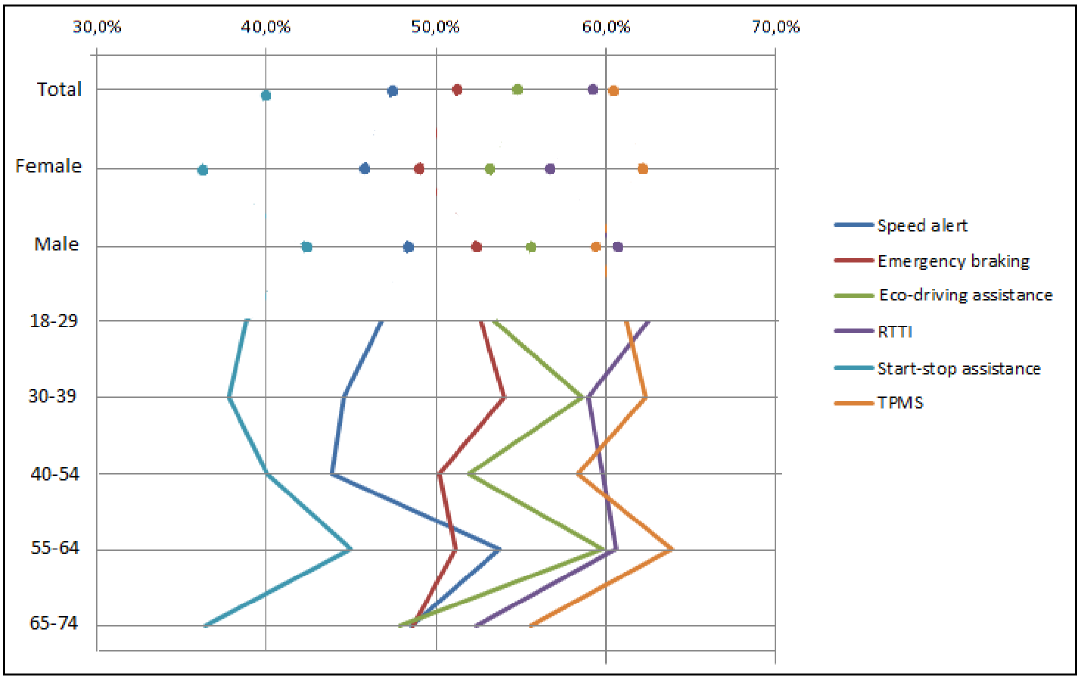

Figure 54. Positive attitude to having the systems in the next car, by demographic group

4.8 Willingness to pay for the systems

In the final question about the systems, the respondents were asked about their willingness to pay for the systems. Willingness to pay something was highest for emergency braking (56%) and lowest for start-stop assistance (38%) (Figure 55). The “I don’t know” answers were high for every system, the total percentage varying within 18-21%; speed alert had the least and emergency braking the most such replies.

There were no major differences between women’s and men’s willingness to pay for the systems, these varying by about 1-2 percentage points. However, there were differences between how many answered “Nothing” and “I don’t know.” Women answered “I don’t know” more often than men, and correspondingly more men would pay nothing compared to women. There were major differences between the age groups’ willingness to pay for the systems. Age group 18-29 were clearly more willing to pay than the other groups, and of them as much as 70% were ready to pay for emergency braking and real-time traffic information. Among the youngest age groups, the lowest willingness to pay something for the system was for start-stop assistance, but even there the share was still 51%. Age group 40-54 had the lowest willingness to pay for the systems, their highest willingness being for emergency braking where 52% were willing to pay something, and their lowest for start-stop assistance where 34% where willing to pay something. Except for start-stop assistance the differences between age groups 30-39, 40-54, 55-64 and 65-74 in willingness to pay for the system did not differ substantially, being around 3-7%.

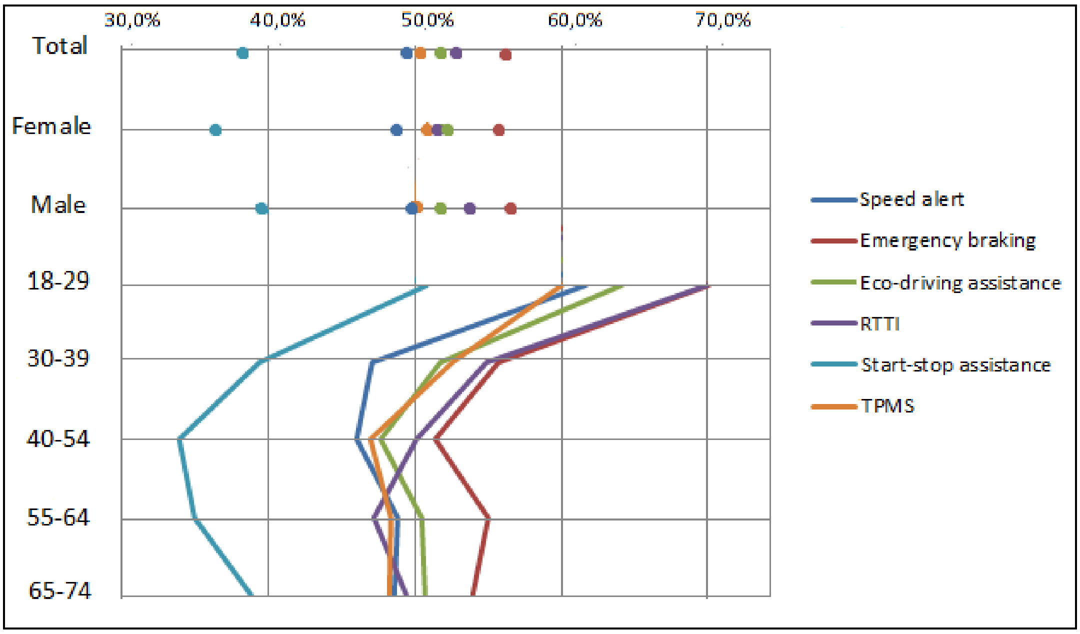

Figure 55. Respondents willing to pay something for the systems

4.9 User acceptance of the systems

To identify the profile for user acceptance of the system a logistic regression analysis was performed. The model was suitable for the data (Table 4). The chi-square for the model fitting information suggests that the model predicted a better result compared to the constant term for all systems (*p*-value of the model fitting information was below 0.05) and the chi-square for the goodness of fit suggests the same for some systems (*p*-value for the goodness of fit over 0.05). The Nagelkerke pseudo R-square was low (0.14-0.33) but is not as determining in logistic analysis as in linear regression analysis.

Table 4. Model fitting for measuring acceptance of the systems

	Model fitting information			*Goodness of fit*			
Systems	X^2	**df**	**p**	X^2	**df**	**p**	**Pseudo R^2**
Speed alert	563	9	0.000	253	250	0.443	0.276
Emergency braking	258	9	0.000	212	200	0.264	0.144
Eco-driving assistance	524	9	0.000	283	285	0.516	0.278
RTTI	415	9	0.000	325	371	0.013	0.220
Start-stop assistance	732	9	0.000	329	337	0.600	0.329
TPMS	380	9	0.000	280	259	0.176	0.230

Furthermore, the model explained about 70% of the total observations and more than 86% of the observations for acceptance for eco-driving assistance, real-time traffic information and the tyre pressure monitoring system and around 60% for the rest of the systems.

Less than five of the nine variables included in the regression analysis influenced the users' acceptance for all systems (

Table *5*). Factors statistically significant for the acceptance were whether the respondents would buy their next car as new or used, their perceived usefulness and the perceived benefits for all the systems. Frequent usage of the system influenced the acceptance of all the systems except for emergency braking, which makes sense given that the system is activated only in rare situations. Household income influenced the acceptance of three of the systems (speed alert, eco-driving assistance and tyre pressure monitoring system). Gender, age, annual vehicle mileage and price of the next car influenced only the acceptance of one or two systems.

Table 5. Likelihood ratio tests for variables affecting acceptance of the system; X is p<0.05 and XX p<0.01

	Speed alert	Emergency braking	Eco-driving assistance	RTTI	Start-stop assistance	TPMS
Gender		**X**			**XX**	
Age		**X**				
Household income	**XX**		**X**			**X**
Vehicle mileage				**X**		
Price of next car		**X**			**X**	
Next car new or used	**XX**	**XX**	**XX**	**XX**	**XX**	**X**
Frequent user	**XX**		**XX**	**XX**	**XX**	**XX**
Perceived usefulness	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**
Perceived benefits	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**

Men were more likely than women to want emergency braking and start-stop assistance in their next car. Younger respondents were also more likely than older respondents to want emergency braking in their next car. Those earning less than €5 000/month were more likely to want speed alert, eco-driving assistance and tyre pressure monitoring compared to those earning more. Those driving less than 10 000 km annually were less likely to want real-time traffic information in their next car compared to those who drove more. For the acceptance of emergency braking and start-stop assistance, those planning to pay less than €20 000 for their next car were less likely to want the systems compared to those planning to pay more. Frequent users of all the systems, except emergency braking, were more likely to want the systems compared to those not using the systems regularly. Those planning to buy their next car as new, and those who rated the systems' average perceived usefulness and benefits above 3.5, were more likely to want all the systems.

4.10 Early adopters of the systems

A logarithmic model was constructed for early adopters of the systems, similarly as above for user acceptance. The model was suitable for the data (

Table *6*). The chi-square for the model fitting information suggests that the model predicted a better result compared to the constant term (*p*-value of the model fitting information was below 0.05) for all systems and the chi-square for the goodness of fit suggests the same for most systems (*p*-value for the goodness of fit over 0.05). The Nagelkerke pseudo R-square was low (0.042-0.098).

Table 6. Model fitting for identifying early adopters of the systems

	Model fitting information			*Goodness of fit*			
Systems	X^2	**df**	**p**	X^2	**df**	**p**	**Pseudo R^2**
Speed alert	74	8	0.000	218	195	0.119	0.045
Emergency braking	66	8	0.000	141	182	0.989	0.065
Eco-driving assistance	92	8	0.000	180	196	0.788	0.056
RTTI	63	8	0.000	188	189	0.498	0.042
Start-stop assistance	182	8	0.000	233	221	0.432	0.098
TPMS	119	8	0.000	192	173	0.150	0.086

Furthermore, the model explained more than 68-91% of the total observations, but this was mostly observations for not adopting the systems early (more than 96% for all systems) and only 0-12% of the observations for early adoption of the systems.

The model was best suited for the early adoption of start-stop assistance, where household income, annual vehicle mileage, price of the next car, the next car being new or used, and the perceived benefits of the system significantly influenced early adoption (

Table 7). Annual vehicle mileage influenced the early adoption of all systems except emergency braking, the price of the next car influenced the early adoption of all systems except speed alert and real-time traffic information, and household income influenced early adoption of all the systems except for the tyre pressure monitoring system.

Table 7. Likelihood ratio tests for variables affecting early adoption of the systems; X is p<0.05 and XX p<0.01

	Speed alert	Emergency braking	Eco-driving assistance	RTTI	Start-stop assistance	TPMS
Gender	**X**					
Age		**XX**				**X**
Household income	**X**	**X**	**XX**	**X**	**XX**	
Vehicle mileage	**X**		**X**	**XX**	**XX**	**XX**
Price of next car		**X**	**X**		**XX**	**XX**
Next car new or used		**X**		**X**	**X**	
Perceived usefulness	**X**					
Perceived benefits			**X**		**X**	

Men were more likely than women to be early adopters of speed alert. For emergency braking and tyre pressure monitoring, young respondents were more likely to be early adopters compared to older ones. Users with low household incomes were less likely to be early adopters of speed alert, emergency braking, real-time traffic information and speed alert, but more likely compared to users from high income households to be early adopters of eco-driving assistance. Similarly, those driving less than 10 000 km annually were less likely to be early adopters of speed alert, real-time traffic information, start-stop assistance and tyre pressure monitoring, but more likely to be early adopters of eco-driving assistance. Those planning to buy their next car for less than €20 000 were less likely to be early adopters of emergency braking, start-stop assistance and the tyre pressure monitoring system, but more likely to be early adopters of eco-driving assistance compared to those planning to buy their next car for more than €20 000. Those planning to buy their next car as used were less likely to be early adopters of emergency braking, real-time traffic information and start-stop assistance compared to those planning to buy their next car as new. For speed alert, those rating the average perceived usefulness and benefits below 3.5 were more likely to be early adopters of the system. For eco-driving assistance, those rating the average perceived benefits under 3.5 were more likely to be early adopters.

4.11 Unawareness of the systems

To identify the profile for unawareness of the systems a logarithmic regression model was constructed. The model was suitable for the data (

Table *8*). The chi-square for the model fitting suggests that the model predicted a better result compared to the constant term for all systems (*p*-value for the model fitting information below 0.05) and the chi-square for the goodness of fit suggests the same for some of the systems (*p*-value for the goodness of fit over 0.05). The Nagelkerke pseudo R-square was low (0.052-0.135).

Table 8. Model fitting for identifying the profile for unawareness of the systems

	Model fitting information			*Goodness of fit*			
Systems	X^2	**df**	**p**	X^2	**df**	**p**	**Pseudo** R^2
Speed alert	144	6	0.000	53	57	0.633	0.052
Emergency braking	253	6	0.000	73	57	0.760	0.083
Eco-driving assistance	149	6	0.000	73	57	0.080	0.053
RTTI	177	6	0.000	72	57	0.083	0.063
Start-stop assistance	254	6	0.000	65	57	0.255	0.093
TPMS	397	5	0.000	71	57	0.108	0.135

Furthermore, the model explained about 65% of the total observations but mostly the observations for awareness of the systems (ranging from 80-96%). For unawareness of the system the model explained 8-38% of the observations.

Unawareness of all systems was significantly influenced by the respondents' gender, annual vehicle mileage and the price of their next car (*next car* would be new or used.

Table 9). Unawareness of eco-driving assistance was significantly influenced by all variables included in the regression analysis except whether the next car would be new or used.

Table 9. Likelihood ratio tests for measuring unawareness of the systems; X is p<0.05 and XX p<0.01

	Speed alert	Emergency braking	Eco-driving assistance	RTTI	Start-stop assistance	TPMS
Gender	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**
Age			**X**			
Household income			**X**		**XX**	
Vehicle mileage	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**
Price of next car	**X**	**XX**	**X**	**X**	**X**	**XX**
Next car new or used	**X**	**X**		**X**		**X**

Men were less likely than women to be unaware of all the systems. Driving less than 10 000 km annually also led to higher unawareness of all the systems compared to those who drive more than 10 000 km annually. For all systems except eco-driving assistance, those who planned to buy their next car for less than 20 000 € were more likely to be unaware of the systems compared to those planning to buy a more expensive car. For all systems except eco-driving and start-stop assistance, those who planned to buy their next car used were more likely to be unaware of the system compared to those planning to buy their next car new. For eco-driving assistance, younger respondents were more likely to be unaware of the system compared to older respondents. For eco-driving and start-stop assistance, respondents from low income households were more likely to be aware of the systems compared to respondents from high income households.

5. Discussion

5.1 General discussion

The objective with this study was to study user awareness and demand for driver support systems depending on demographic variables, and to identify the profile for acceptance, early adoption and unawareness of the systems. The profiles were identified with a logarithmic regression analysis. Systems included in the study were speed alert, emergency braking, eco-driving assistance, real-time traffic information, start-stop assistance and a tyre pressure monitoring system. The data for the study was collected through an Internet questionnaire distributed in five European countries (n=5 051). The results are discussed below according to each research question posed.

<u>What were the respondent's awareness, experience, attitude, demand and willingness to pay for iMobility systems depending on demographic variables?</u>

Awareness of the systems varied from 54% for the tyre pressure monitoring system to 69% for start-stop assistance. Awareness of systems had increased compared to earlier studies (46-64%) (eSafety Challenge 2009, 2011). Actual usage of the systems was low, varying from 5% of respondents who had experienced emergency braking to 19% who had tried start-stop assistance and eco-driving assistance; those who had tried the systems had mainly used them occasionally. The formulation of the questions "How often have you used/has your car activated emergency braking" and "How often have you used/received an alert from your tyre pressure monitoring system" could be understood in different ways; did this mean that 5% of the respondents had driven a car with these systems or that 5% had experienced the system in use, since these systems are not actively used but activate automatically when needed?

On urban roads all the systems were viewed as useful, but the one considered most useful was emergency braking and the least useful speed alert. On highways real-time traffic information was considered the most useful and start-stop assistance the least useful system. On rural roads the tyre pressure monitoring system was considered the most useful and start-stop assistance the least useful system. When evaluating the importance of each system's benefits, the highest scores were awarded to improvements in safety from emergency braking and the tyre pressure monitoring system, reduction in fuel consumption from eco-driving assistance, and selection of the best travel route with real-time traffic information.

The respondents' willingness to have the systems in their next car varied from 40% for start-stop assistance to 60% for the tyre pressure monitoring system. The total willingness to pay varied between 38% for start-stop assistance and 56% for emergency braking, which is in line with an earlier study where the advanced emergency braking system also had the highest willingness to pay compared to the other systems (ESC, adaptive headlights, blind spot monitoring, lane support and speed alert) in the study (eSafety Challenge 2011). The willingness to have and pay correlated for all systems except for emergency braking, which scored highest for willingness to have but came only fourth for willingness to pay. The amount of money most people were willing to pay was, however, mostly below €200. The results cannot be directly compared with earlier studies, since the question was asked in different ways. In the TeleFOT study, the respondents were asked how much they would be willing to pay monthly, which came mostly to €1-10/month (Karlsson et al. 2013). In the eSafety Challenge, only respondents stating that they would be willing to pay for the systems were asked how much they would pay, but the amount they gave was higher, more than one third being willing to exceed €300 (eSafety Challenge 2011).

Men had a higher awareness and experience of the systems than did women, but women rated the usefulness and benefits of the systems more highly. The results concerning awareness of the systems supported an earlier finding that men have higher awareness of all systems compared to women (eSafety Challenge 2009, 2011). Men also had a higher willingness to have and pay for the systems, except for the tyre pressure monitoring system where women showed a higher willingness to have. This could be attributed to men driving more than women; 15% of the women and 28% of the men drove more than 20 000 km annually.

There was no clear trend for all the responses between age groups. The older age groups usually had higher awareness and experience compared to younger groups. This could be attributed to older age groups driving mostly new cars in which the system might be available. For the most important road type for each system, older age groups rated the usefulness more highly than younger age groups, with the same trend for importance of the system's benefits. For willingness to have, 55-64 year olds were in general the most willing and 65-74 year olds the least willing compared to the other age groups, except for speed alert where the latter had the second highest. The 40-54 year olds had the lowest willingness to pay for all systems except for real-time traffic information, where 55-64 year olds had the lowest willingness to pay. The results are partly supported by the earlier eSafety Challenge study of 2011, where the oldest age group (50+) had the highest willingness to pay and 35-49 year olds had the lowest (eSafety Challenge 2011).

Younger respondents usually had the lowest awareness and experience of the systems compared to the other age groups. They rated the usefulness of the systems on rural roads the highest compared to the other age groups, but on the most useful road type they rated the systems' usefulness lower than did older age groups. They also rated the benefits of the systems lower compared to older age groups. Younger respondents were less willing to have the systems compared to older respondents, except for real-time traffic information where they showed the highest willingness to have. However, their willingness to pay for all the systems was highest compared to the older age groups, which is surprising given that their income was the lowest among the age groups.

Studying the correlation of the background variables showed a strong statistically significant correlation between household income and age, older respondents having a higher income than young ones. Household size and car changing time also had a statistically strong correlation. A strong statistically significant correlation was also found between household income and planning to buy the next car new, wealthy respondents being more likely to do so. This might explain why older respondents, i.e. the wealthier ones, had higher awareness and experience of the systems since they are usually available in newer cars.

What was the profile for user acceptance of the iMobility systems?

Acceptance of a system was viewed in this study as representing the variable "willingness to have". In previous acceptance studies the factor "intention to use" was identified to lead to actual usage. Willingness to have is therefore at least a sign that the respondent wishes to have the system. A logistic regression analysis was performed to see which variables influence acceptance and in what way; the variables included were chosen based on the previous studies of user acceptance. The model was suitable and explained 60-86% of the observations for accepting a system. Each system was only statistically significantly influenced by one or two of the included variables related to demography and driving: household income had an influence on speed alert, eco-driving assistance and the tyre pressure monitoring system; gender had an influence on emergency braking and start-stop assistance, and age also had an influence on emergency braking.

Respondents planning to buy their next car new and those rating the perceived usefulness and benefits as high had a statistically significantly higher acceptance of all systems compared to the other respondents. Frequent usage of a system significantly influenced the acceptance of all systems except for emergency braking. Low actual usage of emergency braking may be the reason; only 5% of the respondents had tried the system, which was the lowest compared to all the other systems, and of those who had tried it more than 70% had experienced it less than five times. However, as discussed above, use of emergency braking system, if this is understood as its activation, is not something that happens frequently even if the system were installed in the car; therefore this indicator does not suit the system as well as for the other systems.

The result concerning frequent usage of a system and increased willingness to have it support an earlier finding of the TeleFOT project, where frequent usage of a system led to higher willingness to keep (Karlsson et al. 2013). Also comparable are the results from the eSafety Challenge showing that respondents who were aware of the systems had a higher willingness to have them, and also a higher willingness to pay for them (eSafety Challenge 2011).

What was the profile for early adopters of the iMobility systems?

The model for early adopters was also analysed with a logistic regression. It was suitable for the data but explained better the observations for adopting the systems late than for early adoption, as the model explained less than 12% of the observations for early adoption. Higher household income, vehicle mileage and the estimated price of the respondents' next car were statistically significant variables and led to earlier adoption of the systems. The variable for respondents buying their next car new also statistically significantly increased the early adoption of three systems. This reflects the fact that new and expensive cars are usually equipped with different driver support systems.

The observations for later adoption were better explained with the model; 96% of the observations could be correctly categorised. Late adopters were more likely to have low household income, drive less annually and plan to buy their next car as used.

What was the profile for respondents unaware of the iMobility systems?

The model for unawareness was, similarly to acceptance and early adoption, analysed with a logistic regression. The model was suitable but explained better the observations for awareness of the system; for unawareness it explained less than 38% of the observations. For all the systems only two or less of the included variables statistically influenced the respondents' unawareness. Gender, vehicle mileage and the estimated price of their next car were statistically significant variables for unawareness of the systems. Women, respondents driving less than 20 000 km annually and respondents planning to buy their next car for less than €20 000 had greater unawareness of the systems compared to the other respondents.

The models for performing the regression analysis to determine users' acceptance, early adoption and unawareness of the system were not entirely suitable for the data. Not all the included variables had an influence on the behaviour, but then again the influencing factors were determined as a result. The influence of single independent variables and their significance were not extensively studied. Since the model did not predict the observations for acceptance, early adoption and unawareness of the systems as well as the corresponding category, the odds ratios were not studied further.

5.2 Challenges and limitations with the study

The study had some limitations and challenges. The data was collected from five European countries and as such can be considered to some extent to represent Europe as a whole. However, given the differences between the countries such as car fleet age and infrastructure, any generalisation should be interpreted with caution.

Questionnaires themselves pose a number of challenges, depending on how and where the data is collected. In this case the source was the Internet, meaning that respondents might generally be more positive towards technology than the population as a whole. The questionnaire was translated into the relevant languages and might have had slight differences as a result. The subject itself could also be a challenge: When dealing with new and advanced technology, respondents might understand the questions differently and have a different picture of the systems even if a description was given for each one. Comparison between experiences of the systems was hard, because the alternatives for some questions differed between systems. Some systems are less common than others, which might explain why the respondents were asked how many times they had tried it. In addition, the meaning of "tried" when asking about emergency braking or the tyre pressure monitoring system is unclear. It can be understood either as driving a car with such systems, or activation of the systems.

The regression analysis had some limitations. The factor used to measure acceptance of a system was willingness to have the system. Even if it was not identical to the "intention to use" in previous acceptance models, it was used because the profile for acceptance was important to identify. Since the analysis was performed with binary variables, the conversion of the initial categorical values may pose some restrictions to the analysis. Another restriction may come from the fact that almost all the background factors had a statistically significant correlation and may have skewed the results. The variable "willingness to pay" may also cause problems in questionnaires; respondents may state a higher or lower sum for their willingness to pay that does not equal their actual willingness (Breidert et al. 2006).

6. Conclusions

ITS can effectively reduce emissions from road transportation, a sector with the most rapidly increasing CO_2 emissions in the EU (Eurostat 2013). The EC has implemented strategies to make the deployment more rapid, but the actual usage of many systems is still low (European Parliament, Council of the European Union 2010, Öörni 2014). Eco-driving assistance and start-stop assistance had the highest usage of the systems in the study. Nevertheless, many systems were still not used regularly. The tyre pressure monitoring system had the highest awareness among respondents. The most useful system on different road types was emergency braking and the most important benefit was considered to be the tyre pressure monitoring system. The system most respondents were willing to have was the tyre pressure monitoring system, and that most were willing to pay for was emergency braking. Men had higher awareness, experience, willingness to have and pay of all the systems compared to women, except for the tyre pressure monitoring system where women had a higher willingness to pay. Women, on the other hand, rated the systems' usefulness and benefits more highly than did men. Older respondents generally had higher awareness and experience compared to younger respondents; they also rated the usefulness and benefits more highly. The 55-64 year olds had the highest willingness to have the systems, and the 65-74 year olds the lowest. The 18-29 year olds on the other hand had the highest willingness to pay for the systems and the 40-45 year olds the lowest.

The selection of variables included in the logistic regression model for identifying user acceptance of the systems was based on previous studies presented in the literature study, but not all the included variables influenced acceptance of a system. The same was true of the regression analysis of early adoption and unawareness of the systems; not all the variables were statistically significant. However, the variables affecting these behaviours were determined and the profile for acceptance, early adoption and unawareness could be identified. The profile for high acceptance of a system was: respondents planning to buy their next car new, rating the usefulness of the systems as high, rating the benefits of the systems as high and using the systems frequently. The profile for early adopters of the systems was: high household income, high annual vehicle mileage and planning to buy an expensive next car. The profile for high unawareness of the systems was: female, low annual vehicle mileage and planning to buy a cheaper next car. Planning to buy the next car as used also increased the unawareness of most systems.

Developing the models for identifying the profile of acceptance, early adoption and unawareness of the systems could be interesting to study further. Then the specific variables could be emphasized more. Performing a similar questionnaire at car dealers could also be interesting and result in more realistic answers, at least concerning users' willingness to pay for advanced driver support systems. The price of the system might not seem that high compared to the money one is about to spend on a new car. It can be hard to imagine the amount one is willing to pay for something when there is no connection to the actual purchasing scenario. Including more European countries in a similar study could also result in a more representative result reflecting opinions across the EU. Finding suitable strategies to increase the usage of ITS in private cars and speeding up the deployment in the EU is easier when the situation can be applicable to the whole area.

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Annex I

iMobility Challenge, Driver questionnaire

This questionnaire is intended to assess consumers' awareness, knowledge and experiences of intelligent vehicle systems, as well as their vehicle purchase decision making, and willingness to pay for new technologies. Its answers will be useful to gain better understanding of what users' concerns and priorities are, as well as background information for policy recommendations.

All individual responses will be treated anonymously and the data will be used for the sole purpose of iMobility Challenge activities and not transferred to any third party or used for commercial activities.

Background related to driving:

First, we would like to know a couple of facts related to your driving and travelling.

1. How many kilometres do you drive annually on average?

- Less than 1500 km -> (not included in the survey, as we are aiming at the active driver population)
- 1500 - 5 000 km
- 5-10 000 km
- 10-20 000 km
- 20-30 000 km
- Over 30 000 km

2. How often do you drive on the following types of roads:

Please use the following scale: 1 = daily, 2 = a couple of times a week, 3 = once a week, 4 = a couple of times a month, 5 = once a month, 6 = a couple of times a year, 7 = never - for each environment.

- City streets/urban environment
- Highways/motorways in urban areas (like ring roads, arterial entering the cities)
- Highways/motorways in rural areas
- Rural roads

3. Which other transport modes do you use at least once a week (on average)? Please select all that apply.

- Bicycle
- Motorcycle, moped
- Public transport

Part 2: Car ownership and car purchase patterns:

In this part we are interested in your car purchasing decisions

Current car

4. Which one of the following best applies to you? Please select only one alternative.
- I drive my own car – I have access to it all the time
- I share the car with my spouse/family
- I drive a company car
- I don't have a car – I rent one when I need it
- I use a car sharing service

5. Car make and model you drive most often?
   ____

6. How old is the car you most often drive? If you don't remember, please estimate.

Model year _______________________

7. Did you buy your car pre-owned or as new?
- Pre-owned
- New

8. What type of the car do you drive most often at the moment? Please select only one alternative:
- Economy/Compact
- Intermediate / Large standard
- Station wagon
- Mini-van
- SUV
- Pickup or van

9. How often do you (on average) purchase/change a vehicle?

Every __________ year(s)

Next car

10. Will your next car be a company car (if yeas, jump to question 12) or will you buy it (if yeas, answer question 11)?
- Company car -> jump to question 12
- Own car -> answer question 11
- Don't know yet -> answer question 11

11. When buying your next vehicle, would you select a pre-owned/used or anew car (please select one alternative)?:
- Definitely a new one

- Definitely a pre-owned one
- Most probably a new one
- Most probably a pre-owned one
- Don’t know yet

12. Please estimate the price of the next vehicle you would buy:
- €10 000 or less
- €10 001 - 20 000
- €20 001 – 30 000
- €30 001 – 40 000
- €40 001 – 50 000
- €50 001 – 60 000
- €60 001 – 70 000
- Over €70 000

13. Please select the three (3) most important features of a new car from your perspective. Please give 1 to the most important one, 2 to the second most important one, and 3 for the third.
- Engine (power)
- Looks
- Size
- Comfort
- Safety
- Brand
- Consumption
- CO2 emissions
- Resale value
- Running costs
- Transmission (automatic/manual)
- Engine (gasoline/diesel/hybrid)

Awareness, knowledge, usage, and willingness to pay for the new systems

Next, we would like to know your experiences of the following new systems in cars.

Speed alert

The system alerts the driver with audio, visual and/or haptic (driver needs to apply more pressure on the acceleration pedal) feedback when the speed exceeds a limit set by the driver or the legal fixed speed limit.

14. Which of the following best describes your knowledge/experience of speed alert? Please select one alternative:
    - I don't know this system -> jump to the next section "Emergency braking"
    - I have only heard/read about this system, but not tried it myself -> jump to question 16
    - I have used this system – answer question 15

15. How often do you use the speed alert?
    - I have tried it only a few times
    - I use it occasionally
    - I use it regularly
    - I use it all the time when I can

16. How useful is speed alert on different types of roads in to your opinion? Please use the following scale: 1 = not useful at all … 7 = very useful for each road type:
    - Urban streets
    - Rural roads
    - Motorways/highways

17. How important are the following benefits of speed alert? Please use the following scale: 1 = not important at all … 7 = very important, for each of the statements:
    - It helps control speed
    - It helps reduce speeding
    - It improves driving safety
    - It improves driving comfort
    - It reduces fuel consumption

18. Would you like to have speed alert in your next car? Please select one alternative:
    - Definitely not
    - Most probably not
    - Don’t know yet
    - Most probably yes
    - Definitely yes

19. How much would you pay for speed alert for your next car?

- Nothing
- Up to €100
- €101 – 200
- €201 – 300
- €301 – 400
- €401 – 500
- €501 – 600
- €601 – 1000
- I don’t know

Emergency braking

"Advanced Emergency Braking Systems warn you about the danger of potential collisions and when there is no reaction to the warning, activate the brakes together with systems such as seat-belt pre-tension to avoid or mitigate a crash."

20. Which of the following best describes your knowledge/experience of emergency braking? Please select one alternative:
    - I don't know this system -> jump to the next section "eco-driving assistance"
    - I have only heard/read of this system, but not tried it myself -> jump to question 22
    - I have used this system – answer question 21

21. How often have you used/has your car activated emergency braking?
    - Never
    - Up to 5 times
    - 6 – 10 times
    - More often
    - I don't remember

22. How useful is the emergency braking system on different types of roads in your opinion? Please use the following scale: 1 = not useful at all … 7 = very useful, for each road type:
    - Urban streets
    - Rural roads
    - Motorways/highways

23. How important are the following benefits of emergency braking? Please use the following scale: 1 = not important at all … 7 = very important, for each of the statements:
    - It helps control speed
    - It helps reduce speeding
    - It improves driving safety
    - It improves driving comfort
    - It reduces fuel consumption

24. Would you like to have emergency braking in your next car?
    - Definitely not
    - Most probably not
    - Don't know yet
    - Most probably yes
    - Definitely yes

25. How much would you pay for emergency braking for your next car?
- Nothing
- Up to €100
- €101 – 200
- €201 – 300
- €301 – 400
- €401 – 500
- €501 – 600
- €601 – 1000
- I don’t know

Eco-driving assistance

Eco-driving assistance assists and encourages the driver to eco-driving by providing information about the current fuel consumption, energy use efficiency and appropriate gear selection, taking into account engine and transmission efficiency, vehicle speed and rate of acceleration etc.

26. Which of the following best describes your knowledge/experience of eco-driving assistance? Please select one alternative for each system:
    - I don't know this system -> jump to the next section "Real time traffic information"
    - I have only heard/read of this system, but not tried it myself -> jump to question 28
    - I have used this system – answer question 27

27. How often do you use the eco-driving assistant?
    - I have tried it only a few times
    - I use it occasionally
    - I use it regularly
    - I use it all the time when I can

28. How useful is eco-driving assistance on different types of roads in your opinion? Please use the following scale: 1 = not useful at all … 7 = very useful, for each road type:
    - Urban streets
    - Rural roads
    - Motorways/highways

29. How important are the following benefits of eco-driving assistance? Please use the following scale: 1 = not important at all … 7 = very important, for each of the statements:
    - It helps control speed
    - It helps reduce speeding
    - It improves driving safety
    - It improves driving comfort
    - It reduces fuel consumption
    - It makes driving smoother (less strong accelerations/decelerations)

30. Would you like to have eco-driving assistance in your next car?
    - Definitely not
    - Most probably not
    - Don't know yet
    - Most probably yes
    - Definitely yes

31. How much would you pay for eco-driving assistance for your next car?

- Nothing
- Up to €100
- €101 – 200
- €201 – 300
- €301 – 400
- €401 – 500
- €501 – 600
- €601 – 1000
- I don't know

Real-time traffic information

Real-time traffic information is information to the driver on traffic (congestion) and weather conditions for choosing the most effective route or for preparing to cope with a foreseeable situation ahead.

32. Which of the following best describes your knowledge/experience of real-time traffic information? Please select one alternative:
    - I don't know this service -> jump to the next section "Start-stop assistance"
    - I have only heard/read of this service, but not tried it myself -> jump to question 35
    - I have used/received real-time traffic information – answer question 33

33. How often do you use real-time traffic information?
    - Daily or almost daily
    - A couple of times a week
    - A couple of times a month
    - Rarely

34. How to you get real-time traffic information?
    - Via my navigator
    - Via radio
    - Via Internet
    - Via mobile phone app

35. How useful is real-time traffic information on different types of roads in your opinion? Please use the following scale: 1 = not useful at all … 7 = very useful, for each road type:
    - Urban streets
    - Rural roads
    - Motorways/highways

36. How important are the following benefits of real-time traffic information? Please use the following scale: 1 = not important at all … 7 = very important, for each of the statements:
    - It helps choose the best route
    - It helps choose the time of departure
    - It helps estimate arrival time
    - It improves driving safety
    - It improves driving comfort
    - It reduces fuel consumption

37. Would you like to have real-time traffic information in your next car?
    - Definitely not
    - Most probably not
    - Don't know yet
    - Most probably yes
    - Definitely yes

38. How much would you pay for a device providing real-time traffic information for your next car?

- Nothing
- Up to €100
- €101 – 200
- €201 – 300

- €301 – 400
- €401 – 500
- €501 – 600
- €601 – 1000
- I don’t know

Start-stop assistance

Start-and stop systems automatically shut down and restart a vehicle's internal combustion engine to reduce the engine's idling time: when the vehicle comes to a stop, the engine is automatically switched off. In the case of manual transmission, this will take place once the gear level is in neutral and the clutch pedal has been released.

39. Which of the following best describes your knowledge/experience of start-stop assistance? Please select one alternative:
    - I don't know this system -> jump to the next section "Tyre pressure monitoring system"
    - I have only heard/read of this system, but not tried it myself -> jump to question 41
    - I have used this system – answer question 40

40. How often do you use start-stop assistance?
    - I have tried it only a few times
    - I use it occasionally
    - I use it regularly
    - I use it all the time when I can

41. How useful is start-stop assistance on different types of roads in your opinion? Please use the following scale: 1 = not useful at all … 7 = very useful, for each road type:
    - Urban streets
    - Rural roads
    - Motorways/highways

42. How important are the following benefits of start-stop assistance? Please use the following scale: 1 = not important at all … 7 = very important, for each of the statements:
    - It improves driving safety
    - It improves driving comfort
    - It reduces fuel consumption

43. Would you have start-stop assistance in your next car?
    - Definitely not
    - Most probably not
    - Don't know yet
    - Most probably yes
    - Definitely yes

44. How much would you pay for start-stop assistance for your next car?
- Nothing
- Up to €100
- €101 – 200
- €201 – 300
- €301 – 400
- €401 – 500
- €501 – 600
- €601 – 1000
- I don't know

Tyre pressure monitoring system

A tyre pressure monitoring system alerts the driver when the vehicle's tyres are below their ideal pressure.

45. Which of the following best describes your knowledge/experience of a tyre pressure monitoring system? Please select one alternative:
    - I don't know this system -> jump to the next section "Background information"
    - I have only heard/read of this system, but not tried it myself -> jump to question 47
    - I have used this system – answer question 46

46. How often have you used/received an alert from your tyre pressure monitoring system?
    - Never
    - 1 or 2 times
    - 3 – 5 times
    - 6 – 10 times
    - More often
    - I don't remember

47. How useful is the tyre pressure monitoring system on different types of roads in your opinion? Please use the following scale: 1 = not useful at all … 7 = very useful, for each road type:
    - Urban streets
    - Rural roads
    - Motorways/highways

48. How important are the following benefits of the tyre pressure monitoring system? Please use the following scale: 1 = not important at all … 7 = very important, for each statement:
    - It improves driving safety
    - It improves driving comfort
    - It reduces fuel consumption

49. Would you have a tyre pressure monitoring system in your next car?
    - Definitely not
    - Most probably not
    - Don't know yet
    - Most probably yes
    - Definitely yes

50. How much would you pay for a tyre pressure monitoring system for your next car?
- Nothing
- Up to €100
- €101 – 200
- €201 – 300
- €301 – 400
- €401 – 500
- €501 – 600
- €601 – 1000
- I don’t know

Socio-economic background:

51. In which country do you live?_______________________________

52. Gender: ______ Female ______ Male

53. Year of birth: ____________

54. How many persons are there in your household, including you? __________

55. Household gross income **per month**:
- Less than €3000
- €3001 - 5000
- €5001 - 7500
- €7501 - 10000
- More than €10000
- I don’t want to say