# Measuring acceptance and acceptability of ITS

## Theoretical background in the development of a unified concept

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# Abstract

Intelligent Transport Systems (ITS) are technological devices that can be beneficial for traffic safety and mobility. ITS can be positioned from relatively simple systems that provide the users with traffic and travel information to relatively complex systems that take over parts of the drivers' tasks. The success of ITS deployment largely depends on the willingness of users to adopt these devices. Therefore, it is needed to understand how users (will) react and (will) experience these devices and how users' needs are or can be integrated in the development and implementation of ITS.

The central notion within this paper is to describe which socio-psychological factors can influence ITS-acceptance (or acceptability) and what benefits this will have on policy-making issues. In a first phase, the different approaches used in the ITS-trials to define acceptance will be analyzed. Secondly, the benefits of defining acceptance and acceptability will be described. In a third phase, a unified approach will be outlined which will lead to describe the key-elements that can influence acceptability by individuals. Finally, these different aspects will be integrated in a (provisional) conceptual model, related with behavioural and motivational theories, that will give a base for the development of a general operational research method to define acceptability of ITS in the benefit of developing implementation strategies.



# Keywords

Intelligent Transport Systems (ITS), Intelligent Speed Assistance (ISA), acceptance, acceptability.

# 1 Introduction

The EC states that the challenges for sustainable mobility are a reduction of congestion, an increase in traffic safety (a 50% reduction in fatalities in 2010 compared with 2001), and an increase in energy efficiency and a reduction of the dependency on fossil fuels (European Commission, 2001). The use of different transport technologies (Intelligent Transport Systems or ITS) can play a significant role to achieve these goals. Many ITS applications in the field of traffic management and travel information are already on the market and have proven their effectiveness. These systems support transport system users with traffic and travel information. However, in order to achieve e.g. EC transport policy goals, the implementation of more advanced ITS applications is required which actively intervene in vehicle driving tasks. This category of ITS devices are also known as Advanced Driving Assistance Systems (ADAS) which (partially) take over vehicle driving tasks like distance keeping, lane keeping, overtaking, etc. Many research initiatives on different ADAS technologies are conducted on international, national and regional level. While most of these studies focus on the technological feasibility of ADAS and its' (intended) impacts, the question whether these (new) technologies will be used is still open. ADAS can be positioned from relatively simple systems that provide the drivers with information to relatively complex systems that take over parts of the drivers' tasks to perform 'good' driving behaviour (Brookhuis and De Waard, 1996). Therefore, it is needed to understand how users (will) react and (will) experience the ADAS support and how drivers' needs can be integrated in the development and implementation of ADAS. In general, understanding (potential) users' point of view has been defined as acceptance or acceptability. Although several studies are conducted to examine acceptance or acceptability of ADAS there is little consistency in most of the studies to what is exactly meant by acceptance or acceptability and how it can be measured. This paper aims at defining what acceptance or acceptability implies and which factors can be considered as relevant to measure it. This will be done through the use of a specific ADAS application, the case of Intelligent Speed Assistance (ISA). ISA involves a traffic safety device that warns the driver about speeding, discourage the driver from speeding or prevent the driver from exceeding the speed limit.

# 2 Acceptance and acceptability research

Acceptance, acceptability, social acceptance, public support, social support, etc. are terms frequently used to describe a similar phenomenon: how will (potential) users act and react if a certain measure or device is implemented? The interest in defining the acceptance/acceptability must be seen in the growing awareness that policymaking must be considered as a two-way direction, wherein interaction, transaction and communication with the public are the key-elements (Nelissen and Bartels, 1998). This leads, in terms of road safety policy, to the precondition that the effectiveness of a measure will increase if there is support. Public support for road safety (measures) can be described as a positive valuation of road safety and of measures that evidently increase road safety. This positive valuation leads, under favourable conditions, to an increased willingness to accept a measure and even to support it actively. A strong definition of what the term 'support' implies is absent. In most cases 'public support' has been related to acceptability, commitment, legitimacy and participation

(Goldenbeld, 2002) An important distinction that has been made is between political, policy, and social 'support.' To a certain extent, the terms acceptance or support are strongly related. Goldenbeld (2002), however, describes a nuance between support and acceptance. Acceptance can be available, but would not necessarily lead to the support of a measure. For example: it is possible for an individual to accept paying taxes, but he would not necessarily support it. In this way acceptance must be seen as a precondition to come to support but would not be the same.
In most reports the term support is not used because of the vague description it has. The terms acceptance and acceptability are mostly used in the context of defining, getting or creating support for a policy measure (Hedge and Teachout, 2000; Molin and Brookhuis, 2007).

Some authors state (e.g. Molin and Brookhuis, 2007) that there seem to be as many questionnaires as methods to measure acceptance and acceptability. Besides the problems in finding the right approach in measuring acceptance or acceptability, the terms acceptance and acceptability are still defined and measured in different ways. Ausserer and Risser (2005) define acceptance of ITS as a phenomenon that reflects to what extent potential users are willing to use a certain system. The acceptance will than depend on how user needs are integrated in the development of the system. Nielsen (Young et al., 2003) described acceptability as the question of whether the system is good enough to satisfy all the needs and requirements of the users and other potential stakeholders. More general, in Rogers' diffusion of innovations (2003), acceptability research is defined as investigation of the perceived attributes of an ideal innovation in order to guide Research and Development, so as to create such an innovation. Schade and Schlag (2003) made a clear distinction between acceptance and acceptability. Schade and Schlag (2003) describe acceptance as the respondents' attitudes including their behavioural responses after the introduction of a measure and acceptability as the prospective judgement to be introduced in the future. In this case, the respondents will not have experienced any of the measures or devices in practice, which makes acceptability an attitude construct. Acceptance is than more related to user-acceptance of a device. Van der Laan et al. (1997) distinguish user-acceptance and social acceptance. User acceptance will be more directed towards evaluation of the ergonomics of the system, while social acceptance is a more indirect evaluation of consequences of the system. Related to the previous definition, social acceptance will be part of acceptability but the user-acceptance cannot be evaluated within acceptability research.

In our research we will use the case of ISA to explore the content of and factors that can influence acceptance and acceptability of ADAS (and ITS). Many ISA evaluation studies were conducted since the early 1980s. Besides the measurements on safety effects, aspects in how drivers cope with the system were analysed. Generally these aspects were noted as the "acceptance" indications when driving with ISA.

# 3 Methods in defining acceptance in ISA trials

In most ISA researches and trials, acceptance and acceptability refer to the opinions, attitudes, and values of the users related to the experience they had when driving with the system (Brookhuis and de Waard, 1999; Comte et al., 2000; Vlassenroot et al., 2007; Young and Regan, 2007). In these studies, acceptance is measured by behavioural changes when driving with ISA as compared to driving without ISA

(Biding and Lind, 2002; Hjalmdahl and Varhelyi, 2004; Katteler, 2005). Brookhuis et al. (1999) define these behavioural changes as the level of adaptation instead of acceptance. Adaptation are those behaviours which may occur following in the introduction of changes to the road-vehicle-user (Dragutinovic et al., 2005). Therefore adaptation will better describe the behavioural outcome (and changes) when drivers have experienced the device and acceptance will be more related to the attitudes, norms and believes that may influence the adaptation. Goldenbeld (2002) has noted that opinion and attitude researches are the most adopted research methodology to measure acceptability and acceptance for road safety measures.

Based on recent ISA field trials in different countries, some directions for defining acceptance can be found. Although the main research set-ups and methods used were different in different trails, some communalities can be noticed. Below a short overview is given.

- In large-scale ISA trials in Sweden, different ISA-types were tested by 10 000 voluntary test drivers between 1999 and 2002 (Biding and Lind, 2002), In these trials, acceptance was measured based on defining attitudes to traffic safety and speed, experiences of the tested ISA, willingness to pay, performance when using ISA and the scaling of the use of ISA on satisfaction and usefulness.
- In the Dutch ISA trial a mandatory closed system was tested. The acceptance research was mainly focused on the influence of ISA on drivers' tasks technical functions of ISA and ergonomic issues.
- In the Australian trial (Regan et al., 2006), the acceptance study was based on the model of Davis and Nielsen (as cited in Young et al., 2007). The five main constructs were usefulness (users perceive the system to serve a purpose), effectiveness (users must believe that the system does what it is designed to), usability (the ease of use of the system), affordability (willingness to pay) and social acceptability (broader scale that users may take into account in assessing whether ISA is acceptable). The scope of research in the Australian trial involved, apaprt from ISA, other ITS devices like distance keeping warning as well.
- In the Belgian trial (Vlassenroot et al., 2007), drivers drove with the active accelerator pedal, the concept of acceptance was based on a framework designed to define public opinions on speed measures and ISA (REF). This framework denotes how people see mobility and transportation in relation with road safety, especially with respect to speed, speeding and speeding restrictions. Based on this framework basic attitudes on road safety, speed and speeding; recognition of speed as a problem in society and attitudes about road safety and policy could be measured, distinguishing different socio-demographic backgrounds of transport users. Further aspects were the voluntary use of the system out of the test-area, willingness to pay and the scaling of the use of ISA on satisfaction and usefulness (Van der Laan et al., 1997).
- In the Danish trial (Harms et al., 2007) an open ISA – system in combination with other incentives when driving safely (e.g. lower insurance premiums), was tested. This trial focused on the influence of background factors such as age and driving experience, questions related to driving style, attitudes to safe driving, driving speed and speed limits, and to risky traffic behaviour. The respondents were also asked to judge a number of frequently used ISA features, and to anticipate effects of driving with ISA.

Not much research was conducted during these trials on the acceptability of ISA for non-ISA users. Molin and Brookhuis (2007) defined problem awareness, car drivers' believes about the selected policy instruments and car drives' personal characteristics as main variables that would influence acceptability. De Mol et al. (2001) based acceptability measurement on the attitudes and opinions given by individuals, which stand for the general public. Within this concept several layers with mutual relations were defined: the socio-demographic issues and the individual transportation habits are the 'basic' factors for the creation of a public support. The basic attitudes denote how people perceive mobility and transportation, in particular the perception of speed in relation to motorised vehicles. Public support is also determined by 'being a (problematic) issue in society:' if there is no social indication that a problem about the relationship between road-safety, speed and speeding is perceived, there will not be any chance in future acceptance. Some of the abstract norms and values are made concrete in issues concerning in how people think about road-safety measures. At this level the 'real' discussion on possible acceptance would take place. Within the SARTE (Drevet, 2004) project some questions were related to how people noticed speed and speeding an were brought in relation with the willingness to use a speed limiting device. Some of the aspects that are used in acceptance research will be mutual in acceptability research.

Based on the field trials studies presented above, the main common factors in studying ISA acceptance and acceptability are:

- Background factors (age, gender, driving experience)
- Social influences (degree of other factors that can influence drivers opinions)
- Problem awareness (degree in how speed is recognised as a problem in society)
- Effectiveness (degree in how the system do what it has to do – technical issues)
- Usability (degree in how drivers can work and understand the use of the system)
- Usefulness (degree in how the system do what it has to do from drivers point of view)
- Satisfaction (degree in how the system solves the drivers needs)
- Affordability (degree of willingness to pay)

# 4 Indicators for acceptance and acceptability

Acceptance and acceptability can be considered as layered concepts including different indications based on attitudes, believes and norms of the individual (Katteler, 2005). These indications can be directly related to the characteristics of the device and the personal believes, norms and values about the context in which the use of the device will take place. The acceptance and acceptability of ISA must then be understood in the context of speed and speeding. Based on the previous given indications in acceptance research on ISA, these indications will be further described in detail.

**Background or individual factors**

Gender, age, level of education and employment are considered to have influence on how people think about speed and speeding and therefore on the use of ISA.

Gender and age are considered as relevant determinants within the performance of speeding behaviour. Speed is more associated with young drivers (Ingram D et al., 2001; Parker et al., 1992; Stradling et al., 2000), more specifically with young male drivers. Although male drivers (Stradling et al., 2003) are more likely to speed, some studies noted that difference between sexes could not be found. For instance, within the Belgian ISA-trial, female drivers were more satisfied with the ISA-device (Vlassenroot et al., 2007).

**Travel behaviour, driving style and car use**

Travel behaviour, driving style and the choice of vehicle are also brought into relation with speeding behaviour. Silcock et al. (2000) noted that people admitted to drive faster in more powerful and comfortable cars. Moreover, Steg et al. (2001) did a study to clarify the importance of symbolic-affective as opposed to instrumental-reasoned motives for car use. These motives for car use can have an impact on why they are (not) speeding or why they would (not) like ISA. People that drive more may also speed more. Related to acceptability of ISA, it is therefore hypothesised that travel behaviour and the vehicle can be influencing factors. Stradling et al. (2000) examined the demographic and driving characteristics of speeding, violating and thrill-seeking drivers. They concluded that (English) drivers who speed, who violate other rules of the road, and who seek thrill when driving, pose greater risks to themselves and to other road users. Also crash involvement has been noted as a possible influence on speed and speeding behaviour. To define acceptance and acceptability of ISA, the influence of travel behaviour, car use and vehicle choice and driving style could be considered as relevant indicators.

**Personal and social aims**

Schade and Schlag (2003) describe this as the dilemma between social or personal aims and benefits. They assume that a higher valuation of common social aims will be positively related to acceptability. People, who want to drive as fast as possible according to their own preferences, will have a lower acceptability and acceptance of ISA. Another issue is the effect of speeding measures on individual freedom. Policies or devices that seriously affect individual freedom will be less acceptable (De Groot and Steg, 2006). This implies that mandatory, closed ISA systems (speeding is not possible) will be difficult to accept although these types of ISA will have a higher (social) impact on road safety (Carsten and Tate, 2005; Morsink et al., 2006).

**Social norms**

Perceived social norms and perceived social pressure refer to the (assumed) opinions of others (peers) multiplied by the importance of the others' opinions for the individual. In other words, social norms refer to an individual's assumption about whether his peer would think that he or she should accept the device. (Ajzen, 2002; Schade and Schlag, 2003). It is assumed that peers, e.g. co-workers or specific other road-users, will influence the attitudes and behaviour of individuals. For instance, Silcock et al. (2000) found that drivers exhibit different driving behaviour with passengers in the car as compared to driving without passengers. These findings suggest that immediate peer pressure is an important factor in speeding for some groups. Within the Ghent ISA-trial it was noted that drivers would overrule ISA, when other drivers (without using ISA) 'forced' them to speed. (Vlassenroot et al., 2006) Silcock et al. (2000) also found an influence of other drivers on speeding

behaviour. On the other hand, image and opinions by others when using ISA could be a relevant determinant to accept or not accept ISA.

**Problem perception**

The extent to which speeding is perceived as a problem is a necessary indication in defining acceptance and acceptability. There is common agreement that high problem awareness will lead to increased willingness to accept solutions for the perceived problems (Schade and Schlag, 2003; Steg et al., 1995; Eriksson et al. 2006; Goldenbeld, 2002; Molin and Brookhuis, 2007; De Mol et al., 2001).

Within the problem perception it is possible to distinguish two aspects: the social consciousness, compared with other 'crimes' in society and other road unsafety issues and the personal consciousness of the problem. An important aspect of our study is to find the acknowledgement of individuals if they see speed or speeding as a problem.
How people perceive the social consequences of speeding can be established by looking for the relation between road unsafety and other 'unsafe' issues in society (e.g. criminality, terrorism). Particularly the question arises how people list speeding as compared to other social unsafety issues. It can be assumed that the higher they rank speeding, the higher would be the acceptance of road safety measures regarding decreasing speed. On the other hand, it may be that traffic offences are perceived to be different to non-traffic offences. According to Corbett (2001) speeding is not seen as a 'real' crime by most drivers at least not by themselves, which indicates this means attempts to dissuade drivers from excessive speed will be a difficult process.
How do people see speeding in context of other road unsafety issues? To define this issue, the basis can be found in the SARTRE (Drevet, 2004) research. In this European questionnaire, the respondents were asked to rank the importance of different crash causation factors, such as speed, alcohol, distance, fatigue, weather, traffic jams, drugs, medicine, mobile phone use, lights, roads, steering mechanism, and tires. It can be assumed that the higher speeding is ranked, the more people will perceive speeding as a problem in society. Alcohol and speeding were indicated by the respondents as the most probable cause of accidents in Belgium (like in most countries).
Speeding is generally associated with negative consequences in the form of physical injury and fatal road accidents. Based on the previous topics related to the problem definition, the awareness of speeding as an individual problem should be defined. People's driving styles, or more related (past) speeding motivations, unsafety feelings are key-factors in acceptance of road safety-measures. In this case, individuals' attitudes about speed and speeding are relevant determinants.

**Responsibility awareness**

Responsibility awareness is much related to the personal and social aims and the problem perception at the individual level. This concept is based on the norm activation theory by Schwartz (1977) and environmental travel demand management studies (Eriksson, 2006; Steg and de Groot, 2006; Stern, 2000). This concept declares also in how the individual sees this responsibility: is it the government (others/ excentric) or is it the individual itself (own/incintric). It is assumed that environment-preserving behaviour becomes more likely if persons perceive damaging consequences of their own actions on the environment and others, and at the same time ascribe the responsibility for the consequences to themselves (Schade and Schlag, 2003). Steg and Vlek (1997) noted a positive connection between

responsibility, problem awareness and acceptability of demand management measures.
Hence, with respect to speeding and ISA, if the individual is considered at least partly responsible to solve the problem, a higher acceptance/acceptability can occur. But if he/she only noted that the external parties (governments) are regarded as the problem owners, a negative affect can occur in the free choice of using ISA. In the Belgian trial (Vlassenroot and De Mol, 2003 RAPPORT) some test-drivers participated because they thought they could contribute to a better road safety, which can be considered as responsibility awareness.

**Information and knowledge about**
The level of acceptance/acceptability can depend on how well informed the respondents are about the problem and about the (new) device that is introduced to solve the problem (Schlag and Schade, 2003, Steg et al., 1995). The hypothesis may be that how better people are informed, how higher the acceptance/acceptability will be. However better knowledge about a problem can also lead to less acceptance/acceptability for a specific solution caused by e.g. awareness of alternatives to solve the problem. Schlag and Schade (2003) noted that a distinction must be made between whether a person feels well or badly informed or whether he actually is well or poorly informed. They notified a difference between objective knowledge and the subjective assessment of the own knowledge.
In the case of ISA, a difference can be made in knowledge about speeding, speed management, knowledge about ICT and ITS, and knowledge about ISA. The problem awareness will take place within a certain culture and social system. How governments cope with speed and speed management and how they experience the taken measures will affect the perception of speed by individuals and so the problem awareness. In the acceptance study of Regan et al. (2003), respondents had also to declare how they cope with other ICT systems and issues. The knowledge about and how difficult people would indicate the use of ICT can influence the acceptance of ISA.
In the Belgian trial, all drivers were well informed how the system worked and what the benefits of the system were. This has lead to a higher acceptance by the test-drivers (De Mol and Vlassenroot, 2007). Rogers (2003) noted that trialability and given information (communication) can increase the speed of adoption. Many studies indicate that driving with ISA increased the acceptance for ISA (e.g. Morsink et al., 2006). In the Belgian trial a strategy was conducted to use role models when driving with ISA to increase the information to others and to get more involvement of mass-media (Vlassenroot and De Mol, 2005).

**Perceived efficiency**
The perceived efficiency indicates the possible benefits users expect of a concrete measure (or device) as compared to other measures. In the acceptability study of De mol et al. (2001) respondents had to evaluate how they thought about various speeding measures and how they evaluated ISA as compared to these measures. The recognition of the speeding problem and the information people have will influence the rate of efficiency. If they note ISA as more efficient a higher support can be possible.

**Perceived effectiveness**
Effectiveness refers to the system's functioning according to its design specifications, or in the manner it was intended to function (Young et al., 2003). In most trials this was done through an evaluation of the technical/ergonomic issues. The main question in these trials remained if the system supported the driver to maintain the proper speed. The level of effectiveness can depend in how intervening a system is or was. For instance, an advisory system can be considered as less effective than a system which does prevent the driver from exceeding the speed limit.

**Usability**
Usability can be defined as the ability to use the system successfully and with minimal effort. Usability will be more related to acceptance than to acceptability. Usability is also an indication for how the (potential) users understand how the system works. User friendliness can be associated with usability: the users will expect a service, which does not distract or overload them with information and (difficult) tasks (Landwehr et al., 2005).

**Usefulness**
Usefulness is related to how the system will support the drivers' tasks and driving behaviour. Usefulness is in a certain way different from effectiveness. A (potential) user can find ISA effective but not for his own driving behaviour. Young et al. (2003) define usefulness as the degree to which a person believes that using a particular system will enhance his/her performance. Regarding the SpeedAlert project (Landwehr et al. 2005) some expectations were given based on stakeholders' opinions about speed limiting devices: good information of the service, awareness where it is operational/non-operational, correctness of content and accuracy of the system are major issues to get a higher acceptability/acceptance. These items are directly related to the system. Drivers will use the system within their context and context awareness (problem recognition, aims to reach, etc..) that will influence the degree of usefulness. Another aspect is the integration of ISA within other ITS or route-navigation systems that can lead to a higher degree of usefulness.

**Equity**
In general, equity refers to the distribution of costs and benefits among affected parties by ISA. However, from a psychological point of view, perceived justice, integrity, privacy, etc., are basic requirements for acceptability. This may differ from the objective costs and benefits but it is an important indicator influencing personal perceptions (Schade and Schlag, 2003). The integrity of driver information, privacy and loss of certain freedom in driving can be an issue in willingness to use ISA. Frequently the use of ISA has been related to "big brother " and as a system to take away the control of driver's tasks (Vlassenroot et al., 2007). (Potential) users will also be aware when he/she has to drive with ISA and others will not. Within different trials (Biding and Lind, 2002; Vlassenroot and De Mol, 2005), respondents were also questioned about for whom the system would be most beneficial (frequent speed offenders, older or younger drivers, professional drivers, etc.).

**Satisfaction**
Satisfaction is one of two factors within the scale of Van der Laan et al. (1997). This scale was developed to study user-acceptance. Acceptance is measured by direct attitudes towards a system and provides research with a system evaluation in two

dimensions. The technique consists of nine rating-scale items. These items are mapped on two scales, a scale denoting the usefulness of the system, and a scale designating satisfaction. Satisfaction was given by evaluating the system pleasant/unpleasant, nice/annoying, irritating/likeable, undesirable/desirable. The degree of satisfaction will only be of use when measuring acceptance.

**Affordability**
It may be assumed that socio-economic status will affect acceptance and acceptability. Some will use ISA as a symbol of status and see as "having a new gadget or feature" (Rogers, 2003). On the other hand affordability will depend on an indivual's budget and/or public/private funding. It is to be expected that low income groups should be more opposed to ISA. In many trials acceptance was also made operational by willingness to pay for ISA (Vlassenroot et al., 2007; Biding and Lind, 2002; hjalmdalh, 2004). The willingness to pay will depend on income but in many trials it is assumed that how higher they are willing to pay, how higher the acceptance and acceptability will be. Giving incentives like lower road taxes, lower insurance fee, can stimulate the acceptance or acceptability of ISA (Lahrmann et al., 2007; Schuitema and Steg, 2008)

# 5 Conceptualizing a model

The 14 indications are considered to be the most relevant that can or will influence acceptance/acceptability. We can make a distinction (see fig.1) between general indications (related to the context awareness of the system) and system specific indications (directly related to the characteristics of the device). These general and specific indications will influence each other and the level of acceptance and acceptability. Also mutual relations within the general and specific indications could be found, although it is not clear, or tested in our approach, how these would influence each other.

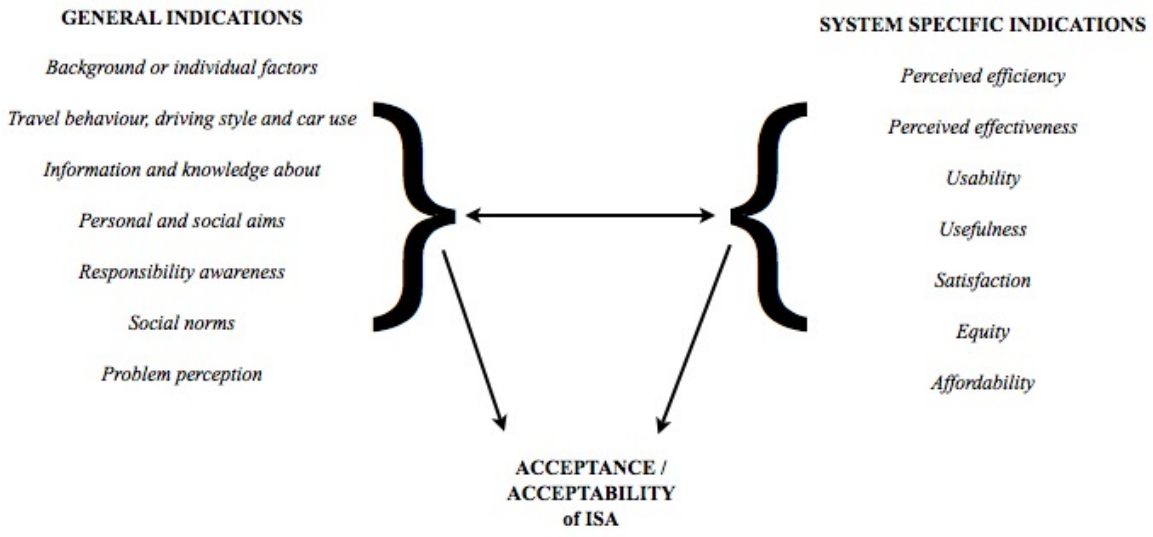


**Figure 1: General and system specific indications that can influence acceptance or acceptability**

## 5.1 General indications related to speeding

The use of ISA must not be seen in an isolated way, but in the context of speed problems and possible speed management policies. Different studies are conducted to define who drive faster (and why) and how they experience speed and speeding. Already in the European Master project (Master final report, 1999) interviews of drivers and pedestrians were carried out in six European countries about the acceptability of current speed behaviour and speed limits, using the theory of planned behaviour by Ajzen (2002). Driving behaviour is than determined by intentions, which in turn are determined by attitudes, subjective norms and perceived behavioural control. The theory of planned behaviour was found relevant in several other studies regarding driving behaviour and traffic safety, like drinking and driving; driving violations (Parker et al., 1992), speeding and speed, (De Pelsmacker and Janssens, 2007; Elliott and Baughan, 2004; Haglund and Aberg, 2000; Paris and Broucke, 2008; Parker and Stradling, 2001). Our "general beliefs" could be related to the factors determined within the theory of planned behaviour and factors examined in these studies. The background factors, driving behaviour, information about speed problems and solutions, personal and social aims, responsibility awareness and social norms would indicate how people note the problem of speed and speeding.

## 5.2 Device specific indications

The device specific believes are directly related with the characteristics of the system. These seven indications are found as the most relevant to define acceptance or acceptability and how user needs are integrated in the system. As noted, ISA (acceptance) is related to drivers' attitudes and behaviour about speed and speeding. Therefore, the previous concepts of the general beliefs must be taken into consideration and will influence the specific beliefs to define the acceptability of ISA. However, ISA also has particular characteristics and ISA-devices exist in different forms. These characteristics have to be translated within the given indications. Satisfaction, usefulness, effectiveness, usability and affordability were found to be relevant indications in defining acceptance of ISA (Adell and Varhelyi, 2008; Biding and Lind, 2002; Brookhuis and de Waard, 1999; Comte et al., 2000; Regan et al., 2006; Young et al., 2003).

## 5.3 Concept of the model

In our conceptual model (see figure 2), the individual factors (e.g. age, gender, income, occupation) will determine the travel behaviour, driving style and car use. As noted before, e.g. young drivers could be more reckless in driving than other drivers. Also the background factors will influence the general beliefs and system specific beliefs directly. Travel behaviour, driving style and car use will influence their level of information, knowledge and experiences about speed and speeding and about ISA as on the general beliefs and system specific beliefs. On the level of "information and knowledge about" a differentiation can be made in knowledge about the consequences of speed and speeding and knowledge about the system (ISA). Experience will refer to people who had driven with the system. At this level a first differentiation in defining acceptance (having experienced driving with the system) and acceptability is made.

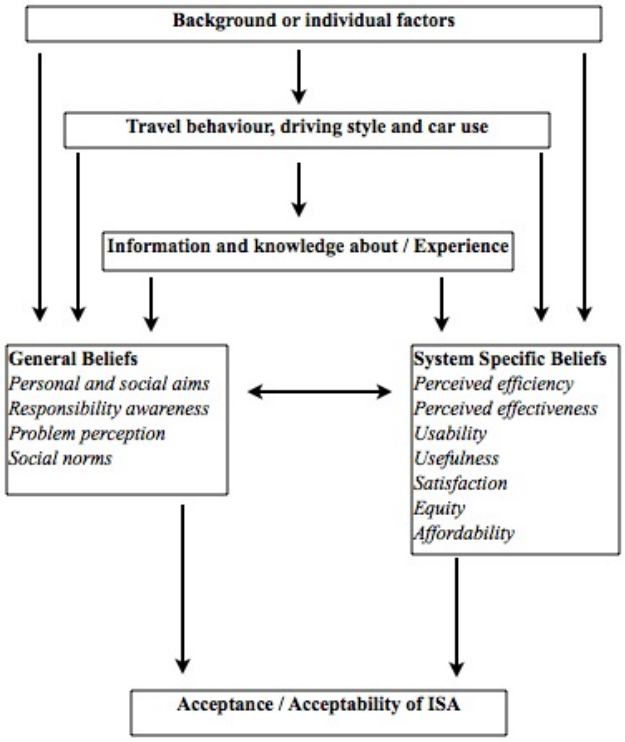


**Figure 2: Conceptual model to define acceptance and acceptability**

The general beliefs are related to the context wherefore the system is used. The use of ISA is related to the context of speed management and speeding. Personal and social aims, responsibility awareness to do something on speeding, the problem perception and the influences of others (social norms) will define certain aspects of acceptance and acceptability but would also give indications on how they perceive the system. (e.g. a driver who do not think that speeding is a problem, likes to speed will not think that ISA is useful for him). At this level the personal or individual context about speed and speeding is cleared out wherein further acceptance or acceptability of the device will take place. The system specific beliefs are these indications that are directly related with the system characteristics of the system (what can it do? How will it do it? Will I use it? Can I use it? Will and can it supports me? How do I experience it? Can I and how will I afford it? Will it be legal, how would it influence my privacy and driving control?). As well as in the general beliefs as in the system specific beliefs, the given indications (as described in figure 2) could or will have mutual influences or relations. These have to be found when the model is made operational. Some of the device specific beliefs will be more relevant when defining acceptance (like satisfaction) than in acceptability. Therefore this general concept has to be interpreted as a dynamic approach in measuring the level of acceptance or acceptability

The found indications are based on several relevant factors in acceptance theories, like the theory of planned behaviour (Ajzen, 2002), environmental models (Steg et al., 2005), technology acceptance models (Venkatesh et al., 2003), and the diffusion innovation theory (Rogers, 2003). These models could be used to make to conceptual model in an next stage operational. Our conceptual design will have to make it possible to use a simple procedure to define acceptance and acceptability but also to know which indications are the most relevant. Every indication has to clear out which

are possible motivators or show stoppers to come to better implementation based on individuals' beliefs and attitudes.

# 6 Conclusions

In many trials and researches acceptance and acceptability are defined in different ways. Until now, a general framework is lacking which make comparison between different results of trials difficult. Venkatesh et al. (2003) also noted the problem that there are several theories and models of user acceptance of information technology, which confront researchers with difficulties to choose the proper model. In our concept as many possible indications that can define acceptance or acceptability are described. The differentiation is made between general context indications and device specific indications. How these indications are related to each other must be investigated. This will be done in the next step of our research. It is our goal to construct a fully operational method that is easy to use for researches but also for policy-makers based on existing social and psychological "acceptance" models.

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