Chapter 3: Literature Review

3.1 Chapter Objectives

This chapter is aimed at providing a framework and a rationale for the collection of empirical data and for relating the empirical results to previous findings in the field of innovation acceptance. Most importantly, this chapter should:

- provide an overview of the key theories in the field,
- discover the important variables relevant to the topic,
- synthesize different results and develop a new perspective,
- identify relationships between ideas and practices, and
- provide an understanding of the structure of the subject.

As explained in the previous chapter, this research aims to provide a contribution to knowledge. Without establishing the state of previous research, however, it is impossible to demonstrate how the present research advances the knowledge in the field. Thus, this literature review is also aimed at locating the present research into the context of current advancements in innovation acceptance literature.

3.2 Literature Review Design

Conducting a literature review is a means of gaining insight into a particular field of study, including theories, main contributors, key variables, methods and history (Randolph, 2009, p.2). According to Fox and Bayat (2008) a literature review also helps to delimit the research problem, to identify recommendations for further research and to gain methodological insights. The literature review also helps to distinguish what has been done already and what needs to be done in future research. This is especially important in a field that produces a considerable amount of research papers, as in the field of innovation acceptance. The general process of conducting a literature review is not too different from the process of conducting primary research. The main components are a rationale for the review, research questions or hypotheses, a plan for collecting the data, a plan for analysing the data and finally a plan for presenting the data (Randolph, 2009, p.4).

The common starting point for a literature review is to select the units of review. This means explicitly determining the criteria for inclusion and exclusion of

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articles and books that should be reviewed (Randolph, 2009, p.6). The present review started with the standard books in the field of innovation acceptance, such as Rogers' "Diffusion of Innovations" with its different editions from 1962 until 2003. In order to develop selective criteria for further review of literature, empirical studies in the field of innovation acceptance were reviewed for methodological and bibliographic citations. It became apparent that regularly cited standard articles, such as Venkatesh and Davis (2000), should be included in the review. Moreover, it was striking that most of the empirical studies in this initial review not only relied on the concepts developed by Rogers (2003), but also included concepts developed in the field of social psychology, such as the Theory of Reasoned Action. Consequently, these concepts and their related books, such as "Predicting and changing behaviour" by Fishbein and Ajzen (2010), were also included in the literature review.

Due to the vast amount of empirical research in the field of innovation acceptance, some rather strict selection criteria had to be defined for the inclusion of empirical articles. Based on the research objectives, articles were included if they met the following criteria:

- The study focused on the acceptance of a product or service in the field of advanced technology (innovations in the field of health, education or organisations were thus intentionally neglected).
- The study reported significant results, employed standard validity tests and documented means and standard deviations.
- The study reported on the methodology employed, especially on the theories and models used for developing the constructs.
- The study reported on the sample size used.
- The study was not conducted prior to 2001.
- The study was written in English.

In the next step, a qualitative synthesis of the empirical articles meeting these criteria was developed by comparing and contrasting the results of the individual studies and generating categories and core concepts. Consequently, the final result of this chapter is a table, containing the common synthesized concepts and results from all innovation acceptance articles reviewed in the process of this literature review.

3.3 Defining Innovation

Even though the creation of new ideas had been studied in many disciplines before, it is widely believed that the term ‘innovation’ was introduced to the world of economics by Peter Schumpeter in 1939. In his description of the capitalistic market, he defined Innovation as "doing things differently in the realm of economic life" (Schumpeter, 1939, p.84). For Schumpeter, innovation can occur in five ways (Schumpeter, 1939, pp.90–93):

- by the introduction of new goods,
- by new methods of production,
- by the opening of new markets,
- by the conquest of new sources of supply and,
- by carrying out a new organization of any industry.

Since Schumpeter, innovation has been studied in many disciplines and has been defined from different perspectives (Damanpour and Schneider, 2006, p.215). Academic discussion is still some way from reaching a common agreement to describe innovation. Depending on the particular research issue, different criteria are employed to characterise what is meant by the term *innovation* (Herzog, 2011, p.9). One reason for the fact that there is not an established single definition of the term *innovation* is that innovation is of interest to practitioners and researchers across a wide range of business and management disciplines. Literature focusing on innovations can be found in human resource management, operations management, entrepreneurship, research and development, information technology, engineering and product design, and marketing and strategy. Consequently, each of these different disciplines proposes different definitions for innovation (Baregheh, Rowley and Sambrook, 2009, p.1324). Whilst there are some overlaps between the various definitions of the term *innovation*, the proliferation and diversity of definitions lead to a situation in which there is no clear and authoritative definition that can be accounted for (Baregheh, Rowley and Sambrook, 2009, p.1324). Table 4 provides a compilation of popular definitions for the term *innovation*.

Table 4: Definitions of Innovation in chronological order

Definition	Author
"The act of introducing something new"	The American Heritage Dictionary
"The process whereby new and improved products, processes, materials, and services are developed and transferred to a plant and/or market where they are appropriate"	White and Bruton (2011, p.19)
"The use of new technological knowledge, and/or new market knowledge, employed within a business model that can deliver a new product and/or service to customers who will purchase at a price that will provide profits"	Kaplan and Warren (2010, p.41)
"A significant positive change"	Berkun (2010, p.17)
"Change that creates a new dimension of performance"	Drucker (2007, p.51)
"An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption."	Rogers (2003, p.12)
"… the transformation of knowledge into new products, processes, and services — involves more than just science and technology. It involves discerning and meeting the needs of the customers"	Porter and Stern (1999, p.12)
"Innovation consist of the generation of a new idea and its implementation into a new product, process, or service, leading to the dynamic growth of the national economy and the increase of employment as well as to a creation of pure profit for the innovative business enterprise"	Urabe (1988, p.3)
"Innovation is any thought, behaviour or thing that is new because it is qualitatively different from existing forms"	Barnett (1953, pp.7–8)
"The introduction of new goods (…), new methods of production (…), the opening of new markets (…), the conquest of new sources of supply (…) and the carrying out of a new organization of any industry"	Schumpeter (1939, p.84)

Reviewing these definitions, it becomes obvious that a new idea by itself is not yet an innovation; it could merely be regarded as a concept or a thought. The process of converting these thoughts into tangible new artefacts (usually a prod-

uct, a service or a process) is usually called invention. The later activities that lead to an invention becoming a success in the marketplace or in a society as a whole represent exploitation. It is, however, the complete process that represents innovation (Trott, 2010, p.14).

There is no doubt that a general definition covering all these aspects of innovation in a multidisciplinary manner would be beneficial to the field of economics (Adams, Bessant and Phelps, 2006, p.22). In an attempt to arrive at a single comprehensive definition, Baregheh, Rowley and Sambrook (2009) recommend defining innovation as a process and including various dimensions for every process step. Their basic definition reads as follows: "Innovation is the multi-stage process whereby organizations transform ideas into new or improved products, services or processes, in order to advance, compete and differentiate themselves successfully in their marketplace" (Baregheh, Rowley and Sambrook, 2009, p.1333). The authors acknowledge that, depending on the context, the term *transformation* may need to be replaced with *creation*, *generation* or *adoption.* Also, many innovation processes may not originate from an *organization* but rather from a *social system, employees* or an *individual*. To make up for these variations, multiple dimensions are necessary for every step in the process definition. It is hard to imagine a definition that covers all these dimensions in one comprehensive and articulate manner. Consequently, Baregheh, Rowley and Sambrook (2009, p.1333) argue in favour of a diagrammatic definition of the term *innovation* instead of a pure textual definition. Chart 10 shows a graphical approach to the definition of *Innovation*.

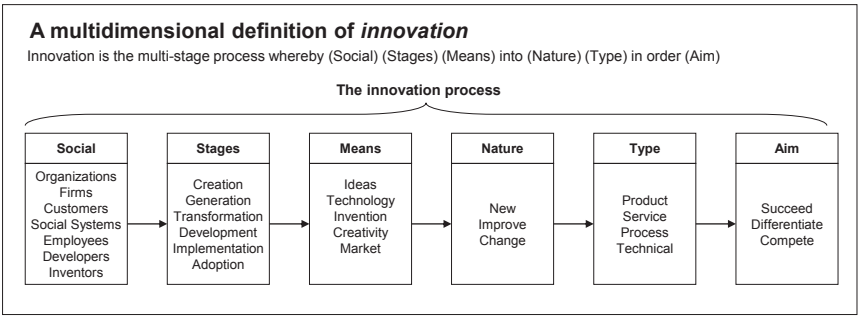

Chart 10: Multidimensional definition of innovation, Source: Own drawing, based on (Baregheh, Rowley and Sambrook, 2009, p.1333)

Since the main interest of the present research is the acceptance of a new technology, a process definition of innovation, like the one by Baregheh, Rowley

and Sambrook (2009, p.1333) is not applicable in this case. The acceptance of an innovation itself is only one partial process within the overall "innovation process": thus, the term "acceptance of an innovation" would not make any sense in this perspective. Consequently, for the purpose of the present research, an object-based definition will be employed. Based on the multidimensional, graphical approach developed by Baregheh, Rowley and Sambrook (2009, p.1333), the author thus developed a definition that incorporates the three object-related dimensions: (1) the object of an innovation, (2) the attribute, which describes the novelty character of this object and (3) the social dimension, describing the unit of adoption. The reviewed definitions of the term *Innovations* delivered the potential items for each of these three dimensions by splitting the definitions accordingly.
Table 5 gives the results of this three-dimensional analysis of definitions.

Table 5: Developing a definition of innovation

Object		**Novelty attribute**		**Social adoption unit**	
Term	**Reference**	**Term**	**Reference**	**Term**	**Reference**
knowledge	Kaplan and Warren (2010, p.41)	significant change	Berkun (2010, p.17)	customers	Kaplan and Warren (2010, p.41); Porter and Stern (1999, p.12)
idea, practice, or object	Rogers (2003, p.12)	perceived as new	Rogers (2003, p.12)	individual or other unit of adoption	Rogers (2003, p.12)
product, process, or service	Porter and Stern (1999, p.12)	qualitatively different from existing forms	Barnett (1953, pp.7–8)		
thought, behaviour or thing	Barnett (1953, pp.7–8)	new	Schumpeter (1939, p.84); Porter and Stern (1999, p.12)		
goods	Schumpeter (1939, p.84)				

Regarding the object dimension, two different aspects are relevant for the definition of *innovation* in the present context. An object could either be a ***product***, referring to any object aimed at commercialization or an ***idea***, referring to any thoughts or knowledge, aimed at diffusion within a society. Reviewing the dif-

ferent attributes for novelty, it becomes apparent that an object can either be *new* or *significantly different* to existing objects in order to be considered an innovation. An important aspect, developed by Rogers (2003, p.12), is that an innovation should be considered as new or significantly different from the perspective of the adoption unit (those, who will eventually adopt it). Concerning this adoption unit, finally, it is important to acknowledge that the adoption decision can be made can be made either by an individual, by an organisation or by a society. Thus the final definition for the term *Innovation* reads as follows:
Innovation is any product or idea, which is perceived as new or significantly different by an individual or other unit of adoption.
Whenever used throughout this document, the term *innovation* will consequently refer to this definition.

3.4 Defining Acceptance, Adoption, Resistance and Diffusion

Since the present research focuses on the *acceptanc*e of an innovation the terms associated with the acceptance or rejection decision have to be defined in the next step.

Acceptance
Before discussing the application of the term *acceptance* in the field of economics, this Chapter will first focus on its general usage in linguistics and its origins. The first approach to the term *acceptance* is derived from its general applications in linguistics. The Oxford Dictionary proposes three basic definitions for the term *acceptance*:

- "The action of consenting to receive or undertake something offered".
- "The process or fact of being received as adequate, valid, or suitable".
- "The agreement with or belief in an idea or explanation" (Oxford Dictionaries, 2011).

According to the Oxford Dictionary, the word's origin's date back to the mid-16th century, based on the Old French word *accepter*. The Mirriam-Webster Dictionary dates the first occurrence of the term *Acceptance* to the year 1574 (Mirriam-Webster Dictionary, 2011).
In the area of social science, however, the term *acceptance* took much longer to be of any interest to researchers. Its usage increased in the late 1970s and 1980s,

with studies focusing on consumer resistance towards new means of communication, such as videotext, or political programmes (Küpper, 2005, p.126). The impact of the introduction of new technologies into personal lives and the workplace has since become an increasing interest of social science researchers. This process established the term *Acceptance* in such diverse fields as politics, philosophy, law, religion and linguistics (Lucke, 1995, p.10).

In the field of economics, the term *Acceptance* is mainly used in the field of organisation theory and marketing. Organisational acceptance research mainly focuses on the implementation of guidelines and the acceptance of new organisational structures (see Rycroft-Malone and Bucknall, 2010, p.147 ff.). In the field of marketing, research is focused on the acceptance of new product or service innovations and is either trying to explain the current market situation or trying to predict a future development (see Cui, Bao and Chan, 2009 and Seeman and Gibson, 2009).

Dillon (2001, p.1) defines acceptance as the "demonstrable willingness within a user group to employ […] for the tasks it is designed". This definition makes an emphasis on the actual ("demonstrable") acceptance behaviour, rather than focussing only on self-reported intention of use (Wu, 2009, p.10). Even though it is important to acknowledge the difference between the intention to use an innovation and the actual usage of it, authors widely agree that there is a direct correlation between these two variables (Fishbein and Ajzen, 2010, p.39). Due to the fact that a measurement of actual usage is not feasible in many cases, most authors thus rely on a measurement of the *Intention to Use* instead (see Hrubes, Ajzen and Daigle, 2001; Jaensirisak, 2002 and Sparks and Shepherd, 2002). Since the present study focuses on the intention to use a technology, rather than on the actual usage of it, acceptance will accordingly be defined as the *Intention to Use a Technology*.

Adoption and Rejection

Adoption is often used as a synonym for acceptance in the consumer behaviour context and many researcher use both terms without distinction (see Carlsson et al., 2006; Pedersen, 2005; Yang, 2005). Rogers (2003, p.21) defines adoption as the "decision to make full use of an innovation as the best course of action available". Following the same line of reasoning, *Rejection* is defined as the "decision not to adopt an innovation" (Rogers, 2003, p.21). It is worthwhile noticing that Rogers uses this definition to point to a single decision, which "can be reversed at a later point" (Rogers, 2003, p.21). In his view, the terms *Adoption* and *Rejection* represent the outcome of a decision process of a single individual. This notion represents a clear distinction from the term *Acceptance*, which is a more general "agreement with or belief in an idea or explanation" (Oxford Dictionaries, 2011). While *Adoption* and *Rejection* thus denote the individual decision as to whether or not to use an innovation, *Acceptance* can be described as the continued usage of it. Consequently, some authors argue that researchers should conduct a separate analysis of the perceptions related to adoption and the perceptions related to acceptance (Hernandez, Jimenez and Martin, 2009, p.1233). Research has found that determinants of continued usage of a technology system are often different from those of initial adoption (Wu, 2009, p.12). Measuring the differences between initial adoption and continuous acceptance, however, requires multiple measurements at different points in time. Because of this, only a few authors so far have gone down this path (see Hong, Thong and Tam, 2006 as a rare example).

Since the present study focuses on the intention to use a technology, rather than on the actual usage of it, a distinction between the terms *adoption* and *acceptance* would not provide any benefit. Consequently, for the purpose of the present study, the terms *adoption* and *acceptance* are used as synonyms representing the *intention of an individual to use an innovation*.

Diffusion

Rogers (Rogers, 2003, p.5) defines *diffusion* as a "process in which an innovation is communicated through certain channels over time among the members of a social system". For Rogers, the term *diffusion* implies social change, meaning that some alteration occurs in the structure and function of a social system. When a new idea is invented, diffused and adopted or rejected by a society, this

leads to certain consequences and social change (Rogers, 2003, p.6). Basically there are two types of diffusion: spontaneous unplanned spread of ideas, for example caused by a political revolution, and the planned and facilitated spread of new concepts, which can occur through governmental policy or marketing efforts. The interest of the present piece of research is clearly the latter type of diffusion, which could be described as *a process in which an innovation is promoted and accepted over time among customers.*

3.5 History of Acceptance Research

"There is nothing more difficult to plan, more doubtful of success, nor more dangerous to carry through than the creation of a new order of things"
Machiavelli, 1513

The roots of diffusion research extend back to the beginnings of social science in Europe. In the history of religion, as well as in some aspects of culture and folklore, much attention was devoted to the diffusion of new ideas and beliefs within a society (Katz, 1999, p.144). However, it took until the early 20th century for diffusion research to make its way into the scientific tradition. Being one of the forefathers of sociology and social psychology, French lawyer Gabriel Tarde was the first to observe and analyse how new ideas flourished within French society at around 1900. In his influential book "Laws of Imitation" Tarde (1903) dealt with the central question of compatibility: that is, the goodness of fit between the attributes of a diffusing item and the social and psychological attributes of the potential adopter (Katz, 1999, p.150).
One reason why innovation acceptance took so long to be established as a distinct research field was the very lack of commonalities between the many different fields of diffusion studies, ranging from agriculture to linguistics, medicine or psychology. It was only when Everett Rogers (1962) combined the diffusion studies in an interdisciplinary manner and thus developed a common framework that diffusion research was accepted as a research field of its own. Since then, the scope of innovation acceptance research has broadened as more and more disciplines became involved. Early studies mainly focused on rural sociology, investigating the spread of new farming techniques, but soon scholarly interest tailed off somewhat to other disciplines such as communication, public health and marketing. Since around 1990, the number of diffusion studies strongly increased, with many focusing on the rapid spread of new communication technologies like the internet and mobile applications (Rogers, 2003, p.83).

Despite these important pieces of work, scientific research in the field of innovation acceptance is still in an early phase and far from consensus regarding central questions of individual behaviour in the innovation acceptance process (Keeling, 1999, p.59; Silva, 2007, p.256; Venkatesh et al., 2003, p.427).

3.6 The Diffusion Paradigm

The widespread success of Everett Rogers' book the "Diffusion of Innovations" created a framework for future research, which today is known as the *diffusion paradigm* (Dearing, 2008). Although Rogers (2003) based this framework on many early diffusion studies, the Ryan and Gross (1943) investigation of the diffusion of hybrid seed corn in Ohio has influenced the methodology and theoretical framework of innovation acceptance studies more than any other study until now. In this detailed field study it became apparent that a certain diffusion process develops because potential customers do not adopt an innovation directly after it becomes available to them, but only with a – varying – time gap. These different time lags build the fundament for the categorisation of adopters as (1) innovators, (2) early adopters, (3) early majority, (4) late majority and (5) laggards (Rogers, 2003, pp.22–23). Plotting the adoption of an innovation over time on a frequency basis will result in a normal, bell-shaped curve or – if the numbers of adopters are cumulated over time – in an S-Shaped curve of adoption (Rogers, 2003, p.272). Chart 11 gives an overview of Roger's Diffusion Process.

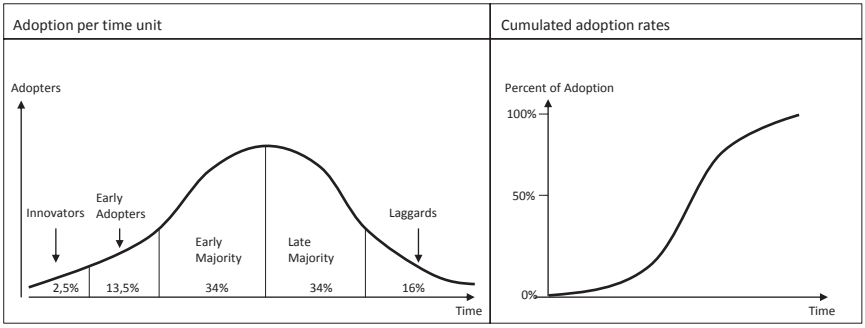

Chart 11: Roger's Diffusion Process, Source: Own drawing based on Rogers (2003, pp.11,281)

Recognizing that adoption is based on a hierarchical mental process, scholars in many disciplines have developed divergent phase models of innovation acceptance. Even though the terminology and the categorisation of process-steps vary throughout these models, there is a common basic structure in most of them: the innovation-diffusion process is essentially an information-seeking and information-processing activity in which an individual is motivated to reduce uncertainty about the advantages and disadvantages of the innovation (Binsack, 2003, p.9). The most basic phases of this process are: (1) Knowledge, (2) Persuasion, (3) Decision, (4) Implementation and (5) Confirmation (Rogers, 2003, p.170). Chart 12 gives an overview of Roger's Adoption Process Model.

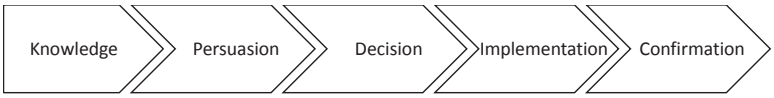

Chart 12: Roger's Adoption Process Model, Source: Own drawing based on Rogers (2003, p.170)

In the knowledge stage, the individual usually plays a relatively passive role when being exposed to new information about an innovation. However, some individuals do intentionally expose themselves to ideas that are compliant with their interests, needs and existing attitudes (Rogers, 2003, p.171). At the persuasion stage, the individual forms a favourable or unfavourable attitude towards the innovation. Attitude in this context is best described as "a latent disposition or tendency to respond to some degree favorable or unfavorable to a psychological object" (Fishbein and Ajzen, 2010, p.76). Other authors emphasize especially the learned and experiential aspects of attitudes (see Keeling, 1999, p.168 for an overview of definitions of attitude). In developing a favourable or unfavourable attitude towards an innovation, an individual may need to mentally apply the new idea to an anticipated future situation before deciding whether or not to try it (Rogers, 2003, p.175). The persuasion and decision stages are usually the main interest of innovation acceptance studies, although recently the consequences of innovation have gained increased attention (Rogers, 2003, p.442).

The question of why certain innovations spread more quickly than others and why some innovations fail is one of the major concerns in the field of innovation diffusion research today (Gottschalk and Kalmbach, 2005, p.221). According to Rogers (2003, p.221), the rate of adoption is influenced by a

multitude of factors, which can be characterised as (1) product-related influences (2) consumer-related influences and (3) external influences.
Performing a meta-study of 1,500 diffusion studies, Rogers (1995) found that the perceived attributes of an innovation are the most important explanation for the rate of adoption and that "most of the variance in the rate of adoption of innovations, from 49 to 87 percent, is explained by only five attribute categories: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability" (Rogers, 2003, p.222). Relative advantage can be interpreted as technological, economical, social or emotional advantage. As Bagozzi and Lee (1999, p.218) argue, perceived advantage can also be seen as a result of anticipated positive consequences towards a personal goal. Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters (Rogers, 2003, p.15). Complexity in this context determines the cognitive efforts a potential adopter anticipates to be necessary in order to make full use of an innovation. In other words, complexity is the perceived difficulty of an innovation by the end-user. Trialability is the degree to which an innovation may be experimented with on a preliminary basis. The Ryan and Gross (Ryan and Gross, 1943) hybrid seed corn study, for instance, found that most farmers did not adopt an innovation until they had tried it on an experimental basis (Rogers, 2003, p.271). Finally, observability is the degree to which the use and the consequences of an innovation are visible to others (Rogers, 2003, p.16).

These original five attributes of innovations, also known as the Rogers criteria, form the standard classification scheme for describing the perceived attributes of innovations in universal terms (Rogers, 1995, p.208). However, in addition to these five universal characteristics, scholars in the field have continuously added other attributes, usually based on a given context of research (Bagozzi and Lee, 1999, p.218). In a literature review, Adams (2002, pp.75–79) identified fifty-two innovation attributes, with many of them being virtual synonyms. He blamed this result on the fact that innovations are researched in a variety of scientific fields and language develops differentially in many disciplines.

Next to the innovation attributes, Rogers (2003, p.221) found that much of the remaining variance in the rate of adoption was explained by four other

variables: Firstly, the type of innovation-decision, which can either be an optional decision, made by an individual independently of others, a collective innovation decision, made by consensus within a social system, or an authority decision, made by relatively few individuals who possess power, status or technical experience (Rogers, 2003, pp.28–29). Secondly, the communication channels used for facilitating the spread of the innovation (Rogers, 2003, p.35). Thirdly, the nature of the social system, meaning the cultural values and relationships in a given society, which can either facilitate or impede the diffusion of innovations (Rogers, 2003, p.26), and finally (4) the extent of promotion efforts by a Change Agent, who is "influencing clients' innovation-decisions in a direction deemed desirable by a change agency"(Rogers, 2003, p.369). Chart 13 illustrates the model described by the Rogers Diffusion Paradigm.

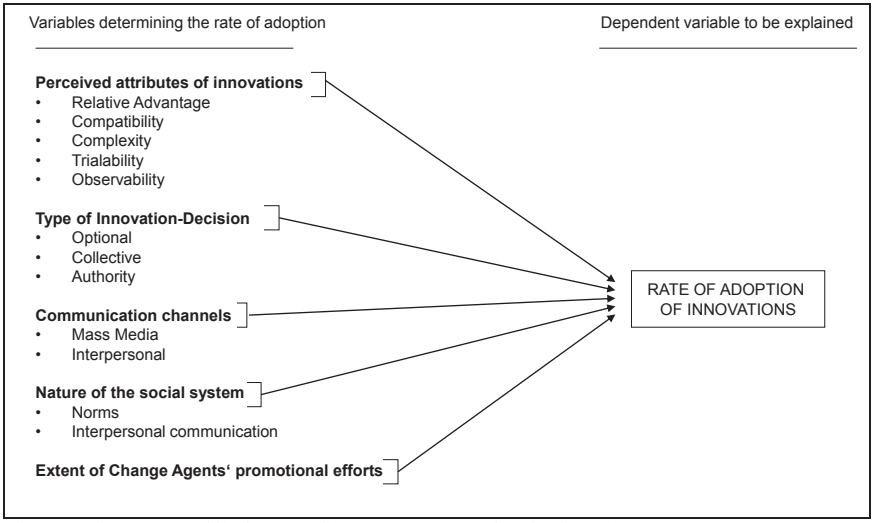

Chart 13: The Rogers Diffusion Paradigm, Source: Own drawing based on Rogers (2003, p.222)

Due to its relative simplicity and universality, the Diffusion Paradigm has found widespread acceptance in contemporary literature on innovation acceptance. At the same time, however, this simplicity and universality of the theoretical model has raised criticism among researchers (Dethloff, 2004, p.29).

3.7 Criticism of the Diffusion Paradigm

The simplicity of the innovation-decision phase model has raised questions since, there are no rational sharp distinctions between the phases; nor is there any empirical evidence for the existence of individual phases within this mental progress. Rogers (2003, p.195) argues that "stages may be useful as a means of simplifying a complex reality, so as to provide a basis for understanding human behaviour change".

Critics have also argued that the five perceived attributes of an innovation are not empirically confirmed to be sufficiently independent. A recent empirical study revealed that the interdependencies among Rogers' attributes are so strong that they result in an extremely poor fit with empirical data if they are completely ignored, as in Rogers original model (van Rijnsoever et al., 2009, pp.419-420). Other critics argue that relative advantage is a multidimensional attribute and thus difficult to operationalise. Depending on the context, economical, social or technical aspects may be more important to consider as a relative advantage in a specific context (Dethloff, 2004, p.29). Additionally, there is a lack of standardised operationalisations for the independent and dependent variables, leaving much room for interpretation when applying the model (Nabih, Bloetn and Poiesz, 1997, p.191). In conclusion, the attributes proposed by the Diffusion Paradigm are found to be difficult to use under different innovation acceptance contexts.
It is maybe because of these shortcomings that very little empirical work has been done in the framework of the *diffusion paradigm*. In order to develop a predictive instrument towards the rate of adoption of an innovation, empirical studies in the field of innovation acceptance make use of behaviour models from the field of psychology, such as the Technology Acceptance model (TAM) or the Theory of Planned Behaviour (TPB). Both of these models originate from the Theory of Reasoned Action (TRA), which will be the focus of the next section.

3.8 The Theory of Reasoned Action

The Theory of Reasoned Action or TRA was developed from Fishbein's (Fishbein, 1967) Theory of Attitude, which in its original formulation was largely adapted from Dulany's (1968) theory of propositional control (Fishbein and Ajzen, 2010, p.17). In general, the model aims at predicting individual

behaviour by postulating that human behaviour is based on the systematic use of available information through the formation of beliefs. Ajzen and Fishbein (Fishbein and Ajzen, 2010) propose that behaviour is determined by intention, which in turn is determined by two fundamental factors: the attitude towards the behaviour and the subjective norms. Attitudes are basically the positive or negative evaluations of the behaviour in question, while norms represent the perceived social pressure to engage or not engage in the behaviour in question (Fishbein and Ajzen, 2010, p.21). Developing this model further, Ajzen (Ajzen, 2002) introduced a third factor, Perceived Behavioural Control (PBC), representing the beliefs of a subject that he or she is able to perform the behaviour in question or that he or she has actual control over performing the behaviour. This addition was necessary because the TRA has lacked the ability to deal with the behaviour of individuals under non-volitional control (Sattabusaya, 2008, p.48). The revised model is referred to as the Theory of Planned Behaviour (TPB).

The TRA and the TPB can be considered together here, since from a theoretical point of view, the TRA simply examines a special case of the TPB – that is, a case of planned behaviour in which there is sufficient PBC (Greve, 2001, p.442).
As noted above, the three components of the model are based on beliefs towards the behaviour. Attitudes are believed to develop automatically and inevitably as new beliefs are formed about an object. Specifically, people are assumed to have pre-existing evaluations of certain attributes of an innovation that become linked to this object in the process of belief formation. Depending on the strength of these beliefs and the evaluations of the innovation's attributes, the overall attitude towards the object is formed. Thus, in future, the attitude object will automatically activate the summated evaluative response: that is, the overall attitude towards the object (Fishbein and Ajzen, 2010, pp.96–97). People can, of course, form many different beliefs about an object, but it is assumed that only a relatively small number determine the attitude at any given moment. Only salient beliefs (i.e. beliefs about the object that come readily to mind) serve as the predominant determinants of the attitude (Swartz and Douglas, 2009, p.26).

This so called Expectancy-Value Model of Attitude can be written as

$$A = \Sigma\, b_i\, e_i$$

Where A is the attitude towards an object, b_i is the strength of the belief that the object has attribute i, and e_i is the evaluation of the attribute i.
The Subjective Norm component represents the perceived social pressure to perform or not to perform a given behaviour. This social pressure is generally associated with two normative components: Injunctive Norms, which represent the perceptions concerning what should be done, and Descriptive Norms, which represent the perceptions that others are or are not performing the behaviour in question (Fishbein and Ajzen, 2010, p.130). When an individual forms an injunctive norm, the normative prescriptions of various individuals and groups are taken into account. However, similar to the attitude formation, only salient or readily accessible referents will influence the person's injunctive norm (Aboelmaged, 2010, p.396). Yet, knowing what a referent prescribes may put little or no pressure on a person to carry out the behaviour unless that person is motivated to comply with the referent in question. Therefore, analogous to the Expectancy-Value Model, the measure of the overall injunctive norm can be written as:

$$N_1 = \Sigma\, n_i\, m_i$$

Where N_1 is the injunctive norm, n_i is the injunctive normative belief about referent *i*, m_i is the motivation to comply with referent *i*, and the sum is over the total number of salient referents (Fishbein and Ajzen, 2010, p.137). Alongside this, the Descriptive Norm component can be seen as a singular factor. It is based on the insight that human behaviour is influenced by the perceived behaviour of others, be it their past behaviour, their current behaviour or their anticipated future behaviour. Although it is usually possible to identify a single social norm construct that incorporates both injunctive and descriptive aspects of perceived normative pressure, it is important to include measures of both injunctive and descriptive norms when normative beliefs need to be assessed in more detail (Hagger and Chatzisarantis, 2005, p.524).

The third factor within this theory, Perceived Behavioural Control, refers to people's general expectations regarding the degree to which they are capable of performing a given behaviour (Fishbein and Ajzen, 2010, p.169). This factor takes into account the availability of information, knowledge and other resources required to perform the behaviour as well as possible barriers that may

have to be overcome (Aboelmaged, 2010, p.396). Whether these resources are internal or external is not of importance in this context. Again, readily accessible beliefs regarding these external and internal control factors are assumed to determine the overall level of perceived behavioural control. These beliefs may be based in part on past experience with the behaviour. In cases where a new, or innovative, behavioural object is about to be concerned, these beliefs will usually be influenced by second-hand information and observation of others already performing the behaviour in question (Sattabusaya, 2008, p.48).

Two types of control beliefs will influence the overall Perceived Behavioural Control and thus intention towards behaviour: the likelihood that a given control factor will be present (belief strength) and the extent to which its presence would facilitate or constrain performance of the behaviour (power of the factor) (Fishbein and Ajzen, 2010, p.177). This could be written as:

$$PBC = \Sigma\, c_i\, p_i$$

Where c_i is the belief that control factor i will be present; p_i is the power of factor i to facilitate or constrain performance of the behaviour, and the sum is over the number of salient control beliefs (Fishbein and Ajzen, 2010, p.170)

The beliefs discussed so far are not predetermined; rather, they are accumulated over time through experiences and interaction with the real world and by the individual's own inferences based on the given set of information. Differences in individual beliefs must therefore be the result of different learning experiences throughout a lifetime. These real life experiences, in turn, are likely to vary as a function of personal characteristics, social and cultural factors and exposure to media and other sources of information (Venkatesh et al., 2003, p.469). As a result, demographic, cultural or socioeconomic characteristics, such as gender, age, religion or income, are often found to be associated with differences in behaviour. However, these variations in personal characteristics do not cause differences in behaviour and by themselves they cannot explain these differences. Rather, they provide a segmentation of the given population along certain dimensions and reveal differences in behaviour among different subgroups. By exploring why behaviour differs among segments of the

population, we can deepen our understanding of behaviour's underlying determinants (Fishbein and Ajzen, 2010, p.234).

In sum, these personal characteristics can generally be seen as background factors in the TPB model. As the number of background factors that could be considered is virtually unlimited, the scope of personal characteristics has to be adapted closely to the behaviour in question.

Chart 14 illustrates the TPB model as described by Ajzen & Fishbein

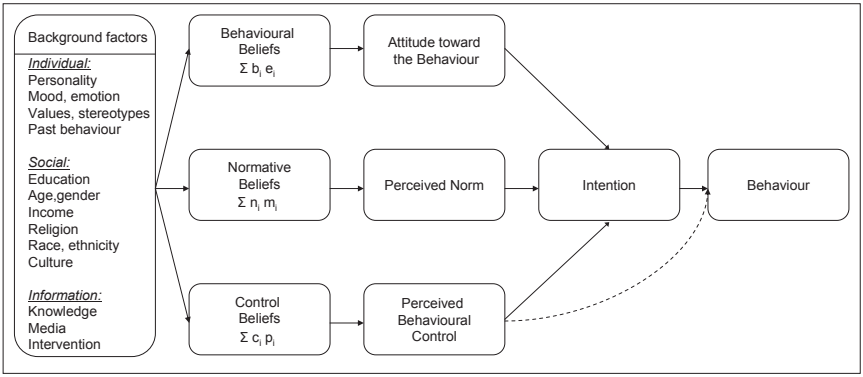

Chart 14: The TPB model, Source: Own drawing based on Ajzen & Fishbein (2010)

Being heavily employed in contemporary social psychology, the model developed by Ajzen and Fishbein has proved to be successful in many behavioural domains. Especially in the field of innovation acceptance, the TPB model became the most widely used theoretical framework for researchers (Venkatesh et al., 2003, p.427). In a meta-analysis based on 185 independent studies (Armitage and Conner, 2001), the TPB was found to account, on average, for 39% of the variance in intentions. Given the fact that before the introduction of these models most studies accounted for, at most, 10% of the variance in behaviour, this was a definite advancement (Ajzen and Fishbein, 2004, p.432). Other, more behaviour specific meta-studies even exceeded these results. On average, if the measures of the theory's construct comply with the principle of compatibility, are reliable, and have convergent and discriminate validity, the theory can account for about 50% to 60% of the observed variance in intentions towards a specific behaviour (Fishbein and Ajzen, 2010, p.283).

Considering that even carefully assessed predictor variables contain random errors of measurement, successful research based on the TPB model tends to approach the theoretical limits of predictive validity.
Nevertheless, it has been argued that there is potential room for improvement. Some investigators have suggested that it may be possible to further improve the predictiveness of the TPB model by adding more predictors to the model (Sattabusaya, 2008, p.51). Examples such as "Attitudes towards uncertainty" (Braithwaite, Sutton and Steggles, 2002, pp.761–764), "Trust in Salesperson's expertise" (Teo, 2009, p.274), "Stress Coping Strategies" (Cui, Bao and Chan, 2009, p.113) and "Self-Identity"(Smith et al., 2008, p.314) have been proposed as possible additions. Empirically, however, most of these variables can be regarded as background factors, since the majority of their variance is moderated by behavioural, normative and control beliefs (Fishbein and Ajzen, 2010, p.293). Other additional factors might only be particularly useful in some instances. "Moral Concerns", for instance, will play only a minor role in the purchase of prevalent consumer goods such as toothpaste or biscuits (Sparks and Shepherd, 2002, p.318). Yet none of the additional factors developed so far has fulfilled the criterion of adding significant additional and unique variance to the explanation of intention towards behaviour.

3.9 Criticism of the Theory of Reasoned Action

Despite its persistence and increasing popularity, criticism of the TPB has emerged from a theoretical as well as from a methodological point of view.

One of the major critiques of the TPB is that not all behaviours are logical or rational. In fact, "it would be hard to argue that behaviours that impair one's health or well-being,[..] such as drunk driving, are either goal-related or rational" (Gibbons et al., 1998, p.1164). However, whether a given behaviour is rational or not is not of any particular importance in the context of the TPB model. It is assumed that in the course of their lives, people form various kind of behavioural, normative and control beliefs, some of which might be perfectly correct, based on logical trains of thought, while others might be inaccurate, misinterpreting or biased by wishful thinking or other self-serving motives (Fishbein and Ajzen, 2010, p.303). No matter how unfounded or biased people's beliefs may be, their attitudes, subjective norms and perceptions of behavioural control are assumed to follow reasonably from these beliefs to produce a corresponding behavioural intention, and ultimately to result in behaviour that is

consistent with the overall tenor of the beliefs (Bamberg, Ajzen and Schmidt, 2003, p.176).

Another basic criticism is that the three factors are not independent. Several studies have argued that subjective norms have a crucial effect on attitude (Teo, 2009, p.276). This is not particularly surprising, since, as a general rule, people who are important to someone will encourage them to perform behaviours that produce positive outcomes and to avoid behaviours that are likely to lead to negative outcomes (Fishbein and Ajzen, 2010, p.204). It is thus important to recognize that although the components are conceptually distinct, empirically there is likely to be at least some overlap among these factors.

One major critique on a more theoretical level is that, at least in principle, a good theory should be able to be rejected. Meta-analysis has revealed studies with an explained variance of the three factors ranging from 14% to 92% for behavioural intentions and a low variance was usually not blamed on the theory but rather explained by a poor operationalisation of the variables or the lack of additional, behaviour-specific factors. The fact that such results are not used to reject the model in question has raised criticisms that the theory is infallible by definition (Ogden, 2003, p.425). Ajzen and Fishbein (Ajzen and Fishbein, 2004, p.431), on the contrary, argue that there is nothing inherently wrong with the model when one of the three factors has no significant contribution to the prediction of intention. Rather, such a result signals that the factor in question has no relevance for intention in this specific behaviour case. If all three factors (i.e., attitude, subjective norm and perceived behavioural control) would fail to predict intention, however, the TPB would be disconfirmed (Ajzen and Fishbein, 2004, p.431). This case, however, has not been reported so far by any TPB study.

Much of the criticism of the methodology applied in the context of the TPB model is quite common to empirical research. For instance, Ogden (Ogden, 2003, p.426) questioned whether the answers given in a questionnaire will reveal pre-existing states of mind rather than ones that have been generated by completing this questionnaire. Especially when the individual has none or only limited experience with the behaviour in question, the risk of generating new beliefs is rather high. From a behaviourist perspective, it is thus dangerous to

attempt to measure attitudes and intention about the use of a new product (i.e. car navigation) when people neither have any experience of using this product, nor have experience of using the technology this product is based on (in this case automobiles) (Keeling, 1999, p.167). It is also known that structural models cannot confirm any causal logical chains in a definite way. Thus empirical studies claiming to test the TRA/TPB model are sometimes labelled "pseudo-empirical" (Greve, 2001, p.442; Silva, 2007, p.257). This critique is quite common for any causal model and can usually be avoided by defining a valid and reasonable logical chain. Definite certainty about its underlying causal relationships, however, will never be achieved by empirical research (Nutt and Wilson, 2010, p.547).

In sum, the TPB model has, despite its criticisms on theoretical as well as on methodological grounds, proven to be a valid prediction model for behaviour in general. Its applications in the field of innovation acceptance are promising, since the validity of the model in this behavioural category was confirmed by virtually all studies conducted in this category so far (see Dwivedi, Lal and D. Williams, 2009; Hashim, 2008; Kwong and Park, 2008; Omar and Owusu-Frimpong, 2007; Pelling and White, 2009; Ramayah et al., 2009 Pavlou and Fygenson, 2006).

3.10 The Technology Acceptance Model

The Technology Acceptance Model (TAM) is an adaptation of the Theory of Reasoned Action specifically tailored to innovation acceptance in the context of using computer information systems in the workplace (Jaensirisak, 2002, p.199). The overall aim of the TAM is to explain the determinants of computer acceptance in universal terms and thus explain user behaviour across a broad range of end-user computing technologies and user populations (Davis, Bagozzi and Warshaw, 1989, p.985).

The TAM is widely used in contemporary science. Bagozzi (2007, p.244) stated that there are already more than 700 citations of the original paper of Davis, Bagozzi and Warshaw. The usefulness of TAM was validated by several empirical meta-studies considering the model as a "robust, powerful, and parsimonious "(Venkatesh and Davis, 2000, p.187) tool for predicting and explaining user acceptance of an innovation. The most distinctive feature of the TAM is the use of a salient belief set, which is called Perceived Usefulness (PU) and Perceived

Ease of Use (PEU). Davis, Bagozzi & Warshaw (1989, p.320) claim that these two constructs are the essential elements in determining the user's attitude towards a technology. In this regard, they defined PU as “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, Bagozzi and Warshaw, 1989, p.320), and PEU as “the degree to which a person believes that using a particular system would be free of effort” (Davis, Bagozzi and Warshaw, 1989, p.985). In essence, perceived ease-of-use (PEU) reduces uncertainty about the cause-effect relationship involved in the innovation’s capacity to solve an individual's problem, while perceived usefulness (PU) describes the anticipated positive effect of using this IT System.
The theory further implies that behavioural intention to use an information system is determined by attitude toward using a system and PU, while Attitude, in turn, is directly determined by PU and PEU (Sattabusaya, 2008, p.53). This can be explained by suggesting that if someone believes that a system is easy to use, this will also have a positive effect on attitude and the motivation to overcome obstacles towards the use of such a system. Thus PEU has also positive effects on PU.

Chart 15 gives an overview of the TAM model in its original formulation.

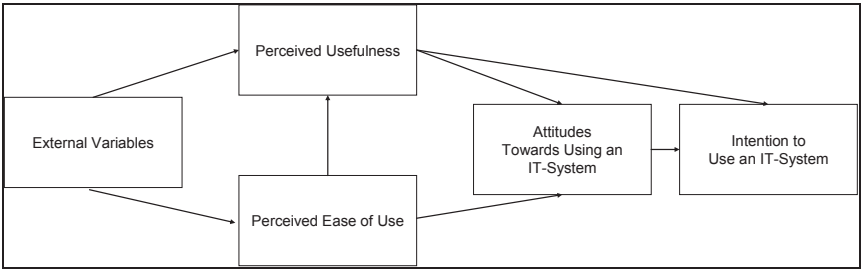

Chart 15: The TAM model in its original formulation, Source: Own drawing based on Davis, Bagozzi & Warshaw (1989, p.320)

Venkatesh and Davis (2000) extended the original TAM model to explain perceived usefulness and usage intentions in terms of social influence and cognitive instrumental processes. The extended model, referred to as TAM2, was validated with several meta-studies, outperforming the original model in most cases (Kwong and Park, 2008, p.1470). Other authors added several more constructs

to the model, like compatibility with existing beliefs and prior experience (Karahanna, Agarwal and Angst, 2006, p.787), perceived risks (Sattabusaya, 2008, p.58), psychological attachment (Alrafi, 2007, p.49) and perceived enjoyment of using an IT System (Chtourou and Souiden, 2010, p.337). However, like additions to the TPB model discussed before, additions to the TAM model tend to reduce the universality of the model and thus tend to reduce the possible range of its application.

3.11 Criticism of the Technology Acceptance Model

In contrast to the TPB, one of the major drawbacks of the TAM certainly is that it focuses exclusively on the acceptance of IT-systems (Aboelmaged, 2010, p.397; Venkatesh and Davis, 2000). Since the TAM was developed in the context of new Information Systems (IS) usage in the workplace, several authors question the ability of the model to predict end-user acceptance of technology in a private user setting. Chen et al. (2007, p.356), for instance, argue that the central constructs of the TAM model, PU and PEU, are different from the diverse needs relevant in the voluntary consumer context. Others argue that utilitarian motives, represented by PU and PEU, are not sufficient to explain consumer behaviour toward a product and thus claim that a hedonic construct towards the usage of technology would be more beneficial for the model (Chtourou and Souiden, 2010, p.337). More than any other single factor, however, the lack of a social pressure construct has raised much critique, since it is a widely accepted fact that individual decision-making is heavily influenced by peer group pressure (Bagozzi, 2007, p.247). Despite this critique, the TAM has demonstrated a high level of predictiveness in many IT contexts, ranging from the employment of personal computers in the workplace to telemedicine acceptance by professionals (Aboelmaged, 2010, p.397).

3.12 Current Trends in Innovation Acceptance Research

Although the TPB and the TAM have been widely applied to examine the adoption and acceptance of technology, neither has been found to provide consistently acceptable explanations or predictions of any behavioural context (Venkatesh et al., 2003, p.426). This may be due to the various factors that actually influence the adoption of technology, such as the type of technology, users' behavioural beliefs and the very context of the research (Chen and Mort, 2007, p.356). Consequently, a growing body of research has focused on developing the models further by extending them with several new constructs, as discussed before.

Recently, however, some researchers have also tried to integrate the existing models to examine technology adoption by employing the complementary and explanatory power of the models taken together. In an attempt to recognize the strengths and weaknesses of different technology acceptance models developed so far, Venkatesh et al. (2003) incorporated Rogers' Innovation Diffusion Theory, the TRA and the TPB as well as the TAM and several other specialized innovation acceptance models into one unified model, which was consequently referred to as the United Theory of Acceptance and Use of Technology (UTAUT). The possible constructs were reduced by means of significance and unique explained variance, with four main variables, alongside four main moderators, remaining in the unified model. According to the UTAUT, intention to use a technology posits three direct determinants: (1) performance expectancy, (2) effort expectancy and (3) social influence, while usage behaviour has two direct determinants, (1) intention and (2) facilitating conditions. Significant moderating influences were found from experience, voluntariness, gender and age (Venkatesh et al., 2003, pp.468–470). Chart 16 gives an overview of the UTAUT model.

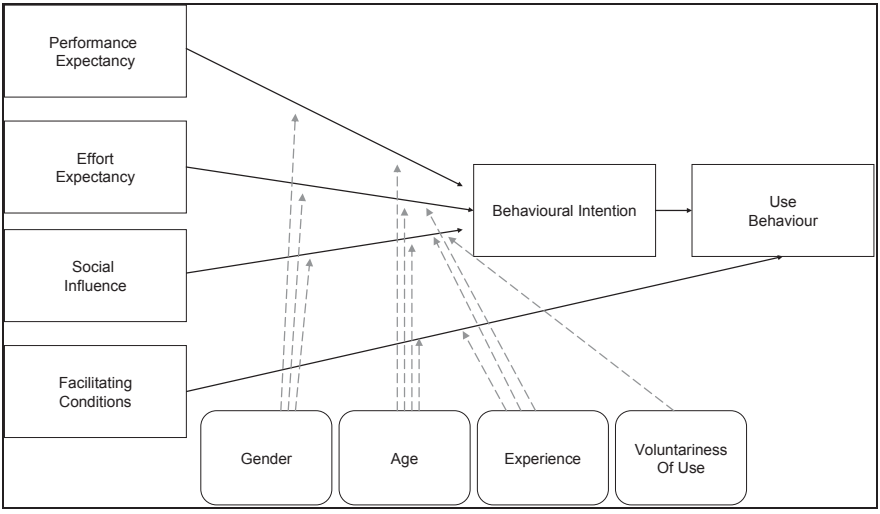

Chart 16: The UTAUT model, Source: Own Drawing based on Venkatesh et al. (2003)

Vankatesh et al. (2003, pp.425–426) tested the UTAUT in direct comparison to the original models discussed so far and found it to outperform the individual

models significantly in terms of predictiveness, using the same data set. Despite this success, the UTAUT has not yet supplanted the TPB and the TAM in contemporary innovation acceptance research and other researchers have not yet reached a conclusion about its usefulness under other than theoretical considerations (Bagozzi, 2007, p.245).

A different approach was recently advocated by MacVaugh and Schiavone (2010). The authors argue that it might be more promising to focus on the non-adoption of innovations instead of analysing successful introductions of new technologies. Their investigation of the limits to innovation can be seen as a framework for explaining resistance rather than acceptance. Based on a historic literature review, the authors argue that resistance occurs in different domains, which can be described as a macro-dimension (market/industry), a meso-dimension (social system) and a micro-dimension (individual). The review of different cases of technology non-adoption led the authors to expose patterns of non-adoption, which are mainly attributed to the technology itself, the social structure and the learning abilities. Their complete model for technology resistance can be seen in Chart 17.

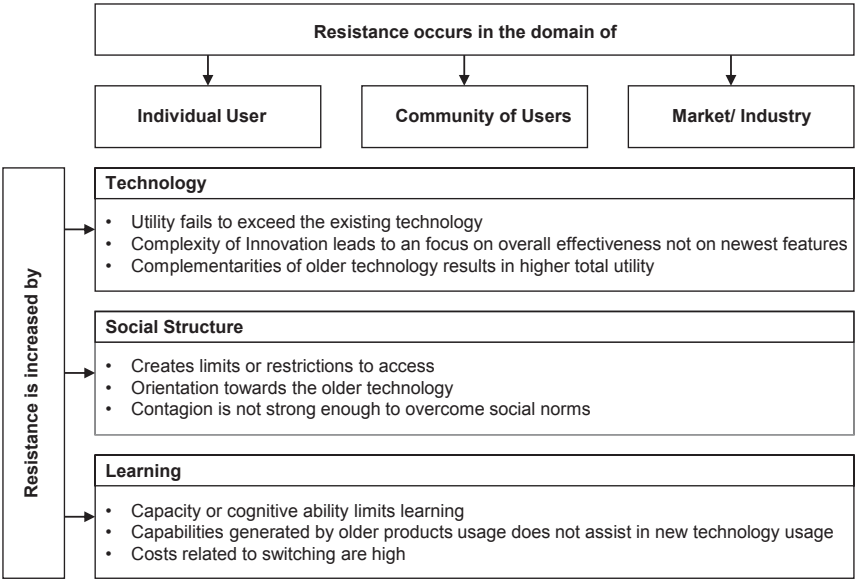

Chart 17: Resistance model of MacVaugh and Schiavone, Source: Own drawing, based on MacVaugh and Schiavone (2010, p.208).

So far, there are no empirical verifications of the model proposed by MacVaugh and Schiavone (2010). The authors do not provide information about how the proposed variables could be measured and operationalised: thus, so far, this model can be rather seen as a conceptual framework for further research.

Despite the conceptual frameworks proposed by Venkatesh et al. (2003) and MacVaugh and Schiavone (2010), the vast majority of papers currently published in the field of innovation acceptance rely on the original behavioural models developed by Fishbein and Ajzen (2010) and Davis, Bagozzi and Warshaw (1989). It can be observed, however, that instead of using these behavioural models in their original formulation, researchers have increasingly modified the models to fit specific needs. Most authors extend the TPB model with context-specific factors, such as *Perceived Risk* or *Perceived Trust*. Others combine elements of the TAM and the TPB in order to arrive at a more comprehensive acceptance model. It is likely that future research in the field of innovation acceptance will follow this trend and will increasingly use context-specific factors in the framework of the TPB and TAM model. Table 6 gives an overview of contemporary acceptance research and the underlying models that were employed by the authors.

Table 6: Contemporary research in the field of innovation acceptance

Study	**Behavioural model employed**
Nasri and Charfeddine (2012)	Combined TPB and TAM model, extended with the factors *Governmental Support* and *Technology Support*
Chong, Chan and Ooi (2012)	TAM model, extended with the factors *Trust*, *Cost* and *Social Influence*
Un Jan and Contreras (2011)	TAM model, extended with the factors *Compatibility* and *Subjective Norm*
Pai and Tu (2011)	UTAUT model, extended with the factor *Task-Technology Fit*
Yang et al. (2011)	TAM model, extended with the factors *Content* and *Interaction*
Lin, Fofanah and Liang (2011)	TAM model, extended with the factors *Information*

	System Quality and *Information Quality*
Lymperopoulos, Chaniotakis and Rigopoulou (2010)	TPB model, extended with the factors *Trust* and *Consumer Pessimism*
Aboelmaged (2010)	Combined TPB and TAM model
Chtourou and Souiden (2010)	TAM model, extended with the factor *Fun*
Crespo, del Bosque and de a los Salmones (2009)	TAM model, extended with the factor *Perceived Risk*
Zhang, Reithel and Li (2009)	TPB model, extended with the factor *Perceived Security Protection Mechanism*
Zolait, Mattila and Sulaiman (2009)	TPB model, extended with Rogers' innovation acceptance process
Ramayah et al. (2009)	TPB model
Seeman and Gibson (2009)	Combined TPB and TAM model

In correspondence to these findings, the author will use divergent sources of information to construct a behavioural model for ADAS acceptance based on the original works of Ajzen and Fishbein (1980). In order to develop relevant factors for this model, the findings of comparable innovation acceptance studies will be analysed in the next step.

3.13 Review of Empirical Innovation Acceptance Studies

The first step in any exploratory study is reviewing secondary literature that addresses a similar research question. As discussed in Chapter Two, research in the field of innovation acceptance is quite popular, with an increasing rate of empirical studies published in relevant journals each year (Rogers, 2003, p.83). Out of these studies, ranging from health innovations to pre-school education methods, the author selected forty-nine studies, which focus on high-tech innovations comparable to the interest of the present research (see paragraph 0 for the selection criteria of empirical studies). Even though some of these studies have a focus on related technologies, such as mobile parking services, none of the publications examines the acceptance of ADAS. Despite this fact, there are some important inferences that can be drawn from these studies, which could be highly relevant for the context of ADAS. In order to compare the research ap-

proach as well as the results of these studies, the author decided to summarize key aspects and bring together the results of the selected studies in tabular form. Key aspects from the perspective of the present research are the subject of study, the geographic location of interest, the methods of data collection, the sample size and the statistical tests employed for data interpretation and reliability analysis. Moreover, the author extracted the factors used to explain acceptance behaviour and the associated background factors. Most importantly, the main findings of each study were summarised briefly. The key question to be answered for each study was 'which factor contributes most to the explanation of acceptance behaviour in the respective field of study?'. Table 7, finally, shows the key aspects of each study summarised following the outlined procedure.

Table 7: Results from Empirical Innovation Acceptance Studies

Author / Date	Research Context	(Psychological) constructs used to explain technology acceptance	Sample	Data collection	Stat. tests employed	Main findings
Huang and Hsieh, 2012	e-book readers	Relative advantage Compatibility Complexity Procedural switching costs Financial switching costs Relational switching costs	395 e-book customers	Online with telephone follow-up	Confirmatory Factor Analysis, GFI, NFI, RMSEA, SEM with AMOS	Innovative attributes (relative advantage, compatibility and complexity) directly affect the acceptance behaviour. Complexity is a key antecedent to switching costs. Financial switching costs are not influential for usage of e-books.
Nasri and Charfeddine, 2012	Internet banking	Perceived ease of use Perceived usefulness Security and privacy Self efficacy Government support Technology support	284 bank account owners	One-to-one interview	SEM with LISREL, GFI, NFI, RMSEA,	Intention to adopt Internet banking can be predicted by attitudinal factors (Perceived Usefulness, Perceived Ease of Use,Security and Privacy), subjective norms and by perceived behavioural control factors (self efficacy, government support and technology support).
Chong, Chan and Ooi, 2012	Mobile commerce	Trust Cost Social Influence Variety of Services Perceived Usefulness Perceived Ease of Use	172 Malaysian and 222 Chinese consumers	Written survey	Hierarchical regression analysis, Cronbach's alpha	The TAM predictors (Perceived Usefulness, Perceived Ease of Use, and Trialability) have no significant relationships with consumer intention. Instead, social factors such as trust and social influence play a significant role in m-commerce adoption
Un Jan and Contreras, 2011	University administration software	Perceived usefulness Subjective norm Compatibility Perceived ease of use Attitude toward use	89 students	Written questionnaire	Cronbach alpha, Correlation analysis, T-Test	Perceived Usefulness influences the attitude toward technology. Perceived Usefulness influences the behavioural intention. Subjective norms influence the attitude towards technology. Attitude influences the intention to use technology.
Pai and Tu, 2011	CRM Systems	Performance Expectancy Effort Expectancy Social Influence Facilitating Condition Task-Technology Fit	271 employees of two service companies	Written questionnaire	Confirmatory Factor Analysis, GFI, NFI, RMSEA, SEM with AMOS	Performance expectancy has no influence on behavioural intention. Effort expectancy has a positive influence on behavioural intention. Social expectancy has shown positive effects on user behaviour. Task-technology fit positively affects behavioural intention .
Yang et al., 2011	Digital Learning Systems	Perceived usefulness Perceived ease of use Attitude toward use Content Interaction	120 university students	Online questionnaire	Confirmatory Factor Analysis, GFI, NFI, RMSEA, SEM	Both Perceived usefulness and Perceived ease of use significantly and positively affect attitude toward digital learning . Contents and interaction service have a direct influence on perceived ease of use
Lin, Fofanah and Liang, 2011	e-Government	Attitude toward behaviour Perceived usefulness Perceived ease of use Information system quality Information quality	167 citizens	E-Mail questionnaire	SEM with LISREL, GFI, NFI, RMSEA,	Information quality and perceived ease of use positively influence the perceived usefulness (PU). However, PU does not have a strong impact on behavioural Intentions.
Gerpot, 2011	Mobile internet	Relative advantage Compatibility Lack of complexity Communicability Trialability	525 effective and 540 potential users	E-Mail survey	Bivariate correlation, multivariate OLS regression analyses	Perceived Relative Functional Advantage and Communicability of mobile internet offers are significantly positively related and their trialability is significantly negatively correlated with mobile internet acceptance.

Author / Date	Research Context	(Psychological) constructs used to explain technology acceptance	Sample	Data collection	Stat. tests employed	Main findings
Aboelmaged, 2010	e-procurement	Perceived Usefulness Perceived Ease of Use Attitude Subjective Norm Perceived Behavioural Control Intention	316 companies	Written questionnaire	GFI, AGFI, CFI, NFI, RFI, RMSEA	Attitude is main determinant of intention Perceived Usefulness and Subjective Norm further determine intention.
Chiu, Fang and Tseng, 2010	Interactive multimedia kiosks for convenience retailing	Optimism Innovativeness Insecurity Discomfort Performance expectancy Effort expectancy Social influence Facilitating conditions Technology Readiness Use intention	387 students	Written questionnaire	R_2 ΔR_2, variance inflation factor (VIF)	Performance expectancy, effort expectancy, facilitating conditions and social influence impact intention. Perceptions of these factors vary significantly between potential versus early users.
Chtourou and Souiden, 2010	Mobile Devices	Perceived Ease of Use Perceived Usefulness Fun Attitude	367 users of mobile devices	Written questionnaire	RMSEA, GFI, TLI, CFI	Usefulness and Ease of Use are confirmed to be important predictors of Attitude. Further, the importance of considering fun as an determinant of Attitude is confirmed.
Tsai, Chin and Chen, 2010	Nutraceuticals	Attitude Subjective Norm Intention Salesperson's Expertise Trust Belief	334 drug-store customers	Written questionnaire (Email)	RMSEA, GFI, AGFI, CFI, Cronbach's alpha, Average Variance Extracted (AVE)	Attitudes and Subjective Norm are predictors of intention, with Attitudes being a stronger predictor than Subjective Norm. Salesperson's Expertise has a positive influence on Intention. Trust beliefs had an indirect influence on consumer's intention through Attitude.
Dwivedi, Lal and D. Williams, 2009	Broadband internet	Age Gender Utilitarian outcomes Hedonic outcomes Self-efficacy Facilitating conditions	358 persons	Written questionnaire	t-test for demographics, regression analysis	All constructs, apart from hedonic outcomes, significantly influence intention.
Hahn and Kim, 2009	Online apparel shopping	Consumer Trust Perceived Confidence of Shopping Online Online Information Search Intention	261 student	Written questionnaire	R_2 ΔR_2, , GFI, AGFI, RFI, RMR	Consumer Trust is a significant predictor of Perceived Confidence and Online Information Search Intention. Online Information Search Intention is a significant predictor of Intention to buy online.
Pelling and White, 2009	Social Networking Websites	Attitude Subjective Norm Perceived Behavioural Control Self-identity Belongingness	233 university students	Written questionnaire	R_2 ΔR_2	Attitude and subjective norm significantly predicted intention. Intention significantly predicting behaviour.Self-identity, but not belongingness, significantly contributed to the prediction of intention.
Ramayah et al., 2009	Internet tax filing	Attitude Subjective Norm Perceived Behavioural	125 tax-paying employees	Written questionnaire	Cronbach's alpha, KMO measure of sampling, Bartlett's Test of Sphericity	Perceived Behavioural Control and Subjective Norm were positively related to intention. In terms of the impact, Perceived Behavioural Control was the most influential factor.

Author / Date	Research Context	(Psychological) constructs used to explain technology acceptance	Sample	Data collection	Stat. tests employed	Main findings
Seeman and Gibson, 2009	Electronic Medical Records	Perceived Ease of Use Perceived Usefulness PCB Perceived Social Influence Attitudes	102 members of faculty	Written questionnaire	R_2	Best explanatory power is obtained by a linear combination of the variables associated with TPB and TAM. However, TPB has a higher explanatory power than TAM.
Cui, Bao and Chan, 2009	3G Phones	Perceived Ease of Use Perceived Usefulness Fun Coping Strategies Attitude	228 persons of the general public	Written questionnaire	Cronbach's alpha, Wilk's lambda	Coping strategies have significant influence on consumers' product beliefs, which in turn mediate the effects of coping strategies on consumers' attitude.
Khalifa and Shen, 2008	Mobile Commerce	Attitude Subjective Norm Perceived Behavioural Control Ease of Use Trialability Observability Communication Knowledge	202	Written questionnaire	Composite reliability measures (r), average variance extracted (AVE),	Knowledge is increased by trialability and communication but not by observability. Subjective Norms have strongest influence on intention to use.
Königstorfer, 2008	Mobile parking service	Innovativeness Mobility Contact to Change Agents External Influences Self-Efficacy Perceived Ease of Use Self-Identity Fun Perceived Usefulness Attitude Social Influence Intention	186 persons in Germany and 170 persons in Austria	Personal interviews	R_2 ΔR_2, Liklehood-Ratio-Test, chi-square difference test, Goodness-of-Fit-test	Perceived Usefulness together with Self-Identity have the strongest influence on intention. Social Influence strongly determines Attitude and Intention. Innovativeness increases Perceived Usefulness.
Hashim, 2008	Web-Based Training	Perceived Ease-of-Use, Perceived Comfortableness Perceived Usefulness Perceived Support	261 employees	Written questionnaire personally administered	Factor analysis	Perceived Ease-of-Use, Perceived Comfortableness and Perceived Usefulness are all significantly related to Attitude. Strongest relationship between Perceived Usefulness and Attitude.
Kwong and Park, 2008	Digital music services	Perceived Ease of Use Perceived Usefulness Attitude Subjective Norm Perceived Behavioural Control Perceived Service Quality	217 students	Online questionnaire	GFI, AGFI, CFI, IFI, TLI, RMSEA	Attitude, Subjective Norm and Perceived Behavioural Control have a positive effect on intention. Perceived Ease of Use and Perceived Usefulness have a positive influence on attitude.
Bouwman et al., 2007	Mobile Services	Barriers towards use Attitude Current Use Entertainment character Flexibility Intended future use	484 persons	Email questionnaire		No overall predictiveness achieved. Entertainment character has a positive influence on intended future use
Kim, Chan and Gupta, 2007	Mobile Internet	Perceived Usefulness Fun Technical Quality Costs Intention	161 persons	Online questionnaire		Perceived Usefulness is the strongest determinant of intention. Cost has the most negative influence on intention. Fun has the most positive influence on intention.

Author / Date	Research Context	(Psychological) constructs used to explain technology acceptance	Sample	Data collection	Stat. tests employed	Main findings
Park, Yang and Lehto, 2007	Mobile Phones	Expected Benefit Expected Cognitive Expenses Social Influence Perceived Ease of Use Attitude, Intention	221 persons	Online questionnaire	Cronbach's Alpha, GFI, CFI, RMSEA	Expected Benefit and Social Influence have a positive influence on attitude. Expected Cognitive Expenses have a negative influence on attitude.
Omar and Owusu-Frimpong, 2007	Life Insurance	Attitude Subjective Norm Intention	240 persons	Written questionnaire	Cronbach's Alpha, T-tests	Intention is mainly determined by Subjective Norm.
Carlsson et al., 2006	Mobile devices and services	Expected Convenience Expected Costs Social Influence Perceived Ease of Use Attitude, Intention Use	157 persons	Email questionnaire	Cronbach's alpha,	Expected Convenience strengthens, while Expected Costs weaken intention. Attitude strengthens intention.
Fang et al., 2006	Mobile applications	Perceived Usefulness Perceived Ease of Use Playful approach Safety concerns Intention	101 persons	Email and written questionnaire	R_2 ΔR_2 T-Tests	Perceived Usefulness and Perceived Ease of Use strengthen intention (not in the case of games). Playful approach increases the intention to play games.
Hong, Thong and Tam, 2006	Mobile Internet	Perceived Usefulness Perceived Ease of Use Satisfaction with status quo Intention	1826 citizens of Hong Kong	Online questionnaire	GFI, AGFI, NFI, NNFI, CFI, RMSR	Perceived Usefulness and Perceived Ease of Use strengthen intention. Satisfaction with status quo has a rather weak influence on intention.
Koivumäki, Ristola and Kesti, 2006	Mobile Services	Perceived Usefulness Perceived Ease of Use Internal Resources External Resources Satisfaction with status quo, Intention	196 persons	Field Experiment and written questionnaire		Perceived Usefulness has the strongest influence on intention. External Resources are an important determinant of Intention.
Mahatanankoon, Wen and Lim, 2006	Mobile devices	Reliability of Service Perceived Usefulness Perceived Ease of Use Trustworthiness Attitude Intention	212 students owning a smartphone	Online questionnaire		Reliability of Service strengthens Perceived Usefulness, Perceived Ease of Use and Trustworthiness. Perceived Ease of Use has a stronger influence on Attitude than Perceived Ease of Use.
Wang, Lin and Luarn, 2006	Mobile Services	Self-Efficacy Financial Resources Perceived Usefulness Perceived Ease of Use Trustworthiness Intention	258 participants of a trade fair	Written questionnaire	$\chi 2$/d.f., GFI, AGFI, NFI, NNFI, CFI, RMSR, SRMSR, RMSEA	Perceived Usefulness, Trustworthiness and Financial Resources have the strongest influence on intention. Self-Efficacy increases Perceived Ease of Use. Perceived Ease of Use increases Perceived Usefulness and Trustworthiness.
Spence and Townsend, 2006	Genetically Modified Food	Moral Norms Emotional Involvement PCB Intention Behaviour Self-Identity Attitude Subjective Norms	99 participants	Written questionnaire	T-tests, Cronbach's alpha.	All TPB components significantly predicted behavioural intentions, with attitudes toward being the strongest predictor. Self-identity and emotional involvement were also found to be significant predictors of behavioural intentions but moral norms were not.

Author / Date	Research Context	(Psychological) constructs used to explain technology acceptance	Sample	Data collection	Stat. tests employed	Main findings
Bruner II and Kumar, 2005	Mobile Internet	Perceived Ease of Use Perceived Usefulness Fun Visual predisposition Type of device Attitude Intention	212 Students	Experiment followed by a written questionnaire	CFI, IFI, NNFI, RMR,RMSEA	Attitude is influenced more by Fun than by Usefulness. Perceived Ease of Use increases Perceived Usefulness and Fun.
Luarn and Lin, 2005	Mobile Banking	Perceived Ease of Use Perceived Usefulness Trustworthiness Self-Efficacy Costs Intention	180 participants of a trade fair	Written questionnaire		Perceived Ease of Use, Perceived Usefulness and Trustworthiness are major determinants of intention. Perceived Ease of Use increases Perceived Usefulness and Trustworthiness.
Pedersen, 2005	Mobile Internet	Perceived Ease of Use Perceived Usefulness External Factors Subjective Norms PCB, Attitude Intention Use	228 persons	Online questionnaire	$\chi 2$/df, NFI, CFI, IFI, RMSEA	Perceived Behavioural Control has a stronger influence on intention to use than Attitude and Subjective Norms. Perceived Usefulness is the strongest determinant of Attitude.
Wu and Wang, 2005	Mobile Commerce	Risk Costs Compatibility Perceived Usefulness Perceived Ease of Use Intention Use	310 persons	Combined online and written questionnaire	GFI, AGFI, NFI, NNFI, CFI, RMSR	Intention is a strong predictor for actual use. Compatibility and Perceived Usefulness are the strongest determinants of Intention. Perceived Ease of Use has no influence on intention.
Yang, 2005	Mobile Commerce	Individual characteristics Perceived Usefulness Perceived Ease of Use Attitude	866 students	Written questionnaire	R_2, ΔR_2, Cronbach's alpha	Perceived Usefulness positively influences Attitude and Perceived Ease of Use. Perceived Ease of Use has no influence on intention.
Fusilier and Durlabhji, 2005	Internet Usage	Perceived Ease of Use Perceived Usefulness Attitude Subjective Norm PCB Intention	269 college students	Written questionnaire	R_2, ΔR_2	User experience did significantly interact with components of the TPB and the TAM model, suggesting that it has a complex influence on internet user intentions.
Gruner t and Ramus, 2005	Internet Food Purchasing	Attitude Subjective Norm PCB Perceived Difficulty Risk Aversion Food-Related Lifestyle Wired Lifestyle	na	na	na	Perceived Benefits and Disadvantages, beliefs about others' reactions, beliefs about availability of resources, and beliefs about personal abilities strongly influence Intention.
Kleijnen, Wetzels and de Ruyter, 2004	Mobile Banking	Perceived Ease of Use Perceived Usefulness Costs System Quality Social Norms Attitude Intention	105 persons with mobile internet access	Written questionnaire	R_2 ΔR_2, Cronbach's alpha.	Usefulness and Perceived Ease of Use are the only determinants of Attitude Social Norms and Attitude are the only determinants of intention.
Pedersen and Nysveen, 2003	Mobile Parking	Perceived Ease of Use Perceived Usefulness Attitude	459 individuals	Combined online and written questionnaire	confirmatory factor analysis, NFI, RFI, IFI, CFI, RMSEA	Usefulness and Attitude have a positive influence on Intention . Usefulness and Perceived Ease of Use have a positive influence on Attitude.

Author / Date	Research Context	(Psychological) constructs used to explain technology acceptance	Sample	Data collection	Stat. tests employed	Main findings
Teo and Pok, 2003	Smart Phones	Relative Advantage Perceived Ease of Use Image Compatibility Risk Subjective Norms PCB Intention	1012 with 587 asked via Newsgroup and Forums and 425 asked via mail	Internet Questionnaire	GFI,AGFI, NFI RMSEA, RMR	Perceived Behavioural Control has no influence on intention. Relative Advantage and Image strengthen intention while perceived risks reduce intention.
Hung, Ku and Chang, 2002	Mobile internet services	Attitude Subjective Norm Perceived Behavioural Control Perceived Ease of Use Perceived Usefulness Innovation affinity	267 individuals	Written questionnaire		Attitude and Subjective Norm positively influence intention. Perceived Behavioural Control has no influence. Attitude is mainly determined by Usefulness.
Jaensirisak, 2002	Road User Charging	General Attitudes Personal Characteristics Effectiveness Perceives Current Situation Perceived Attributes Acceptability Intention	830 persons of the general public	Written questionnaire	Likelihood ratio test, chi-square difference test	The acceptability of road user charging is influenced by perceptions of benefits to self and to society and by the system features of the charging scheme.
Sparks and Shepherd, 2002	Genetically Modified Food	Attitude Subjective Norm Perceived Behavioral Control Perceived moral obligation. Intention	61 persons of the general public	Written questionnaire, personally administered in a second step	R_2 ΔR_2	Salient Beliefs representing Attitudes, Subjective Norms, and Perceptions of Behavioural Control were significant determinants of intentions, Independent predictive effect of perceived moral obligation on behavioural intentions.
Braithwaite, Sutton and Steggles, 2002	Testing technology for hereditary cancer	Attitude Subjective Norm Perceived Behavioral Control Attitude Towards Uncertainty Intention	124 persons (breast cancer), 168 persons (colon cancer)	Written questionnaire	R_2 ΔR_2, chi-square difference test	The TPB components and Attitude Towards Uncertainty are the strongest predictors of intention. Attitude Towards Uncertainty moderates Intention.
Hrubes, Ajzen and Daigle, 2001	Hunting behaviour	Attitude Subjective Norm Perceived Behavioral Control Intention Behaviour	395 outdoor recreationists	Written questionnaire	R_2 ΔR_2	Attitudes toward hunting, subjective norms, and perceptions of behavioural control were significant determinants of intentions. These predictors correlated highly with sets of underlying beliefs. Background factors were largely mediated by the components of the TPB.
Li, 2001	Tertiary education program	Country-of Origin (COO) (Australia, UK, USA) Attitude Subjective Norm Perceived Behavioural Control Intention Behaviour	633 year 12 students	Written questionnaire in the normal class setting	RMSEA, RMR, Cronbach's alpha, chi-square difference test	Attitudes, Subjective Norms and Perceptions of Behavioural Control were significant determinants of intentions, irrespective of the Country of Origin (COO) of an education program.

The above summary of the main aspects from contemporary research in the field of acceptance research reveals a number of similarities among the reviewed studies. First of all, there is a clear focus on computer-related technologies as a research subject. The most common research subjects are mobile phone related services and online commerce systems. In terms of geographic location, there are no clear commonalities apparent among the reviewed studies. Acceptance research takes place on every continent, and in lesser-developed countries, such as Nigeria or Tunisia, as much as in well-developed countries, such as the USA or the UK. In terms of applied methodology, most of the studies rely on the application of a survey instrument, in written or online form. Only two of the studies have employed personal interviews and a further two have combined a field experiment with a written questionnaire. The resulting questionnaire data was analysed using a range of statistical tests. Most of the authors employed a structural equation model or regression model and estimated the predictive power of the model using a measurement of R-squared and further model-fit estimates such as RMSEA.

Recapitulating the chapter objectives, the most important reason for conducting this review of empirical studies was to elicit potential determinants of acceptance behaviour. Thus, the extracted factors, which were employed by the authors to predict the acceptance behaviour in the respective context of study, deserve the most attention and will consequently be discussed in detail in the next step.

3.14 Main Findings and Implications of Reviewed Studies

Each reviewed study used between three and fourteen predictors to explain acceptance behaviour. It is particularly interesting that most studies relied on either the TPB or the TAM model, as a basis, and extended the models with several novel predictors that were suspected to be important in the relevant research subject. Chart 18 shows a summary of the applied psychological constructs in the 49 studies reviewed. For this chart, only constructs that were used in more than three studies were considered.

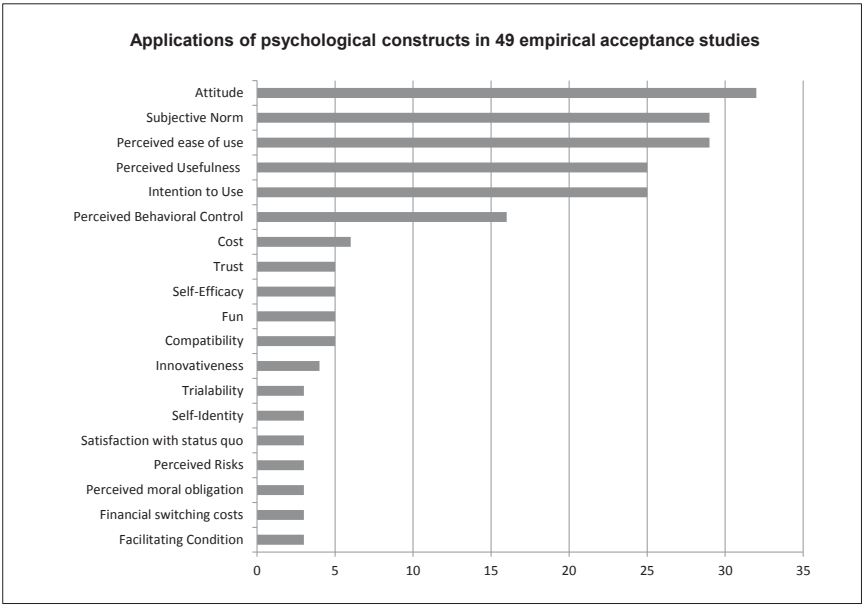

Chart 18: Applications of psychological constructs in empirical acceptance studies

It is important to acknowledge, however, that the above overview only gives the frequency of applied constructs, disregarding the outcome of the respective studies. Most studies revealed that one or more of the employed predictors did not significantly contribute to the prediction of acceptance behaviour. The results vary markedly from one study to the next, so that only major tendencies across all studies can be reported.

Generally, attitudes and subjective norms, which are at the core of the TPB model, as well as Perceived Ease of Use and Perceived Usability, which are at the core of the TAM model, were consistently found to be the main determinants of product acceptance. Since these factors were already discussed in the previous theoretical chapter as major determinants of acceptance behaviour, this is not particularly surprising. A closer look at the research findings, however, revealed that below the surface of these core factors, a multitude of further motives were found to be involved in the innovation acceptance decision, which deserve more attention.

One common result of this review is that generally the acceptance of innovations involves paradoxical effects, meaning that motives that support acceptance and motives that support resistance are both prevalent in the consumer's belief set. One such motive for resistance, especially in the field of private consumer behaviour, is the technologies' effect on non-functional motives, such as perceived enjoyment. Further examples of resistance motives are the perceived risks of a new technology and the technology's effect on personal freedom of choice. Generally, satisfaction with the status quo leads to increased reluctance towards change and thus towards innovation resistance. Factors supporting the acceptance decision were found in the area of social norms. Increased peer pressure based on the perceived spread of a new technology in the peer group or based on moral obligations tends to support the acceptance decision. The general attitude towards new technologies and past experiences with a technology were also reported to be decisive factors for technology acceptance by many authors.

Since these factors are the major contribution of this review to the further research progress, the implications of each psychological determinant for the present research subject will be discussed in the next step.

Paradoxical Effects

Comparing the findings of empirical studies in the area of technology, it becomes obvious that acceptance and resistance co-exist in consumers' evaluations. New technologies often involve paradoxical effects, which end-users are actually quite aware of (Heiskanen et al., 2007, p.501). On the one hand, consumers generally appreciate the comfort or safety benefits that these systems offer, while on the other hand consumers have serious concerns about the reliability of these systems and the influence they have on their daily life (Brookhuis, de Waard and Janssen, 2001, pp.247–251). It is expected that in the context of ADAS, consumers will correspondingly form positive and negative evaluations at the same time. Thus, it is a necessary precondition to investigate motives for both acceptance and resistance in order to fully understand the adoption process of ADAS.

Non-Functional Motives

One important aspect of resistance towards innovations is the technologies' effect on non-functional motives. Acceptance studies in the field of online

shopping behaviour consistently report that the shopping task provides more to the customer than the simple purchase and replacement of goods (Keeling, 1999, p.129). Various social and personal motives, such as self-gratification and sensory stimulation, are involved in the shopping process in addition to the acquiring of a good or service. In general, non-functional motives, like enjoyment and entertainment, have been found to be more influential than the pure utility function (Wonga et al., 2012, p.240).

Based on an empirical study, Chtourou et al. (2010, p.340) have reported, consistent with other work, that enjoyment mediates the effect of usefulness on the attitude towards a new technology. In other words, if the usefulness of a product does not generate amusement for the consumer, then even a high utility will have only a limited impact on the decision to adopt a new technology. As an example, a useful system that is very slow might fail in satisfying the user not because it is useless but because it is irritating and annoying (Chtourou and Souiden, 2010, p.341).

When transferring these findings to the context of ADAS it becomes apparent that customer motives in the case of personal transport reach far beyond only driving from A to B. Driving enjoyment and the general entertainment factor of driving might play an important role in the motives of many customers and thus might influence the acceptance decision towards ADAS.

Perceived Risks of Technology

Perceived risk as opposed to objective risks serve as a major motive for technology resistance. It is acknowledged that some activities are perceived as being more hazardous than others. A failure in a part of a bicycle, for example, is perceived as being less hazardous than the failure in a part on a plane (Bekiaris and Stevens, 2005, p.284). When a new technology is associated with potential hazards to one's well-being, it comes as no surprise that this fact might have a negative influence on the acceptance decision. Most studies in the field of technology acceptance indicate that perceived risks differ substantially from objective risks (see Wu and Wang, 2005 and Grunert and Ramus, 2005). In general, perceived risk affect the adoption decision when circumstances of the decision create feelings of uncertainty, psychological discomfort and anxiety (Sattabusaya, 2008, p.58). In the case of ADAS, technology is aimed at supporting or substituting manual tasks. Perceived risks are thus dependent on the extent to which the consumers believe that potential system failures are

more likely than own driving errors. Recent studies indicate that most drivers consider themselves at least as better drivers than average with respect to safe behaviour (Brookhuis, de Waard and Janssen, 2001, p.251). At the same time, information about the potential reliability of ADAS technology is very low in the public (German Road Safety Council e.V. (DVR), 2010). Nabih et al. (1997, p.52) postulate that a lack of understanding of the product's functionality may create "fear effects" which lead to extreme resistance towards the technology. Customers might thus be more likely to trust in their own capabilities instead of handing over these tasks to a device. As a result, perceived risks might act as a major motive for resistance towards innovation in this specific case.

Loss of Control, Autonomy and Empowerment

Another related motive for resistance is the technologies' effect on control, autonomy and empowerment. In general, handing over control to a device is evaluated as a negative aspect of technology (Brookhuis, de Waard and Janssen, 2001, p.247). Mick and Fournier (1998, p.125) argue that on a personal level, people are concerned that smart technologies might one day "take over" their lives, substituting their own responsibilities and leading to a loss of individual choice and the freedom to follow one's impulses. In a highly planned and organized world, people want to preserve their zones free of management. Smart technologies can improve life, but at the same time they come at the cost of giving up control and decision freedom. In the context of ADAS, this effect might be particularly important, since automobiles are, in general, an expression of personal freedom. If ADAS technology is perceived as restricting the free choice of travel route, travel speed or driving style, this fact might act as a motive for resistance towards the technology.

Satisfaction with Status Quo

While perceived risks often create active resistance towards new technology, many innovation acceptance studies indicate that passive resistance occurs as well, mainly caused by satisfaction with the status quo (see Hong, Thong and Tam, 2006; Koivumäki, Ristola and Kesti, 2006 and Bamberg, Ajzen and Schmidt, 2003). By using some products repeatedly over a long period of time, consumers form habits and routines. In general, they aim to preserve these habits and strive for consistency and status quo rather than to continuously search for and embrace new behaviours (Bagozzi and Phillips, 1982, p.219). According to Sheth (1981, p.275) this might even be "the single most powerful

determinant in generating resistance". Based on an empirical study, Bamberg et al. (2003, p.176) concluded that habits are even a stronger predictor of behaviour than the TPB Model in some behavioural categories (the study investigated the choice of transport options). Generally, strong attitudes toward existing objects usually increase the resistance to change and may prevent consumers from being open to innovations. In this case, further processing of information about an innovation may require a new openness to change or even a change in one's attitudes toward the habitual target (Hee-Woong and Kankanhalli 2009, p.567). However 'changing people's customs is an even more delicate responsibility than surgery in many cases' (Rogers, 2003, p.436).
The introduction of ADAS technology requires a change in driving habits. Since driving is, as noted before, generally a rather emotional activity with strong attributes towards specific behaviours, the impact of resistance towards change is expected to be significant in this context.

Perceived Installed Customer Base

Another attribute that is important in the context of many acceptance studies is the perceived installed customer base. In general, humans base their decisions as to whether or not to adopt a new behaviour on the perceived number of relevant others who are or are not already performing the specific behaviour (Fishbein and Ajzen, 2010, p.130). Especially in the field of consumer innovations, the perceived customer base was found to have a relevant impact on the acceptance decision. The perceived market share of an innovation can serve as a signal of product quality to potential adopters, who may infer the quality and utility of a product from the number of existing adopters (Song, Parry and Kawakami, 2009, p.304). While for highly visible innovations, perceived market share may be almost equal to, or sometimes even exceeding, the real market share, for nonvisible innovations, in contrast, the perceived installed base of customers might be much smaller than it actually is. Since in the case of ADAS, the adoption of the technology is not directly visible to others, the perceived installed customer base will potentially be a restricting factor for technology diffusion unless communication efforts (e.g. an "ADAS" badge on the back of a car) are established.

Linguistic Attributes

The name of a new product is another important aspect influencing the individual decision-making. Usually new products are labelled with novel, often rather technical, attributes. The name given to an innovation often affects its perceived compatibility, and therefore its rate of adoption. According to Rogers (2003, p.250), inadequate attention has been paid to what innovations are called by potential adopters, and as a result, many serious mistakes have been made. Past research suggested that adding novel linguistic attributes to a product is likely to improve its product evaluation in the mindset of potential customers. However, more recent studies indicate that positive effects of novel attributes are likely to be obtained only in the case of relatively low-complexity products, such as refrigerators and washing machines, in the case of high-complexity products, such as computers or automobiles, the addition of novel linguistic attributes can actually reduce product evaluation because of learning-cost inferences made about these attributes (Mukherjee and Hoyer, 2001, p.470). In the field of ADAS a vast amount of highly technical acronyms and abbreviations are offered to the customer (such as ESP, ABS, ACC etc.), who often draws his or her first conclusions about the possible utility of these systems from the name alone (European Commisson esafety initiative, 2007, p.4). Thus the current linguistic attributes used for this technology are another possible motive for resistance in the case of ADAS.

Subjective Norms / Peer Pressure

According to many studies, understanding the relationships between users may be more critical than factors relating to the product itself (see Khalifa and Shen, 2008; Omar and Owusu-Frimpong, 2007; Park, Yang and Lehto, 2007). Rogers (2003, p.245) argues that individuals do not evaluate an innovation solely on the basis of its performance as judged by objective attributes. Rather, they decide whether or not to adopt the product on the basis of the subjective evaluations of the innovation conveyed to them by others like themselves (peers). These findings are in accordance with the original TRA model proposed by Fishbein and Aizen (2010), which postulated that behaviour is only determined by attitude and subjective norms, where Subjective Norms are defined as "perceived social pressure to perform or not to perform a given behaviour" (Fishbein and Ajzen, 2010, p.130). Even though the majority of acceptance studies (27 out of 49, see Chart 18) report a major effect of subjective norms, it must be acknowledged that in some contexts, subjective norms were not found

to significantly influence the adoption process (see Karahanna, Agarwal and Angst, 2006, p.213; Omar and Owusu-Frimpong, 2007, p.967; Swartz and Douglas, 2009, p.36). The level of influence of subjective norms or peer pressure on the adoption decision in the case of ADAS is thus difficult to estimate from literature research alone. However, based on that fact, that especially in the area of consumer goods, subjective norms are rather important, it is expected to find some impact of peer pressure on the decision to use ADAS technology.

Self-Identity

Several researchers have addressed the concept of self-identity for predicting innovation acceptance (see Königstorfer, 2008; Pelling and White, 2009; Spence and Townsend, 2006). The concept of self-identity is a set of socially constructed roles reflecting the extent to which individuals see themselves as fulfilling the criteria for particular societal roles (Pelling and White, 2009, p.756). In other words, self-identity reflects the extent to which engaging in a behaviour is important to an individual's self-concept. On the basis of past research, Conner and Armitage (1998) argued that it is reasonable to assume that there are certain behaviours for which self-identity is an important determinant for innovation acceptance. Empirical research confirmed that self-identity impacts intentions to engage in behaviours that are performed relatively frequently (e.g., food choices), and those performed relatively infrequently (e.g., consumption of luxury goods); however, it is expected to have a stronger impact on the latter (Smith et al., 2008, p.215). Since the purchase of ADAS technology is linked to the purchase of a new car, which is a rather rare act for most people, it is expected that the self-identity of consumers plays a major role in the acceptance process.

Perceived Moral Obligation

A number of studies have incorporated moral concerns as a potential motive for innovation acceptance (see Bradley, 2007; Spence and Townsend, 2006). According to Sparks and Shepherd (2002, p.300), this is congruent with positions in other disciplines that would argue for the importance of morals in social and personal actions. Additionally, the rising tide of ethical consumerism means that moral issues are likely to be present in many instances of consumer behaviour. Perceived moral obligations are thus expected to be an important

determinant of innovation acceptance in the consumer product context (Sattabusaya, 2008, p.51). Generally, moral norms are defined as personal norms regarding what is right and what is wrong (Spence and Townsend, 2006, p.658). As opposed to laws and regulations, moral obligations are completely subjective and solely based on the subjective impression of what ought to be done or not done. Especially in the context of food innovations (e.g. fair-trade coffee), moral concerns have been found to be an important motive for acceptance (see Bradley, 2007; Spence and Townsend, 2006). Whether or not moral concerns have an influence on the adoption decision towards ADAS technology is unknown. It is expected, however, that the overall positive influence of these systems on road safety might have a positive moral influence on the purchase decision.

Past Experiences

According to Rogers (2003, p.15) past experiences determine the degree of compatibility of an innovation with existing ideas, values and practices. The compatibility in turn is a major determinant for the adoption decision. Ajzen and Fishbein (2010, p.289) report correspondingly that "including past behaviour as an additional predictor has consistently been found to produce a substantial increase in the amount of explained variance in later behaviour". In some contexts, past behaviour was even found to be the single most important determinant of the adoption process (see Fusilier and Durlabhji, 2005). It remains unclear whether past experience is a motive in its own right or whether it is part of the attitude component as discussed above (Keeling, 1999, p.168). However, transferring these findings to the context of ADAS, it becomes obvious that past experience with similar technologies might have a significant influence on the future adoption decision. If, for instance, a customer has purchased an early driver assistance system, such as ESP, which he believes has saved his life in a critical driving situation, this would certainly have a positive influence on the decision to adopt the more advanced ADAS technology.

Innovativeness

Rogers and Shoemaker (1971) defined innovativeness as "the degree to which an individual is relatively earlier in adopting new ideas than other members of his social system" (p. 27). Others define innovativeness as the relative affinity to test new products or technologies (Königstorfer, 2008, p.42). Even though only a minority of studies employ this concept, those that do emphasize the "role

individual innovativeness plays in shaping technology acceptance" (Chiu, Fang and Tseng, 2010, p.454). Since driver-assistance systems are part of a highly emotional product, namely cars, it is expected that general innovativeness plays a significant role towards the acceptance of this technology.

Emotional Involvement

One determinant of technology acceptance that has mainly been found in a consumer context is emotional involvement with the behavioural or product category. According to Chtourou et al. (2010, p.340), the impact of emotions goes beyond the consumption of hedonic products and extends to the adoption of technological products, such as mobile phones or computers. Emotional involvement is generally defined as "the extent to which the individual is engaged with (or disinterested in) the behaviour at hand" (Spence and Townsend, 2006, p.659). In other words, emotional involvement represents the level of perceived personal importance and/or interest evoked by a certain technology. This emotional engagement with a new technology or the broad category of its application has been found to positively impact the decision to adopt a new product offered in this field. Transferring these results to the context of ADAS, it is expected that consumers who are generally more emotionally attached to cars are more likely to adopt ADAS technology. On the contrary, however, it could be argued that automobile enthusiasts might be more reluctant to adopt a technology that is aimed at substituting driving tasks and thus a reciprocal causal relationship could also hold true.

Conclusion

In conclusion, the discussed studies have delivered a comprehensive list of potential determinants which have been proven useful in their respective contexts of research. It has to be acknowledged that most of these studies have focussed on the use of technological innovations that are significantly different in many aspects from the use of ADAS. Due to the lack of scientific work in the context of ADAS, the next chapter will focus on studies conducted by commercial and governmental entities in the field of driver-assistance systems.

3.15 Review of Commercial Innovation Acceptance Studies

By extending the literature review to non-scientific publications, several studies in the context of ADAS conducted by governmental authorities and the industry are available for drawing conclusions. It should be acknowledged that most studies in the commercial field only survey the overall level of ADAS usage and the level of ADAS awareness without an attempt to assess the underlying reasons for these results. Some of these studies, however, are especially noteworthy and allow for generalisations to be drawn, since they are based on a relatively large and representative sample size.

Performing a representative market study, Oliver Wymann (2007, p.9) found several reasons for resistance towards ADAS along the innovation acceptance process. In the knowledge stage, the plethora of available innovations, the perceived complexity of the innovation's usage and the multitude of confusing terms used for these innovations tend to reduce the acceptance rate. In the decision stage the main problems according to this study are budget restrains (mainly due to uptrading of car models) and the different benefit perceptions along different customer segments (mainly due to customer polarisation). Another industry study by one of the leading suppliers of ADAS components asked a representative sample of German end-users to agree or disagree with a set of eight possible advantages and shortcomings of ADAS (Happe and Lütz, 2008, p.14). While around sixty percent of end-users agreed that ADAS would provide "more safety", around thirty percent reported that they feared that ADAS might result in "unconcentrated driving" or "distraction". Interestingly, another almost thirty percent did not find any disadvantage of the four listed to hinder them from using an ADAS (Happe and Lütz, 2008, p.14). It was not disclosed, however, how these eight advantages and disadvantages were selected and the limitation to these eight factors certainly influenced the decision making of respondents. The complete results of this study are displayed in Chart 19.

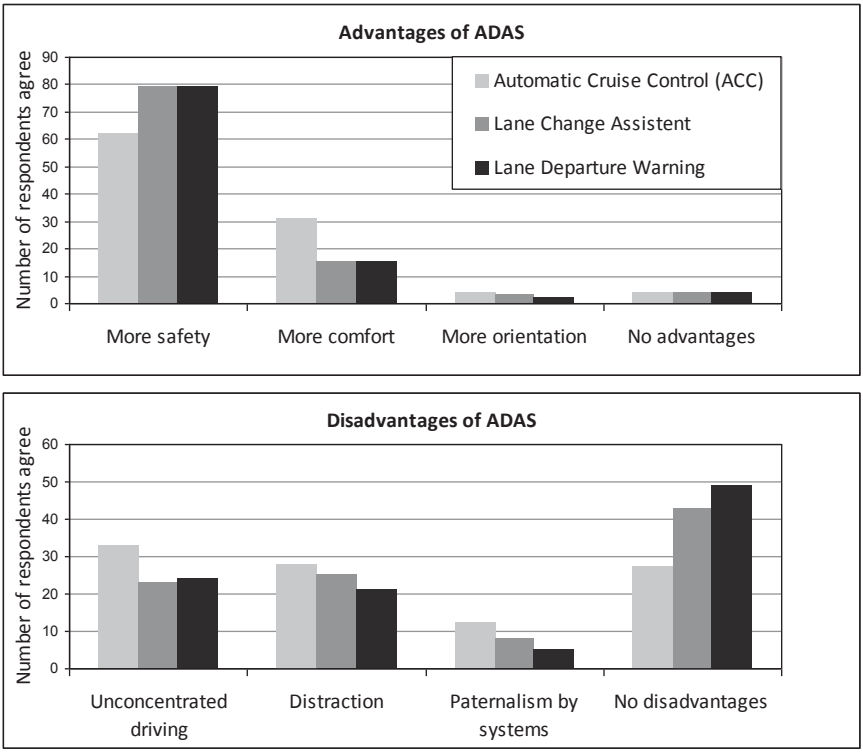

Chart 19: Perceived advantages and disadvantages of ADAS on the German market, Source: Own drawing based on Happe and Lütz (2008, p.14)

The most comprehensive study in the context of ADAS, however, was conducted on behalf of the European Commission as part of the Eurobarometer research. The study covered representative samples of all twenty-five member states of the European Union, with a total of 24,815 citizens being interviewed face to face about their perception of intelligent vehicle system (European Commision - Eurobarometer, 2006, p.3). In conclusion, this empirically strong study revealed seven core reasons for resistance towards ADAS. ADAS was perceived as being: too expensive (fifty-one percent), too unreliable (twenty-four percent), reducing drivers' alertness by creating an artificial feeling of being protected (twenty-three percent), too expensive to service (twenty-two percent), creating too much visual and sound warning (nineteen percent), being too difficult to understand (twelve percent) and undermining drivers' freedom

(eleven percent) (European Commision – Eurobarometer, 2006, p.47). Capturing a vast amount of demographic data (including driving habits), this study also analysed the user segments in accordance with perceptions towards ADAS usage. One of the major findings was that "males and those who have a higher level of education as well as those who drive a lot and have bought a new car – the categories that are also likely to belong to the group of potential users of intelligent vehicle systems – tend to consider these systems more useful" (European Commision - Eurobarometer, 2006, p.56). Those who indicated that they drove a small car or a second-hand car were, however, slightly less likely to consider these systems worth having in their car (European Commision - Eurobarometer, 2006, p.56). In other words, the group that appears to have limited access to these systems also appreciates them less, while individuals with easier access to this technology tend to have more positive attitudes towards them. Chart 14 gives an overview of the reasons for resistance towards ADAS elicited in this study.

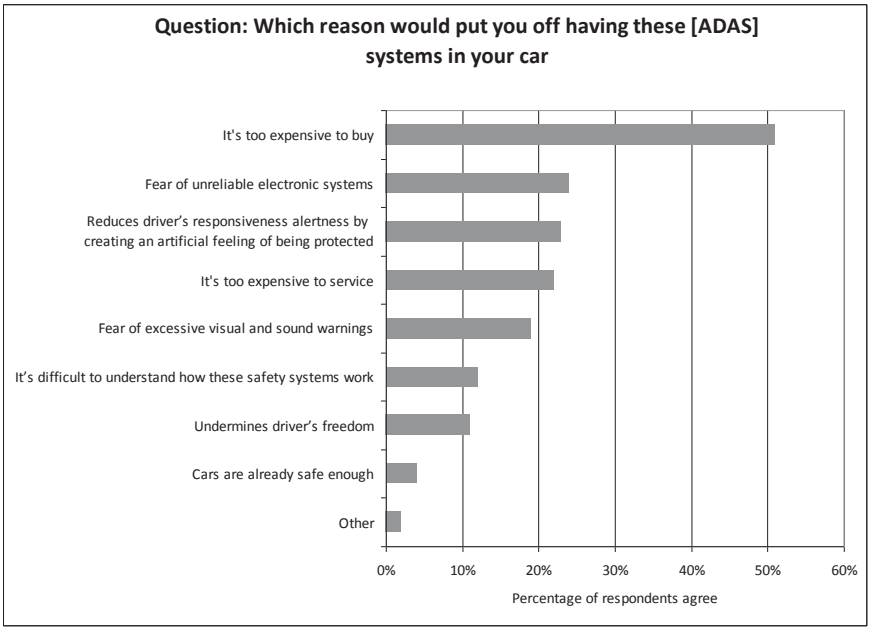

Chart 20: Reasons for resistance towards ADAS, Source: Own drawing based on European Commission - Eurobarometer (2006, p.47)

In sum, the commercial studies discussed so far have provided a first representative overview of potential determinants of ADAS acceptance. It has to be

acknowledged, however, that these studies have only asked for predetermined beliefs towards ADAS acceptance, while none of the studies has revealed the process of how these potential beliefs were elicited beforehand. From a scientific point of view, these studies have also failed to explain the causal relationships of individual beliefs and thus failed to create an explanatory and predictive behavioural construct towards the end-user acceptance of ADAS.

3.16 Implications from the Literature Review

Scientific as well as commercial studies have contributed important aspects for understanding individual innovation acceptance behaviour. In order to use these findings for the later stages of the present research, it is necessary to concentrate and integrate these findings in a clearly arranged manner. Each of the innovation acceptance studies reviewed so far has applied or developed concepts in order to explain the acceptance behaviour. Some of these concepts, such as attitude or perceived social pressure, appear regularly, while others, such as moral concerns, were only found to be relevant in a few studies. Thus it was necessary to generate a list of potential core concepts derived from the literature. This set was developed by:

1) Extracting the main findings from the considered acceptance studies;
2) Grouping similar concepts from different authors;
3) Grouping concepts with different wordings but the same meaning.

In sum, a list of fifteen core concepts resulted, which are expected to explain most of innovation acceptance behaviour in any given context. The relevance of these concepts for the present research was judged by:

1) Elaborating their relevance in the literature, based on the number of applications;
2) Assessing the explained variance in innovation acceptance behaviour, which was attributed to these concepts in the reviewed studies;
3) Evaluating the potential relevance for the subject of driver-assistance systems based on logical reasoning.

Using this process, the set of seventeen core concepts was again grouped from the top tiers, which are expected to have very high influence on acceptance behaviour, to the lowest rank, which are expected to have only a minor influence on acceptance behaviour. The following table gives an overview of the results matrix.

Table 8: Acceptance factors derived from secondary research

Concept (alphabetic order)	**Short description**	**Significance of the concept** (Based on applications of the concept in the literature and the explained variance in innovation acceptance behaviour that was attributed to the concept in the reviewed studies)		**Reference** (Original reference and applications)
Attitude	A learned orientation, or disposition, providing a tendency to respond favourably or unfavourably to an object (Gross, 1992, p.515).	Very high	Attitudes towards an innovation were consistently found to be a major explanation for its acceptance.	Fishbein and Ajzen, 2010, multiple applications
Behavioural Control	People's perceptions of their ability to perform a given behaviour, i.e. adopting a certain innovation (Fishbein and Ajzen, 2010, p.21).	Low	Even though this concept is widely employed in acceptance research as part of the TPB model, its ability to explain the acceptance behaviour was in most cases found to be insignificant.	Fishbein and Ajzen, 2010, multiple applications
Emotional involvement	The extent to which an individual is engaged with (or disinterested in) the adoption object (Spence and Townsend, 2006, p.659).	Context specific	Rarely applied in innovation acceptance literature, this concept was only found to be significant in consumer product acceptance.	Chtourou and Souiden, 2010; Spence and Townsend, 2006
Innovativeness	"The degree to which an individual is relatively earlier in adopting new ideas than other members of his social system" (Rogers and Shoemaker, 1971, p.27).	High	Widely applied in empirical research, this concept is generally treated as a background variable (like age, gender or socio-economic status). Two studies, however, also used this concept as a predictor for attitude towards an innovation.	Chiu, Fang and Tseng, 2010; Königstorfer, 2008; Rogers, 2003
Linguistic Attributes	Novell attributes and names given to an innovation.	Low	Despite the fact that this concept is often discussed in the literature on a theoretical level, there is too little empirical material to judge the significance of this concept.	European Commisson esafety initiative, 2007; Mukherjee and Hoyer, 2001; Rogers, 2003
Loss of control, autonomy and empowerment	The degree to which an innovation substitutes personal responsibilities and leads to a loss of individual choices.	Context specific	This factor was only applied in the area of technological innovations that are aimed at substituting manual tasks. In these cases, however, the concept was found to be significant.	Brookhuis, de Waard and Janssen, 2001; Mick and Fournier, 1998
Non-functional motives	Personal motives that are not related to the basic function of an innovation, such as self-gratification, enjoyment or sensory stimulation.	High	Non functional motives were generally found important in consumer product innovation acceptance.	Bruner II and Kumar, 2005; Chtourou and Souiden, 2010; Cui, Bao and Chan, 2009; Kim, Chan and Gupta, 2007
Past Experiences	Past experiences determine the degree of compatibility of an innovation with existing ideas, values and practices (Rogers, 2003, p.15).	Moderate	This concept was found to be a significant factor for acceptance in some studies, others could not report any impact.	Fishbein and Ajzen, 2010; Fusilier and Durlabhji, 2005; Rogers, 2003
Perceived Ease of Use	The degree to which a person believes that using a particular system would be free of effort (Davis, Bagozzi and Warshaw, 1989, p.985).	Very high	Virtually all studies applying the TAM model report that this concept has a significant influence on attitude, which in turn significantly influences the acceptance of innovations.	Davis, Bagozzi and Warshaw, 1989, multiple applications

Concept (alphabetic order)	**Short description**	**Significance of the concept** (Based on applications of the concept in the literature and the explained variance in innovation acceptance behaviour that was attributed to the concept in the reviewed studies)		**Reference** (Original reference and applications)
Perceived installed customer base	Perceived number of relevant others who have or have not already adopted a specific innovation (Fishbein and Ajzen, 2010, p.130).	High	Especially in the field of consumer innovations, this concept was found to have a relevant impact on the acceptance decision.	Fishbein and Ajzen, 2010; Song, Parry and Kawakami, 2009
Perceived Moral Obligation	Personal norms regarding what is right and what is wrong (Spence and Townsend, 2006, p.658).	Context specific	Even though the rising tide of ethical consumerism means that moral issues are likely to be present in many instances of consumer behaviour, empirical studies could only report significance of this concept in some product categories so far (e.g. food).	Bradley, 2007; Sattabusaya, 2008; Spence and Townsend, 2006
Perceived risks	The perception that the adoption of a certain innovation involves risks and thus creates feelings of uncertainty, psychological discomfort and anxiety (Sattabusaya, 2008, p.58).	Context specific	This concept has only been reported significant for some technological innovations like mobile banking, thus its significance is likely to be context dependent.	Grunert and Ramus, 2005; Wu and Wang, 2005
Perceived Usefulness	The degree to which a person believes that using a particular system would enhance his or her job performance (Davis, Bagozzi and Warshaw, 1989, p.320).	Very high	Virtually all studies applying the TAM model report that this concept has a significant influence on attitude, which in turn significantly influences the acceptance of innovations.	Davis, Bagozzi and Warshaw, 1989, multiple applications
Satisfaction with status quo	By using some products repeatedly over a long period of time, consumers form habits and routines, which they like to preserve (Bagozzi and Phillips, 1982, p.219).	Context specific	Several studies found this concept being the strongest predictor for acceptance behaviour; others, however, reported only minor impacts.	Bamberg, Ajzen and Schmidt, 2003; Hong, Thong and Tam, 2006; Koivumäki, Ristola and Kesti, 2006
Self-Identity	Self-identity is a set of socially constructed roles reflecting the extent to which individuals see themselves as fulfilling the criteria for particular societal roles (Pelling and White, 2009, p.756).	High	Even though rarely applied, this concept was consistently reported to be a significant predictor.	Königstorfer, 2008; Pelling and White, 2009; Spence and Townsend, 2006
Social Norms	Perceived social pressure to adopt or not to adopt a certain innovation (Fishbein and Ajzen, 2010, p.21).	Very high	A widely applied and integral part of the TPB model, this concept was consistently found to be a significant predictor.	Fishbein and Ajzen, 2010, multiple applications
Trust	The reasonable expectation (confidence) of an individual that the adoption of an innovation will be beneficial for him or her.	Context specific	Only a minority of studies, mainly in the field of high-tech innovations such as mobile banking, considered trust as a factor influencing the acceptance behaviour. Yet, those studies reported a strong significance of this factor.	Hahn and Kim, 2009; Luarn and Lin, 2005; Mahatanankoon, Wen and Lim, 2006; Tsai, Chin and Chen, 2010; Wang, Lin and Luarn, 2006

As expected, the concepts derived from the Theory of Planned Behaviour (TPB) and from the Technology Acceptance Model (TAM) were judged highest in terms of their potential predictiveness towards the acceptance behaviour. Other concepts received varying results depending on the context in which they were applied. It remains to be clarified whether or not these concepts will be relevant in the specific context of ADAS acceptance. Consequently, it is imperative for the author to conduct primary research in the context of ADAS in order to verify and revise the results presented so far.

3.17 Chapter Conclusion

The present chapter has provided a substantial contribution to the current research and laid out the foundation for the further empirical research phase. In the absence of widely-agreed definitions for the relevant terms of the present thesis, this chapter started by providing an overview of available definitions for the terms *Innovation*, *Adoption* and *Rejection*. Subsequently, the differences and similarities of definitions and the specific components of the term *Innovation* were discussed in order to develop a new definition which is most comprehensive yet applicable to the present research context. In the next step, the author provided an overview and a critical evaluation of available models for explaining the acceptance of innovations. Contemporary empirical work employing these models was consequently reviewed and the core elements were integrated into a tabular overview. Based on this academic work, the author developed a compendium of potential determinants of innovation acceptance and discussed their potential application in the case of ADAS. The chapter ended with a list of potential determinants of innovation acceptance, providing a first conceptual framework for further research.