Chapter 1: Introduction

1.1 Chapter Objectives

The main purpose of this first chapter is to provide a comprehensive introduction to the research topic and the objectives of the present thesis. The chapter starts with an explanation of the research context, the acceptance of Advanced Driver-Assistance Systems. Next, the research aims and objectives are outlined and initial hypotheses are proposed, serving as a starting point and justification for the research. Thereafter the relevant stakeholders, involved in or affected by this research, will be highlighted. Finally, the chapter will end with a brief explanation of the thesis structure

1.2 Research Introduction

Innovative driver-assistance systems have the potential to change the way of personal transportation by increasing safety and efficiency. To some extent, they already have accomplished this. Today most cars are equipped with ABS (anti-lock brake system) and ESP (Electronic Stability Program), which can be considered as early driver-assistance systems. More complex innovations like distance, lane or parking assistance, which are commonly called Advanced Driver Assistance Systems (ADAS), have not yet reached market acceptance despite their technical maturity and proven usefulness.

In 2010, the car industry spent approximately € 48 billion on Research & Development of innovative technologies, which is an increase of more than 15 percent compared to the previous year (Bratzel and Tellermann, 2011, p.113). Many innovations, however, do not meet customer needs and are thus abandoned before they reach the market (Story, O'Malley and Hart, 2011, p.952). The main barriers towards market penetration are no longer only technology-based but rather based on the lack of acceptance of potential customers. End-users are increasingly overwhelmed by the rapid proliferation of technological advancements and thus are more likely to be resistant to change (MacVaugh and Schiavone, 2010, p.198; Nabih, Bloetn and Poiesz, 1997, p.47). From an objective point of view, the decision as to whether or not to adopt an innovation should depend mainly on its usefulness compared to the technology it is substituting. However, customers are not always rational, objective and utility-maximising: instead, they tend to base their decisions on other more subjective

beliefs about the technology in question (MacVaugh and Schiavone, 2010, p.199). Different areas of technological development have shown that reasonable innovations do fail in the market or take longer than expected to reach acceptance despite their proven usefulness (Rogers, 2003, pp.1–10). Thus, learning about the reasons and root causes of beliefs that lead towards the acceptance of innovations by potential end-users is a necessary prerequisite for developing new technologies, as in the case of driver-assistance systems.

1.3 Research Aims and Objectives

The overall aim of this study is to explain the individual psychological factors that lead to either acceptance or resistance of Advanced Driver-Assistance Systems (ADAS) on the German market and thus help the industry to market this new technology.

In particular, the research objectives are formulated as follows:

1)   Identification of psychological factors that explain the individual acceptance or resistance decision towards ADAS

2)   Development of a predictive model towards the acceptance of ADAS that permits organisations to successfully market this technology.

1.4 Initial Hypotheses

The fact that Advanced Driver-Assistance Systems are rejected by many individuals despite their proven usefulness in increasing road safety has led the author to develop three initial hypotheses about the potential causal relationships behind this apparent paradox. Based on more than five years' working experience in the automotive industry, the author has recognised a set of characteristics that might have an effect on the acceptance of ADAS technology in the given research context.

First, driving an automobile creates a primary benefit for an individual in the form of transportation, but might also create secondary benefits in the form of thrill, sensory stimulation or exertion of power. The author has recognised that ADAS technology is perceived as potentially reducing these ancillary driving benefits through an increased rate of automation. Thus, initial hypothesis 1 follows:

H_{i1}: The more ADAS is perceived as reducing ancillary driving benefits, such as thrill, sensory stimulation or exertion of power, the less individuals will intend to use this technology.

Second, the author has recognised that the perceived usefulness of ADAS technology is largely dependent on the estimated likelihood of making a hazardous driver error. Individuals with strong confidence in their own driving skills tend to place a lower value on the potential safety benefits of ADAS technology. Thus, initial hypothesis 2 follows:

H_{i2}: The greater the confidence in their own driving skills, the less individuals will intend to use this technology.

Finally, the author noticed strong concerns about the reliability of Advanced Driver-Assistance Systems in daily usage. In particular, the fear of malfunctions, leading to hazardous driving situations, might create an additional reason for resistance towards this technology. Thus, initial hypothesis 3 follows:

H_{i3}: The greater the concerns about potential malfunctions of ADAS technology, the less individuals will intend to use this technology.

These hypotheses can be regarded as initial, or working, hypotheses in the sense that they are not based on primary or secondary research, but only on experience and logical reasoning. In the following, these hypotheses will subsequently be supplemented, modified and tested based on the results of the literature review and primary research.

1.5 Research Questions and Gaps in Knowledge

In order to address the defined research objectives, the author reviewed a range of secondary literature to consider the existing state of knowledge and to identify potential gaps for which primary research will be conducted. This analysis revealed that there is no existing empirical study on the psychological factors which determine the consumer acceptance of Advanced Driver-Assistance Systems. Based on this gap of knowledge, this research should provide sufficient evidence to answer the main research questions, namely which psychological factors influence consumer acceptance of ADAS and which factor contributes most or least to the acceptance decision. Table 1 provides an overview of the research questions and the associated gaps in knowledge. Next to this, the in-

tended research strategies as well as the potential data sources are listed in each row.

Table 1: Research questions and gaps in knowledge			
Research Question	**Gaps in Knowledge**	**Research Strategy**	**Data Sources**
1 Which factors influence the acceptance of ADAS?	Factors influencing acceptance behaviour in the case of ADAS	Literature Review, Qualitative research, Chapter 3&5	Books and articles, interviews with car drivers at the point of sale
2 How can these factors be arranged in a model, explaining the acceptance behaviour of customers towards ADAS?	A predictive model towards the acceptance of ADAS technology	Quantitative research, regression model, group difference tests, Chapter 6	Data from the representative survey on the German market

The research questions outlined in the above table provide the basic guideline for developing the research methods of the present thesis. In the next step, the context and subject of the research will be defined in more detail and will be justified based on the research objectives.

1.6 Rationale for Industry and Location Focus

The focus of this research is the automobile industry and within this industry the Advanced Driver-Assistance Systems (ADAS), increasingly offered as optional equipment in modern cars. This research context was chosen for two reasons. First, the automotive industry is, in general, an innovation-driven industry in which competitiveness is heavily determined by innovativeness and continuous improvement. Accordingly, automobile companies have invested billions into research and development of innovations like driver-assistance systems with the belief that these systems will reach market maturity soon (OECD, 2008). Yet, many of these companies now face the classical dilemma that their innovations, despite technical maturity and proven usefulness, are not accepted by the potential customers. This situation yields a promising field for the application of innovation acceptance research.

Second, from the theoretical perspective of innovation acceptance research, the context of ADAS combines some very unique aspects:

(1) ADAS are part of a highly emotional product, the automobile.
(2) ADAS are aimed at regulating the driving task, which is known to have a special role in the self-identity of consumers
(3) ADAS represent, at least in part, a preventive investment, which, like insurance or contraceptives, do not posses a direct short-term benefit for the customer.

For this reasons, the beliefs towards the acceptance of ADAS are expected to differ substantially from other cases of consumer goods. Consequently, this unique context offers promising insights into the field of innovation acceptance from a new perspective.

Germany is chosen as the location of interest for the present research. This decision is due to several purposes. Since the author works for a German car manufacturer, the focus on the German market increases the possibility of gaining access to potential car customers that serve as objects of study in the present research. This choice also provides further advantages. With 67 percent of the German population owning a car and an above-average percentage of luxury cars on the roads, Germany clearly offers a great opportunity for reaching an acceptable sample size (European Commision – Eurobarometer, 2006, p.6).

It has to be acknowledged that there are some important limitations regarding the selected research context. First, the very uniqueness of the ADAS technology discussed above may limit the applicability of the findings to other innovations. Second, the novelty of this innovation to the customers may raise problems, since people who are not aware of a new technology are not likely to develop beliefs towards it. Thus, it might not be possible to elicit readily accessible beliefs towards this new technology in the chosen sample (Keeling, 1999, p.167). Finally, the focus on German automobile customers may limit the generality of the findings, since multiple authors have reported a significant effect of cultural differences on the acceptance of innovations (see Bagozzi, 2007, p.247; Zakour, 2004, p.156; Fishbein and Ajzen, 2010, p.224). This geo-graphical limitation, however, can be by partly resolved by discussing the find-

ings from a cross-cultural perspective, which will be part of the last Chapter of this thesis. Consequently, while the research context is limited to the German market, the results of this study will also benefit the global industry and international governmental institutions.

1.7 Stakeholder Analysis

It is important to acknowledge the different stakeholder groups who are interested in the results of the present research and to specify what interests these groups have in relation to the research objectives. In sum, the author identified three groups of stakeholder: the Academic Community, the Industry and the Government.

Interests of the Academic Community

From a theoretical point of view this piece of research is aimed at advancing the scientific model for innovation acceptance. Based on Fishbein's and Ajzen's (2010) Theory of Planned Behaviour (TPB), this study develops a conceptual framework in the context of ADAS usage. While the TPB model only delivers a broad framework, further research is necessary to develop an understanding of the underlying sets of salient beliefs that eventually initiate the behaviour of individuals in a given context (Sattabusaya, 2008, p.51). Currently only a minority of innovation acceptance studies have considered salient beliefs as origins of intention. Ajzen and Fishbein (2010, p.206) remarked that "of the multitude of studies conducted in the context of our theory, only a minority have assessed beliefs; most rely on direct measures of the three major components to predict intentions and behaviour". Moreover, relatively few studies so far have looked at background variables (such as gender, age or socioeconomic status) in relation to the behaviour-relevant beliefs (Elliott and FU, 2008, p.50; Fishbein and Ajzen, 2010, p.252; Venkatesh et al., 2003, p.469). By studying the interrelation of background factors, the origins of salient beliefs that serve as the cognitive foundation for a behaviour of interest can be identified (Fishbein and Ajzen, 2010, p.253). Previous studies that have considered underlying beliefs have shown that these sets of beliefs vary significantly, depending on the very context of the behaviour in question. Therefore "future researchers should continue to test the validity of the TPB model to understand the complex interplay among attitudes, norms and identity processes in the different consumer contexts" (Smith et al., 2008, p.329).

Consequently, applying research in the framework of the TPB model to the context of ADAS not only promises insights in the respective field of study but might also help to advance the understanding of the behavioural model itself.

Most innovation acceptance studies of recent years have focused on health issues, like the use of contraceptives. The few studies that focused on consumer technology acceptance mainly investigated IT innovations, such as mobile commerce and electronic banking. Very few researchers have yet studied the motivation to adopt highly emotional innovations, such as cars or laptop computers, which are expected to have a very different set of modal beliefs (Rogers, 2003, p.116). From the perspective of the academic community, the context of ADAS combines some very unique aspects that could alter the belief sets included in behavioural acceptance models significantly.

Interests of the Industry
Despite their obvious importance and their economic implications for the automobile industry, Advanced Driver-Assistance Systems have so far not reached the focus of commercial research. Only a few studies have been published so far in the context of ADAS, mainly focussing on absolute user intention and demographic variables. From the perspective of the industry, this research will provide a scientific approach to the practical question of why product innovations take longer than expected to be accepted by the market. Especially for the automobile industry, investing billions each year into the development of product innovations like driver-assistance systems, profound knowledge of customer behaviour in terms of innovation acceptance is essential for effective product development as well as for an effective adjustment of the marketing-mix (Bratzel and Tellermann, 2011, p.113). The overall interest of the industry in research on the acceptance of ADAS technology is therefore twofold. First, a predictive model, taking into account background variables such as age and gender, will help the industry to adjust the marketing strategy in order to address potential reasons for customer rejection. Second, the knowledge of which factors have the strongest influence on consumer acceptance in the case of ADAS technology will help the industry to develop this technology further in order to better meet customer needs.

Interests of the Governmental Institutions

Generally, most governments follow the aim to increase road safety, which is often accompanied by initiatives to foster safety technology development and market penetration. In order to foster the market spread of ADAS technology, for instance, the European Commission has initiated the *eSafety* project, which is aimed at "accelerating the development, deployment and use of so-called 'intelligent integrated safety systems'" (Kosch et al., 2012, p.358). Based on this project, national level campaigns are initiated in order to increase awareness and acceptance of ADAS technology by end-users. The German branch of this campaign, which is called *Bester Beifahrer* ("best co-driver"), acts as a local level change agent and informs car customers about the potential benefits of modern driving-assistance systems. Similar initiatives can be found in many countries. Whether or not these initiatives will be successful in increasing the market share of ADAS is not yet known.

It is obvious that a profound understanding of the reasons and root causes for the acceptance of driver-assistance systems will help governmental institutions to develop more efficient and effective legislative action towards their ultimate goal to increase road safety. Consequently, governmental institutions are an important stakeholder in the present research project.

Summary

Table 2 gives an overview of the results of the stakeholder analysis of the present research.

Table 2: Stakeholder analysis	
Stakeholder	**Interest**
Academic Community	Advancement of behaviour model for innovation acceptance
Industry	Understanding the decisive factors which explain consumer acceptance or non-acceptance of ADAS technology, helping to better market this technology
Governmental Institutions	Understanding critical success factors for the acceptance of ADAS as a safety technology, helping legislation to foster the development towards safer road traffic

1.8 Thesis Structure

So far the research objectives, initial hypotheses and the research questions, together with identified gaps in knowledge, have been provided. This information outlines the main academic and personal influences that formed the basis of this research as well as the justification for undertaking this research.

The structure and content of this thesis begins with **Chapter 2**, which provides the key concepts about Advanced Driver-Assistance Systems. A basic understanding of the main functionalities and technological concepts is a prerequisite for understanding which advantages, but also which disadvantages or risks are related to this technology. The chapter is completed by outlining the current market situation for this technology in Europe as well as the legislative situation.

Chapter 3 outlines the key foundations, definitions and important terms related to innovation acceptance. The key concepts and models for innovation acceptance by relevant authors in the field are described in detail, but also evaluated critically. These psychological constructs form the underpinning theory and concepts upon which the rest of the research is based. By reviewing past empirical work, the author will derive potential acceptance constructs in different fields and will discuss their applicability in the case of ADAS.

Chapter 4 considers philosophical approaches, methodological choices and the most appropriate research design. The post-positivistic research philosophy as well as the triangulation of methods, combining qualitative and quantitative methodology, is justified.

Chapter 5 provides information about how qualitative research should be conducted in general and how in particular the interviews for the present research were designed and administered. The qualitative data analysis of the full interview transcripts is outlined in detail and the final findings are presented using a concept mapping approach.

Chapter 6 outlines the general concept of quantitative research and explains how the questionnaire is developed from the combined results of the qualitative phase and the literature review. The operationalisation of question items, as well

as the decision on the appropriate sample size and sampling method, is present-
ed in detail. Descriptive statistics of the survey results are provided, along with
tests of representativeness and normality. A correlation analysis is employed to
test for potential associations between variables. Next, the question items are
tested for group differences in order to identify significant differences based on
background variables, such as age or gender. Finally, a regression model is
fitted to the data, which forms the basis of the final conceptual model described
in the last chapter.

Chapter 7 provides a discussion of the findings and introduces the final concep-
tual model. Recommendations for each stakeholder group are proposed based on
the key findings. Finally the contributions to knowledge are illustrated in detail.

1.9 Chapter Conclusion

This chapter has provided an introduction to the research topic and a description
of the research aims and objectives. Together with the rationale and justification
of the research objectives, this chapter has laid out the foundation for the entire
thesis. The chapter concluded with a stakeholder analysis and a brief description
of the thesis structure.