Chapter 4: Research Approach

4.1 Chapter Objectives

The present chapter is aimed at specifying the methods and procedures for collecting and analysing data within the empirical part of the research project. In a first step, this chapter will discuss the author's philosophical approach towards the research questions. Based on the author's epistemology in alignment with the research problem, appropriate methodologies for data collection will be discussed. Finally, a research design will be proposed and justified, including multiple research steps and incorporating different methodological approaches.

4.2 Understanding Epistemological and Ontological Considerations

In order to investigate the reality of research problems, a philosophical approach for research has to be adopted. Different philosophies imply different ways of finding a solution to a theoretical problem. Applying different approaches to the solution of the same problem, however, might generate different results (Sattabusaya, 2008, p.88). In general one has to distinguish between the philosophy's ontology, meaning the theory of being, focusing on the beliefs about the real world which is being researched, and the epistemology, meaning the knowledge that is required and seen by the researcher (Alrafi, 2007, pp.101–102). The research methodology in this context refers to how we do logical and empirical work (Lee, 2004, p.5). It is often argued that research methods carry with them an inherent cluster of epistemological and ontological commitments, such that the decision for one research method inevitably selects a specific science model and worldview. Research methods, however, are versatile instruments and do not necessarily indicate an assumption about knowledge and the nature of social reality (Bryman and Bell, 2007, p.631). In contrast, it is more promising to define the epistemological and ontological positions as a starting point for making methodological decisions. According to Easterby-Smith, Thorpe & Jackson (2008, p.56), there are at least three reasons why an understanding of philosophical factors is a necessary prerequisite for defining an appropriate research design:

1) It helps to clarify what kind of evidence is required and how this evidence is to be gathered and interpreted in order to answer the research question.

2) It helps to recognise which research design will be most appropriate to answer the research questions and which limitations this design inherits.

3) It helps the researcher to identify or even create designs that are outside his or her past experience and to adopt these designs according to the constraints of different subject or knowledge structures.

The starting point for identifying a philosophical position is the researcher's ontology. Ontological views are mainly divided into two opposing schools of thought, which can be traced back to the philosophers Heraclitus and Parmenides. While the Heraclitean approach views the world as changing and emergent, Parmenides places an emphasis on a permanent and unchanging reality. Followers of Parmenides see reality as being composed of clearly formed entities with identifiable properties, which can be represented by signs and language. In contrast, Heracliteans place an emphasis on formlessness, interpenetration and the limitations of truth-seeking due to an ever-changing environment. The Parmenidean ontology of *being* clearly dominates in Western thought; however, recently, notions of an increased orientation towards a Heraclitean ontology of *becoming* are noticeable (Gray, 2011, p.7). Today, ontological schools of thought are usually divided into *realism* and *relativism*. Realism builds on Parmenides' thoughts and emphasises that the world is concrete, external and independent from scientists and their activities. Relativists, on the other hand, argue that the development of scientific laws is always influenced by the protagonists, their position and their resources, and thus the truth of scientific laws is never independent from the process of its discovery (Easterby-Smith, Thorpe and Jackson, 2008, p.61). Between these extreme positions, researchers have recently developed a new paradigm, the so-called *critical realism*. Critical realism can be seen as a compromise between both positions and claims that a reality can exist independently from our knowledge of it, but also recognises that concepts in social sciences are human constructions and are thus subjective (Bryman and Bell, 2007, p.62).

4.3 Major Philosophical Paradigms in Social Research

Epistemologies are general sets of assumptions about the most appropriate ways of generating knowledge about the nature of the world (Easterby-Smith, Thorpe and Jackson, 2008, p.62). It is obvious that epistemological decisions are gener-

ally, if implicitly, based on the worldview of the researcher, or in other words, on his or her ontological school of thought. Rooted in different worldviews, epistemological approaches also have two opposing extreme positions: *Positivism* and *Interpretivism* (Carson, 2001, p.5).

The positivistic research paradigm argues that the study of human behaviour should be conducted in the same way as studies are conducted in the natural sciences. It is based on the principle that reality is independent of the observer and exists regardless of whether one is aware of it. Thus the positivist takes a rational approach to understanding the world that is always external and objective (Sattabusaya, 2008, p.89). "Positivism holds that an accurate and value free knowledge of things is possible. It holds out the possibility that human beings, their actions and institutions can be studied as objectively as the natural world" (Fisher, p.19). In a positivist approach, the theory to be tested is generally deductive. Firstly hypotheses are developed by the researcher and then they are used to test the theory in order to prove it or dismiss it. In positivism, objective knowledge can be gained from direct experience or observation, the only available source of knowledge for science (Alrafi, 2007, p.122).

Interpretivists, on the other hand, believe that reality can only be discovered through an understanding of the multiple social constructs of meaning and knowledge. Interpretivism puts an emphasis on the belief that knowledge can only be gained through understanding the social construction of the world (Alrafi, 2007, p.123). According to Klein and Myers (Klein and Myers, 1999, p.69), research can be classified as interpretive if "it is assumed that our knowledge of reality is gained through social construction such as language, consciousness, shared meanings, documents and other artefacts". In interpretive research, the scientists do not predefine dependent and independent variables: instead, they focus on the complexity of human sense-making as the situation emerges and try to understand how people invent structures to explain phenomena around them (Easterby-Smith, Thorpe and Jackson, 2008, p.63).

Followers of both philosophies view their paradigms as the ideal approach for research. Over the last decades, however, a number of further paradigms have been developed, each situated between these two extreme positions. The most well known is the so called *Postpositivism*, which acknowledges that scientists

actively construct scientific knowledge rather than passively noting laws that are found in nature (Crotty, 2009, p.31). A further step towards interpretivism represents the school of *Critical Theorists / Critical Realists*, which emphasises the understanding of the (objective) world through subjective meanings. Table 9 shows the major philosophical paradigms in social research and their associated ontology, epistemology and methodologies.

Table 9: Major philosophical paradigms in social research, Source: Based on Guba and Lincoln (2009, p.193)				
	Positivism	**Post-Positivism**	**Critical Theory**	**Interpretivism**
Ontology	Naïve realism – "real" reality	Critical realism – "real" reality but only imperfectly	Historical realism – reality is virtual and shaped by society	Relativism – local and specific constructed reality
Epistemology	Objectivist: findings are true	Modified objectivist, critical tradition – findings probably true	Subjectivist – value-mediated findings	Subjectivist – created findings
Methodology	Experimental/ manipulative: verification of hypotheses, mainly quantitative methods	Experimental/ manipulative – critical multiplism, falsification of hypotheses, may include qualitative methods	Dialogic/dialectical	Hermeneutical/dialectical

According to Easterby-Smith, Thorpe & Jackson (2008, p.71), the major strength of the positivist paradigm is that it generally provides a fast and economical method for generating evidence in a wide range of situations. At the same time, the positivistic approach suffers from inflexibility and has been found to be "not very effective in understanding processes or the significance that people attach to actions"(Easterby-Smith, Thorpe and Jackson, 2008, p.71). Since positivists usually focus their approach on empirical data, there is a risk of ignoring important nuances and/or explanations that lie outside of the conceptual framework being employed (Neergaard and Ulhøi, 2007, p.105). Postpositivism emerged as a reaction to these disadvantages, while still putting an emphasis on the importance of empirical, thus "value-free", data for problem solving

(McNabb, 2010, p.19). This rather new approach links the observer to that being observed, acknowledging that there are no objective things standing apart from human subjectivity. Objectivity is seen as an ideal by Postpositivists; however, given the multiplicity of causes and effects and the problem of social meaning, it requires a critical community of interpreters to arrive at a most objective interpretation of reality (Yolles, 2006, p.74). This worldview also has methodological implications. When objectivity can never be entirely achieved, relying on many divergent sources of information decreases the potential to arrive at misinterpretations of reality (Guba, 1990, p.21). It needs to be acknowledge that there are no right/ wrong or better/worse paradigms. However, since these philosophical paradigms are incommensurable and widely incompatible, it is important to clearly state which school of thought underlies the reasoning of one's scientific work (Okasha, 2002).

4.4 Justification of Postpositivistic Research Approach

As outlined in the previous chapter, the researcher's decision on the evidence needed to solve a particular research question inevitably carries along a certain set of philosophical assumptions. While the author beliefs in the existence of a reality which is concrete, external and independent from the observer, the author also acknowledges that reality can never be fully known, since the efforts to understand reality are limited by human beings' sensory and intellectual limitations.

Recalling the research objectives of the present research, it is the central aim of this thesis to develop an understanding of which psychological factors influence the decision-making towards the acceptance of driver-assistance systems. The author beliefs that there is no single and thus entirely objective answer to this question, since both, the individual decision-making of consumers, as well as researcher's interpretation of it is based on human subjectivity. The knowledge that will be developed throughout this thesis is consequently a human construct and generally based on observations and perceptions. Because perception and observation are fallible, the researcher's constructions are generally imperfect which may affect the neutrality of this work. The author, however, strongly believes that it is the responsibility of the researcher to put aside personal biases and beliefs and strive to be objective, neutral and ensure that the findings fit with the existing knowledge base. The best approach for achieving objectivity is to triangulate across multiple fallible perspectives in order to derive a combined,

thus less biased perspective on the research question. Transferred to the research questions this means that the author will develop different measurements of the psychological constructs involved in the acceptance of driver-assistance systems. Since all measurements are fallible, multiple measures and observations, which may possess different types of error, will reduce the overall error of measurement and thus deliver a more objective and neutral result.

In regard to the discussion of philosophical paradigms outlined in the previous chapter, this research position can be best described as following the post-positivist paradigm. As noted before, this also causes several methodological implications, which will be discussed in the next step.

4.5 Methodological Considerations

After determining the philosophical approach, the next step is to identify the appropriate methodologies that will be employed in order to answer the research questions. Methodology can be defined as "the logic of the application of scientific methods for investigation of phenomena" (Mouton and Marais, 1988, p.16). There are various classifications of methodologies; the most common, however, is the distinction into quantitative and qualitative methodologies (Bryman, 2006b, p.1). Quantitative methodology is usually associated with inferences based on large numbers of dataset observations and statistical analysis, while qualitative methodology bases inferences on relatively few datasets and puts an emphasis on causal-process observations (Gerring, 2012, p.362). Both methodological approaches will be discussed in more detail in the next step.

4.6 Quantitative Research in Social Science

Quantitative research is generally associated with applying methods and procedures of the natural sciences to the social sciences. The main idea is that there are regular patterns in human and organisational behaviour, but these are difficult to detect because of the number of factors and variables which might produce the observed result. Consequently, multiple factors need to be measured simultaneously to examine the potential underlying relationships. Since this process involves making approximations of reality, relatively large samples are usually required (Easterby-Smith, Thorpe and Jackson, 2008, p.90).

Even though the quantitative approach can be associated with a number of different data collection methods, the main methods of data collection, which are also used as a classification for this research approach, are surveys and experi-

ments. Due to the need for large sample sizes in sociology, the survey has emerged as the most popular method of data collection in this research field (Bryman, 2006b, p.11).

Addressing a research problem with quantitative methods usually means generating hypotheses that derive from general theories about the research object. These hypotheses are expectations about potential causal relationships between psychological concepts, whereby their degrees of variation and co-variation maybe measured (Bryman, 2006b, p.18). Consequently,quantitative methods require the use of standardised measures to fit the divergent views of people into a limited number of predetermined response categories to which numbers are assigned (Patton, 2005, p.46). Usually this is accomplished by conducting a survey, based on a questionnaire with a number of multiple-choice questions, each asking the respondent to choose an answer on a fixed-point scale.

The review of existing innovation acceptance studies has revealed that surveys were used in most of the cases as exclusive research methods (see Table 7). All of these studies applied standardised quantitative models (e.g. the TRA/TPB model) for predicting the acceptance of technological innovations. In accordance with this, the present research will employ a survey method to develop a quantitative model of acceptance behaviour.

4.7 Qualitative Research in Social Science

Qualitative research mainly originated from the intellectual field of sociology, "a science which attempts the interpretive understanding of social action in order to arrive at a causal explanation of its course and effects" (Weber, 1947, p.90, quoted in Bryman, 2006b, p.57). Qualitative research has become a fashionable term, being used for any method other than a survey. The main distinction of qualitative research, in contrast to quantitative research, however, is that it produces data that are freely defined by the subject rather than structured in advance by the researcher (Dey, 1998, p.15). While quantitative methods reduce data to scales and numbers, qualitative methodologies allow for an interpretation of the rich and complex reality of the world (Mayring, 2002a, p.10).

A fundamental characteristic of qualitative research is its approach to view actions from the perspective of the people who are being studied. This implies that

the researcher has to develop a sound understanding of his target population, usually achieved by persistent participant observation. Yet, other methods, most importantly in-depth, unstructured interviews and group discussion, also proved to be successful in generating the necessary empathy to see the world through the eyes of those being studied (Bryman, 2006b, pp.61–62).

Since this study is aimed at uncovering the beliefs that lead to technology adoption or rejection, direct observation is not feasible. Even if the observer would be present at the point of sale, he or she would not be able to draw any conclusion on action motives from observation alone. Neither focus groups nor any other sort of group discussion are particular useful in this context, since those methods tend to reveal the salient beliefs of dominant individuals that lead the discussion and might therefore give a biased view of the readily accessible beliefs represented in a population (Fishbein and Ajzen, 2010, p.103).

Personal interviews, finally, enable the researcher to elicit personal motivations, attitudes and beliefs pertaining to a particular topic (Flick, 2010, p.156). The strengths of interviews as a qualitative research method fit with the research objectives stated. Consequently the author decided to use in-depth personal interviews as a qualitative research method for the present study.

4.8 Mixed Methods Approaches

In a purist's view, qualitative and quantitative research methods, including their associated methods, cannot and should not be mixed. Over the last decades, however, support for a mixed method approach to research has emerged, and can now be considered as a paradigm in its own right (Johnson and Onwuegbuzie, 2004, p.14). This new paradigm recognises that both qualitative and quantitative methods offer different strengths and weaknesses. Both methods constitute alternative, but not necessarily mutually exclusive, strategies for research. A mixed methods approach thus could "bridge the schism between quantitative and qualitative research" (Johnson and Onwuegbuzie, 2004, p.15) and lead to an advancement in science (Sattabusaya, 2008, p.91). At the same time, however, criticism of the mixing of methods has emerged. The main arguments against mixed methods are that research methods inevitably carry epistemological commitments which are often incompatible and that qualitative and quantitative research are two distinct paradigms on their own (Bryman and Bell, 2007, p.643). While this apparent conflict is not yet completely resolved, there is common agreement that the purpose of mixing different methodologies must be

made clear by the researcher, as well as the intended process of combining different approaches (Bryman, 2007, p.8).

In principle, there are various ways of combining divergent methodological approaches and it is important to acknowledge that there is no one mixed methods methodology (Bazeley, 2002, p.2). One of the most common forms of mixed methods is triangulation. In social science, triangulation means the mixing of data or methods so that diverse viewpoints or standpoints cast light upon a topic. Triangulation can thus be defined as "an approach in which multiple observers, theoretical perspectives, sources of data, and methodologies are combined" (Denzin, 1970, p.310, cited in Bryman, 2006b, p.131). The basic intent of triangulation is to use two or more aspects of research to strengthen the design and thus to increase the ability to interpret the findings (Thurmond, 2001, p.253). Mixing data types is often thought to help in validating the claims that might arise from an initial study, while the mixing of methods, e.g. mixing survey and interview methods, is a more profound form of triangulation. (Olsen, 2004, p.3).

One idea of triangulation is to employ more than one method of investigation, for instance quantitative and qualitative research methods. Generally, quantitative and qualitative research may be perceived as different ways of examining the same research problem (Bryman, 2006b, p.131). Thus, a combination of both promises a better understanding due to the different perspectives on the research problem. Next to the methods triangulation, researchers can also combine more than one type of data or more than one type of data analysis technique. Table 10 gives an overview of the different triangulation methods and their characteristics.

Table 10: Types of triangulation, Source: based on Thurmond (2001, p.253)

Triangulation Type	Characteristic	Example
Data Source Triangulation	Data sources for investigation vary based on time, space or person	Repeat a survey in different locations
Investigator Triangulation	Using more than one observer, interviewer, coder or data analyst	Using two different researchers analysing the same data set
Methods Triangulation (within-method)	More than one data collection procedures from the same design approach	Using a survey and secondary data for quantitative analysis
Methods Triangulation (between- or across-method)	Employing both qualitative and quantitative data collection methods	Using interviews and a survey
Data-Analysis Triangulation	Combination of two or more methods of analysing data	Using different statistical-techniques to determine similarities or validate data

Next to triangulation, mixed methods can also be applied for explanation. This means that one method is used to explain the findings resulting from another. The reciprocal of this is exploration. This means that one method is used to identify units of research, which are investigated with a second method (Bryman, 2006a, p.98).

So far, most studies in the context of innovation acceptance literature apply a rather positivistic approach, eliciting dependent and independent variables by employing questionnaire-based empirical research. Recently, however, studies applying a mixed method approach have increased in number (Lee, Kozar and Larsen, 2003, p.753). Many of these studies reported that applying this paradigm helped them to gain a deeper insight and a better understanding of behaviour than either paradigm could have provided separately (Hwa, 2006, p.129). This idea is also increasingly supported by behavioural theorists. In one of their latest publications, Ajzen & Fishbein (2010) recommended basing the application of their model on extensive formative research, applying free-response

interviews to elicit salient beliefs and thus employing a mixed methods approach towards the exploration of innovation acceptance. In correspondence to these findings, this study will be incorporating the strengths of both methodological approaches by applying a methods triangulation of qualitative and quantitative methodologies.

4.9 Defining a Research Design

A research design is defined as "... a set of advance decisions that makes up the master plan specifying the methods and procedures for collecting and analyzing the needed information"(Burns and Bush, 2002, p.120). Primarily, a research design helps to align the planned methodology to the research problems in accordance with the research philosophy chosen for a given study (Sattabusaya, 2008, p.93). Thus, it can be seen as a detailed construction plan used to guide a research study towards its objectives. The most crucial decision in creating this plan is the choice of an appropriate research approach, since this determines how the information will be obtained (Kumar, Aaker and Day, 2002, p.67). As discussed in the previous chapters, the choice of a research approach depends widely on the nature of the research and the philosophical approach towards problem solving. This includes not only the choice of specific data collection methods but also the data analysis, research tactics and most importantly the continuous safeguarding that all pieces of the research fit together and deliver what should be delivered according to the research objectives (Kumar, Aaker and Day, 2002, p.67). Robson (2009, p.81) argues that all aspects of research design are interrelated and thus should be kept balanced to ensure that the interaction of different methods and approaches will support the research objectives.

In order to develop the most appropriate research design for the present research objectives, different aspects have to be considered. In accordance with the research philosophy stated in the previous chapter, the author will follow a post-positivistic approach, which aims at complete objectivity but acknowledges that psychological constructs are based on human subjectivity. Qualitative research methods offer a deep understanding of individuals' beliefs, but have the disadvantage that they are usually limited to a non-representative sample and thus increased subjectivity. This means that the findings cannot be generalised for the chosen population. Quantitative methods, on the other hand, have the advantage of a huge sample size, which comes at the cost of reducing individual

beliefs to predefined answer sets. As a consequence of this, and in alignment with the research philosophy, a methods triangulation of quantitative and qualitative research methods will be necessary to approach the research problem in the most appropriate way.

It is important to acknowledge, however, that even though quantitative and qualitative methods may provide mutually reinforcing results, the possibility of discrepant findings also exists. (Bryman, 2006b, p.133). Generally, discrepancies are not a sign of a flawed research design, but instead can be beneficial in their own right. Investigating the differences in the results may lead the researcher to probe certain issues in greater depth, which may lead to fruitful areas of inquiry in their own right (Bryman, 2006b, p.133). For the present research, triangulation will lead to a multi-stage process in which data from secondary research and qualitative research will build the foundation for a standardised, quantitative research. This approach diminishes differences between the data sets, since the quantitative stage can only produce data within the merits of the results from the qualitative stage. Yet, initial results or hypotheses from the qualitative stage might be refuted due the analysis of the quantitative data.

The decision on a mixed-methods approach raises further important methodological issues. The first question to be addressed is the process of combining methods and thus in the present case whether quantitative and qualitative data will be collected simultaneously or sequentially. Second, the question of focus arises. Robson (2006b, p.128) remarks that even though methods triangulation means giving quantitative and qualitative methods comparable weight, most researchers rely mostly on one approach, but support their findings with a method using the other approach. Third, and probably most important, is the question of which function the mixing of methods has in the research progress – triangulation, exploration or explanation (Bryman, 2006a, p.98). The approach of the present research towards these key questions is summarized in Table 11.

Table 11: Decisions on the mixed-methods approach	
Key questions of mixing methods	**Research decision**
Are qualitative and quantitative data collected simultaneously or sequentially?	Qualitative data will be collected before quantitative data. Thus a sequential mixed-methods approach will be employed.
Which method has priority?	In the case of discrepancies in findings, only findings that were confirmed by the quantitative stage will be accepted as real; thus, the quantitative stage has a priority function.
What is the function of the integration of methods?	The qualitative research phase will have both an explorative function, supporting the development of the quantitative research instruments, and an explanatory function, helping to interpret the results of the quantitative research instrument.

To conclude, the basic research design will include three steps. In the first step the literature review will deliver the basic psychological and behavioural models as well as potential determinants of innovation acceptance from previous studies in different technological contexts. In the second step qualitative interviews will be employed to elicit individual beliefs that are related to the acceptance of ADAS. These determinants will be matched against the determinants that evolved from the literature review.

The resulting list of potential determinants of innovation acceptance will constitute the main content of the questionnaire. For each construct, a set of items will be developed based on the interview results and the literature review of comparable questionnaire formulations. Finally, scales will be developed for each item and the questionnaire will be administered to a small sample for a pre-test. After necessary corrections, the final questionnaire will be administrated to a representative sample of potential car customers in Germany. The resulting data will be analysed using statistical methods. Finally, the quantitative results will be interpreted by integrating the findings from the qualitative stage. Chart 21 gives an overview of the intended research process.
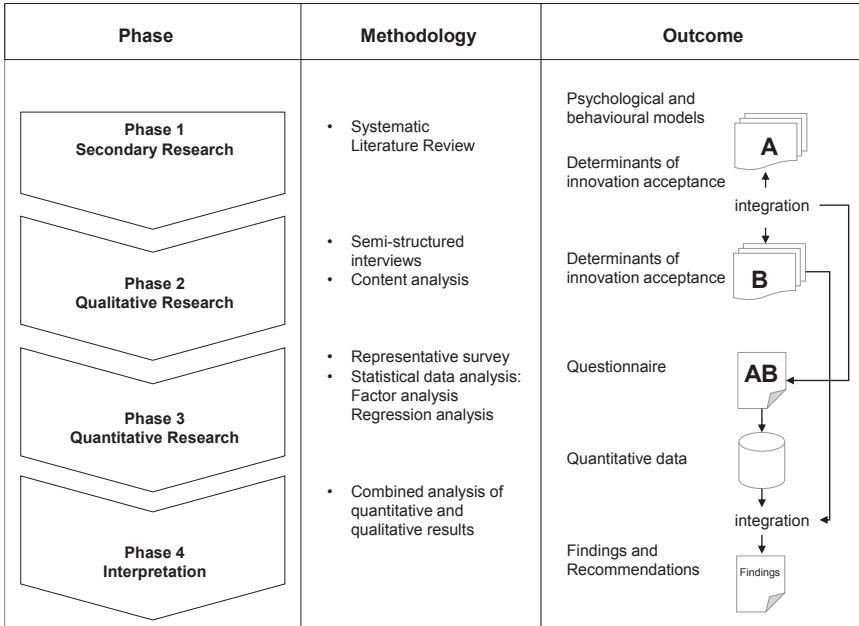
Phase	Methodology	Outcome
Phase 1 **Secondary Research**	• Systematic Literature Review	Psychological and behavioural models Determinants of innovation acceptance
Phase 2 **Qualitative Research**	• Semi-structured interviews • Content analysis	Determinants of innovation acceptance
Phase 3 **Quantitative Research**	• Representative survey • Statistical data analysis: Factor analysis Regression analysis	Questionnaire Quantitative data
Phase 4 **Interpretation**	• Combined analysis of quantitative and qualitative results	Findings and Recommendations

Chart 21: Intended research process, Source: Own drawing

4.10 Chapter Conclusion

The aim of the present chapter was to develop a well-defined research process for collecting empirical data. Starting with a discussion of different philosophical viewpoints, the author's postpositivistic epistemological position was acknowledged and justified based on the research questions of the present thesis. The author discussed the differences between quantitative and qualitative methods as well the current developments towards a mixed-methods paradigm. By sequentially aligning qualitative and quantitative methods in a mixed-methods approach, the proposed research design of the present thesis will integrate the results of both methods in two ways. First, the qualitative phase will provide an explorative approach to the subjective belief sets of individuals in the case of ADAS acceptance, supporting the development of a quantitative questionnaire in the next step. Second, the results from the qualitative stage will be used to interpret findings from the questionnaire data, and consequently also have an explanatory function. In sum, the presented research design provides a strong methodological foundation and a detailed guideline for the remainder of the present research and thus fulfils the objectives of the present chapter.