

Smartphone Integration in the Car IT:
User Acceptance of Phone-Centric Car Connectivity Solutions

Masterarbeit

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TABLE OF CONTENTS

| | |
|---|-----------------|
| Abbildungs-/ Tabellenverzeichnis | Seite II |
| Abkürzungsverzeichnis | III |
| 1. Introduction | 1 |
| 2. Background..... | 4 |
| 2.1. Telematics | 5 |
| 2.2. Advanced Driver Assistance Systems (ADAS) & In-Car Infotainment Systems (CIS) | 6 |
| 2.3. Integration of smartphones and apps in the Car-IT | 8 |
| 2.4. Mobile operating Systems | 10 |
| 2.2.1. Android..... | 11 |
| 2.2.2. iOS | 12 |
| 2.5. Security Issues and Legislation..... | 13 |
| 2.6. Driver Acceptance of new Infotainment Systems | 14 |
| 3. Literature Review | 18 |
| 3.1. Evaluation of the Economic Importance | 18 |
| 3.2. Research Findings..... | 19 |
| 4. Investigating Users' Acceptance of Phone-Centric Car Connectivity Solutions and Hypothesis Generation | 23 |
| 4.1. Analyzing the initial Situation | 23 |
| 4.2. Theories of relevant Acceptance Research | 24 |
| 4.3. Deriving of the Reference Framework | 28 |
| 4.3.1. Perceived Usefulness (PU) respectively Performance Expectancy | 28 |
| 4.3.2. Perceived Ease of Use (PEU) respectively Effort Expectancy (EE) | 28 |
| 4.3.3. Task-Technology Fit (TTF) | 29 |
| 4.3.4. Self-Efficacy (SE) | 30 |
| 4.3.5. Perceived Driving Safety (PDS) | 31 |
| 4.3.6. Compatibility (COMP) | 31 |
| 4.3.7. Subjective Norm and Image respectively Social Influence (SI) | 31 |
| 4.3.8. Attitude | 32 |
| 4.3.9. Behavioral Intention (BI) | 32 |
| 4.3.10. Excluded Items..... | 33 |
| 4.4. Reference Framework..... | 35 |

| | | |
|-----------|--|---|
| 5. | Research Design and Methodology | 36 |
| 5.1. | The Survey Instrument | 36 |
| 5.2. | The Design of the Questionnaire | 37 |
| 5.3. | Simulation Environment..... | 38 |
| 5.4. | Survey Design | 38 |
| 5.5. | Data Analysis and Results..... | Fehler! Textmarke nicht definiert. |
| 5.5.1. | Presentation of the methods of analysis with SPSS and smartPLS | 40 |
| 6. | Discussion and Recommendations | 46 |
| 7. | Implications for Research and Practice | Fehler! Textmarke nicht definiert. |
| | Literaturverzeichnis | 48 |
| | Appendix..... | 1 |

TABLE OF FIGURES

Seite

| | |
|-----------------------------------|---|
| Figure 1: The Connected Car | 4 |
|-----------------------------------|---|

1. Introduction

The innovation in the automobile industry is driven by electronic developments. Scenarios of connected and automated vehicles which are known from science fiction movies are no longer just futuristic visions¹. The high-tech revolution made it already into the vehicles cockpit. While a decade ago, infotainment meant only radio, today's consumers are spoiled from the electronics industry and have completely new possibilities. With the internet, new opportunities for innovative technologies and companies have arisen. Buzzwords such as internet of things and services (IoT) and connectivity are dominating the market. In this context smartphones and cars will stand out in the next few years.

Smartphones have become a part of human's everyday life. Among other computing devices, they have an important role in business, education and personal life. These technologies offer easy and fast management and access to information and communication (Choudrie, et al., 2014, p. 1). Smartphones also impacted the field of entertainment and journalism (The Denver Post, 2012). These are a few reasons why consumers are more and more tending to have a mobile-centric lifestyle. According to a Bitkom-statistic more than 55 % of the German population older than fourteen years uses smartphones (Bitkom, 2014, p. 1). The marketing agency Tecmark (2014) found out, that an average user is checking up his or her smartphone more than 200 times a day.

For everything there is a season and now smartphones even made it into the cars cockpit – behind the steering wheel. They are used for texting messages, checking emails or making phone calls while driving (Basacik, et al., 2011, p. 2). And windshield mounted contemporary smartphones used for navigation are slowly replacing traditional navigation systems (Händel, et al., 2014). But using a smartphone in a car leads to a distraction and thus to “[...] a detriment in driving performance” (Basacik, et al., 2011, p. 2ff). In some regions more than a quarter of car accidents are caused by driver distraction through smartphones (Governors Highway Safety Association, no date, p. 16) . To cope with the phone-centric lifestyle of consumers, the auto maker and their suppliers developed different solutions. But traditional in-car infotainment systems (CIS) which are supporting the

¹ e.g. The 6th Day, The Dark Knight or Minority Report

driving behavior with information while entertaining the driver can only satisfy the customers' needs for a certain time. This is because "[...] they are usually not designed to be updated or replaced during the whole life of the vehicle, which leads to unsatisfied users" (Tornell, et al., 2015). This life cycle gap respectively convergence between automotive and consumer electronics is an important factor to meet the demands of today's customers. These demands are affected by the electronics industry, where technologies change in a six month life cycle (Scoltock, 2014) and where consumers want new devices every couple of years (Gitlin, 2014). This megatrend that the automotive industry as well as the smartphone industry has to cope with is not only seen as a thread; it is also seen as an opportunity for a better and safer driving experience, allowing diversifying everyone's business-models² (JUNIPER RESEARCH, 2014). "The challenge is to create a smart in-car infotainment system that can stay up to date even as your car ages" (Rivington & Swider, 2014, p. 1). Several companies therefore started developing solutions to connect smartphones with the CIS. These disruptive innovations which will come in 2015 in new vehicles are among others CarPlay, MirrorLink, and Android Auto. They are called Phone-Centric Car Connectivity Solutions (PCCS) (BusinessWire, 2015). In contrast to the integrated CIS, which couldn't be updated so easily, these so called 'bring-your-own-device' solutions (BYOD) are constantly updated by the operating system provider. The CIS main function here is to *mirror* some special selected applications (Apps) from the smartphone into the cars dashboard. In designing this new BYOD environment, it will be important to consider the human factor, so that the new system will be created from a driver-centered perspective (Regan, et al., 2014, p. 4). For researchers as well as practitioners it is of high interest to see why users accept or reject new systems. Measurement models can help to identify important indicators to measure the acceptance and to avoid system rejection by the users (Meschtscherjakov, et al., 2009, p. 81). For example, Apple was not the first company which introduced a smartphone on the market, but with the iPhone, the revolution of the smartphones has begun (The Denver Post, 2012).

² Location Based- or Value-added services. A location based service provides services based on the user's geographical location. It is possible to classify LBSs based on the target market: business-to-customer (B2C) and business-tobusiness (B2B), the service type: infotainment, navigation, information provision, games, emergency response, supply chain management and tracking (Andreev, et al., 2012)

The research goal of this thesis is to investigate the users' acceptance of two alternative phone-centric car connectivity solutions, which are CarPlay and MirrorLink. The study will provide an understanding into identifying constructs which affect the decisions of people to accept and adopt PCCS by using a mixture of diverse acceptance models as the theoretical model. Hereby two questions should be answered:

- a.) To what extent are CarPlay and MirrorLink accepted by the iOS and Android user?
- b.) How does the acceptance of iOS and Android User differ?

The present thesis is divided in 8 chapters. Following this introduction, the second chapter of this paper will present background information to get a better insight in the topic. In chapter 3 a literature review was done to see the current state of the research. Here, the focus lies on the current research literature with regard to acceptance studies of smartphones and in-vehicle-infotainment systems. This was done due to the fact, that literature made directly in the field of Phone-Centric Car Connectivity Solutions is rare. In chapter 4 the reference framework for the empirical investigation will be derived. Therefore all relevant concepts found in the literature review are first presented. This is the base I will use to derive the framework model and the Hypothesis. In chapter 5 I will present the methodology of how the investigation was carried out and introduce the results. Chapter 6 demonstrates the findings in a comprehended view and based on them will give implications for further research and for the practice. The conclusion will be following in Chapter 7.

H9: SI is positively related to Attitude.

This construct is insignificant in all groups. Thus H9 cannot be confirmed.

H10: SI is positively related to BI.

With a $\beta_{(\text{Android})}=0.192$ and $\beta_{(\text{iOS})}=0.310$ both constructs are significant. An irritating result shows $\beta_{(\text{All})}=0.688$ and not significant. (This could be an smartPLS problem, but after many many trials the same result was shown). However, from these results, H10 cannot be confirmed.

H11: Attitude is positively related to BI.

With a $\beta_{(\text{Android})}=0.430$ and $\beta_{(\text{iOS})}=0.074$ and $\beta_{(\text{All})}=0.379$ they also show a high significance. This indicates, that a higher Attitude induce a higher behavioral intention to use PCCS.

In the end 7 out of 11 Hypothesis could be confirmed.

6. Discussion and Implications for Research and Practice

In this thesis the acceptance of users toward PCCS was investigated. In the research it was revealed that little research has been done in the field of in-car infotainment system and no research was done in the PCCS field. It was also illustrated that there are a lot of possibilities to measure acceptance with different kinds of Acceptance model. In the end a construct was created that attempted to measure the acceptance of individuals based on UTAUT and other models. It could be seen that the results hadn't have the deired effect as some hypothesis couldn't be approved. The biggest problem seemed to be that the users of different smartphones have really different behavior in consumption. For research it implies that new model have to be developed that distinguishes between those different target groups. Hence it is not the technology that determines the BI, it could also be the surroundings, ethics and other factors. In practice, such as automotive and electronics industry, new market research methods have to develop. In particular for those companies who are trying to tell us, that Apple, Google and Co. are no thread for them.

The reactions of the participants suggest that it would not make a difference if we would also use Android Auto for the Android users. The reaction was not about comparisons between apple and android. It was a reaction about the new technology that was introduced. Due to security and an overload of technologies which makes them feel uncomfortable; a new construct is necessary, which is measuring the behavior during the tests. One Problem could be that nowadays nearly every day, newspaper shows information about data privacy, thus the participants were very confused. On the one hand they liked both of the systems; on the other hand many asked why such a system is necessary because they can just use their smartphone as an infotainment system. While all of the participants used a smartphone, they did care about the data privacy and another technology which they thought would “catch their minds”

7. Conclusion

The results implicated that usual Acceptance Models are not enough anymore. If we presume that the participants of User Evaluations are distorted in their minds, because of data security and an overload of technologies which makes them feel uncomfortable, a new construct is necessary, which is measuring the behavior during the tests. Either it should be like in the driving school where the learner is being taught not to drive while he is angry or distorted – that means if he is in such a state about the new technology, he or she should not participate in the survey - , or a measurement model is needed where participants with different affections and preferences must have different weightings of their answers. (Adell, et al. 2014)

User experience is mostly common to research field in technology. To improve technology acceptance models, more UX models have to be included in this field (Hassenzahl & Tractinsky, 2006). Acceptance depends on a usable design of the system as well. Usability issues include ease of system use, ease of learning, perceived value, advocacy of the system or willingness to endorse, as well as driving performance. Cars will still be the dominant form of transportation for individual passengers. But the strongest regions for growth will come from emerging markets, including China, India, and Russia. the cultural factors have to be included as well.