WHO IS READY FOR AUTONOMOUS VEHICLES? – ANALYSIS OF CONSUMER ACCEPTANCE OFSELF-DRIVING CARS IN DIFFERENT EUROPEAN REGIONS[1]

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Introduction

Automotive companies, such as Mercedes-Benzand BMW, are fighting to become the first car manufacturer to bring autonomous passenger vehicles on the market(Mercedes-Benz, 2017)(Nica, 2016). But not only traditional car manufacturers have realised the impactof the disruptive technology, ranging from reputation to maintaining future market share, alsonew companies, such as Tesla, as wellas companies originally within the technology industry such asWaymo(Waymo, 2017), have entered the race. But, while having a fully functioning autonomous vehicle on the road is a key step towards integrating autonomous vehicles in society, if future consumers do not accept and adapt the technology, it will not reach its full disruption potential.

Recent studies have found that autonomous vehicle acceptance has declined over the past few years (Cox Automotive, 2016)(American Automotive Association, 2018). Aspects, such as trust in the safety of autonomous vehicles, have declined. Considering the benefits autonomous vehicles can bring its users, such as being able to use commuting time to work, the key question that arises from this is how rational are humans'thoughts and attitudes towards autonomous vehicles. The two topics addressed in this paper focus on the influence of household income on autonomous vehicle acceptance, as well as a difference in acceptance between the strong-technologically influenced Scandinavian area, in comparison to Southern European countries. Overall, these findings are part of a larger study conducted across Europe, and further parts of the world. Strong influences on the acceptance of autonomous vehicles must be found through the application of the Risk Integrated Technology Acceptance Model (RITAM) on driverless vehicles, to enable the technology to expand fully.

Literature Review

Technology Acceptance Model

The Technology Acceptance Model (TAM) was created in 1989 by Fred D. Davis. It is a practical approach to the acceptance of a technology, and has been used for a variety of technology studies such as, e-commerce systems (Jarvenpaa, Tractinsky, & Vitale, 2000). A technology is accepted, ifit is user-friendly (Perceived Ease of Use) and if it is actually seen as useful to the user (Perceived Usefulness) (Davis, 1989).However, Davis also criticizes his initial model; only if both factors apply, the technology is accepted. Further, Davis believes that intrinsic values are key to accepting a technology, and adapts these in further versions of the TAM model, TAM2 (Venkatesh & Davis, 2000) and UTAUT (Venkatesh, Davis, Davis, & Morris, 2003). Tianyi Pan also believes that people are focused on their own believes. Even if a technology is useful and easy to use, people would fall back on their own opinions towards it(Pan, 2011). Thus, a broader TAM must me created, to get a full understand of the (potentially irrational) consumer believes.

As previously mentioned, in combination with recent accidents involving Level 2 to Level 3 autonomous vehicles, acceptance of self-driving cars has declined (Cox Automotive, 2016). Perceived risks related to autonomous vehicles should be thoroughly considered to get a better understanding of consumer

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acceptance. Gary Mortimer's *Determining The Drivers Of M-Banking Adoption: A Cross Cultural Study*, is one of the more recent studies focusing on Perceived Risk in the TAM model.The higher the Perceived Risk of a studied technology, the lower the intention of using it, showing that Perceived Risk has a negative influence on acceptance. (Mortimer, 2015)(Lai & Zainal, 2015)

Income Influence

In 2017 the average price for a new car purchased in Norway was 47,276€.Spaniards on the other hand spent 26,061€ on average on their new car. (Statista, 2018)The starting price for a BMW i3 electric car of 38,000€(BMW, 2019) is thus higher than what Spaniards have spent on their car on average, but well within reach of Norway's car spending behaviour. Scandinavian nations are among the four highest ranking countries in terms of average wage, with Denmark leading the way in 2017 with an average of 3,095€ monthly income. Italy, Spain, Portugal and Greece rank on places 12, 13, 17 and 18, with Greece's average wage being less than a third of Denmark's. (Fischer, 2018)With the higher proportion of technology installed in autonomous cars, they are most likely going to be more expensive than an electric car currently is priced at. It thus seems logical, that those with a higher income plus higher average car spending behaviourmay be more accepting of such a high price tag and thus technology, as their financial circumstances may allow them to purchase a more expensive car more easily.

Based on this, the following hypothesis is assessed:

H1: Household income level has an influence on Behavioural Intention.

Technology Background

Scandinavian countries have a long list of technology companies with a high global success rate. This includes telecommunication giants Ericsson and Nokia, and the streaming service Spotify.(Davidson, 2015)Stockholm, has "produced more unicorns per capita than any other city in the world" and 15% of the total foreign direct investment placed in the European Union has gone to this capital city (Mizner, 2016). Scandinavian nations have been influenced by its technologically-influenced history. Due to the technology environment, it is possible that Scandinavian countries, in comparison to other European areas, in this particular case Southern Europe, has a higher preparedness and willingness to accepting autonomous vehicles. This idea is further supported by Helsinki often being considered as the first city to have a large Mobility-as-a-Service (MaaS) offering (Köllinger, 2018).

Therefore, the following hypothesis is proposed:

H2: Scandinavian Europe has a higher acceptance rate of autonomous vehicles compared to Southern Europe.

Methodology

The focus of this study is to identify which factors truly influence acceptance, and to find solutions to best handle the acceptance of autonomous vehicles.The original Technology Acceptance Model (TAM) was extended to RITAM (Risk Integrated TAM), to assess whether risks influence the acceptance of driverless cars.

Questionnaire Design

Questions to measure Perceived Ease of Use and Perceived Usefulness were taken from Davis' original study (Davis, 1989).

With a population of 742 million Europeans, a 99% confidence level as well as confidence interval of 5, the sample size was 666. This target was met, with a total of 1470 answered questionnaires. Out of this,

93 filled out questionnaires came from Scandinavian area, and 403 from Southern Europe. This rate of almost 1:5 reflects the actual distribution of Europeans across these two sectors.

The Perceived Risk questions were based on a few observations from the automotive industry. With the number of cars stolen increasing due to technologies interfering with electronic car keys(Fuest, 2016), and the high proportion of software in driverless cars, hacking (either stealing or causing an accident while a car is in use) could therefore become an issue. Furthermore, Steve Finlay argues that the more technology is built into cars, the higher the costs and repairs(Finlay, 2013). With the technological advances in the automotive industry, the safety aspect in five and in 15 years was assessed, to see whether participants believed that the safety measures and progress in the development of autonomous cars will improve over 10 years.

As previously addressed, Davis in his study criticised the lack of intrinsic motivation relevant for assessing user acceptance. He highlights that enjoyment plays a key role in "performing a behaviour"(Davis, 1989, p. 334). Thus, in this questionnaire, this intrinsic value was considered and participants were asked if they enjoy driving a car. However, it is essential to keep in mind that if drivers enjoy driving their own car, autonomous cars would take this joy ride away. David Santo in his article *Making the Autonomous Car a Reality: Getting Drivers Ready is Half the Battle* states that "the enjoyment that comes with the sense of empowerment of controlling a vehicle yourself is something that many drivers are not ready to renounce". Thus, enjoyment in this case should have a negative impact on behavioural intention. (Santo, 2017)

Lastly, the Behavioural Intention of participants was assessed by asking about their intention of replacing their current car with an autonomous car in the future, to assess their willingness to fully adopt the technology. Overall, a total of 27 questions and statements were assessed regarding the participants demographic information, such as gender, age group and level of education, as well as relevant statements regarding Perceived Ease of Use, Perceived Usefulness, Perceived Risks and Enjoyment, for the basic RITAM model.The questionnaire distribution took place viaEUSurvey and as in Davis' original model, all PU, PEOU and PR questions were measured on a Likert-scale from 1 to 5: 1=Strongly disagree, 2=Disagree, 3=Neither Agree, Nor Disagree, 4=Agree, 5=Strongly Agree. Scales were used to be able to successfully analyse the perceived factors and derive future intentions of accepting a driverless car.

Data Analysis

Due to the simplified RITAM model, a basic linear regression was used. Two models (one basic RITAM and one extended version) were set up and run for an independent assessment of the results of Scandinavian and Southern European countries. The aim was to predict the dependent variable (Behavioural Intention), based on different independent focal variables(PU, PEOU and PR, as well as Enjoyment). In Model II the control variables (age, gender etc.) were added to the list of independent variables, to see their influence on Behavioural Intention. Lastly, the results of the two regions were comparedto assess the outcome of the hypothesis set above.

Conclusion

Overall, autonomous cars have become a key focus of the automotive industry. Even the technology industry has entered the race to be the first sector (and company) to bring these machines on the road. However, it is not enough to have the possibility of using a self-driving vehicle, if we are not willing to accept it. With acceptance rates declining, possibly due to large amounts of negative press and little action taken to improve the acceptance of autonomous vehicles, industries must fully understand their future consumer to minimise long-term acceptance damage. In order to do so, two hypotheses were derived from a larger study focusing on acceptance of self-driving vehicles across the globe. The outcomes were assessed and discussed in the presentation connected to this paper. Necessary measures to be taken can be derived from RITAM surveys, such as subsidies to purchase autonomous vehicles offered tonations with

lower household incomes, if household income has an influence on the acceptance. Overall, it is key to understand that humans, especially when it comes to autonomous driving technology, are not acting rationally and to fully drive acceptance, actions from governments and industries must be taken to continuously improve the acceptance rate of the technology.

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