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Predicting Market Acceptance of Autonomous Vehicles

ABSTRACT

Nowadays we are facing a digital era submerse in technology. Information technology is embracing every industry, causing significant impacts and leading to considerable adaptations. The distribution industry is no exception. This study aims to collect evidence supporting that distribution channels are still not benefiting from information technologies entire potential. This research proposes to understand and analyse the factors that can influence customer mindset towards technology, either positively or negatively, helping to predict technology acceptance and use more accurately, specifically approaching autonomous vehicles, who promise to revolutionise distribution, particularly in terms of mobility. This research analyses autonomous vehicles growth and predict their impact in a global perspective and objectively in the distribution industry. An online survey was conducted, allowing the collection of most up-to-date information about distribution channels, in terms of efficiency and potentialities and concerns influencing the acceptance and use of this innovative technology.

Keywords: Distribution Channels; Technology; Acceptance and Use; Autonomous Vehicles

CONTEXT

Over the last two technology has been causing a relevant impact in many industries, in the up-rise and self-improvement of many industries, or in the development of new revolutionary industries, this digital age where we live in digital age has revolutionized many industries and the distribution industry is no exception.

Technology is changing people in many ways, from relationships, to attitudes, tastes and routines (Huang & Benyoucef, 2013). Human preferences and expectations will keep shifting proportionally to the technological advances, especially among the millennials generation, indicating that companies will need to be continuously aware of the technological improvements and the potential impact caused, even before the implementation of those technologies occur, in order to assure competitive advantage, by delivering customers what they want and keeping up their expectations.

Due to the high technological development across industries, new technologies can only be considered and implemented, when fully accepted by the final consumer. Therefore, their acceptance is a key factor for the success of new technologies, implying a deep knowledge of the consumer in order to meet their expectations and to ensure greater reliability regarding the social acceptance of these technologies.

Mobility is at the core of our society. Better and faster solutions allow for a greater potential market, a faster alignment of supply and demand, more specialization and higher productivity. Changing from muscle to steam to fuel powered transport was one of the major enablers of the industrialization and the explosion of global economic growth in the last two centuries, improving the life of billions of people.

Automation promises to overcome one of the last obstacles to nearly unlimited growth of mobility, which is the human driver. Even though humans are excellent drivers, they have to rest, make errors, and their time is expensive. Autonomous vehicles (AVs), or self-guided vehicles (SGVs), can drive without a human driver. AVs promises to make mobility cheaper than ever, significantly reducing distribution costs to a minimum, and minimize externalities per distance traveled, making mobility faster and safer. However, AV technology is still not globally consensual, as many concerns are still challenging AVs massive adoption, principally regarding to the assured safety of these vehicles.

Customer acceptance of AVs analysis is crucial, as most studies based on AV technology, focuses on technology development, revealing a gap in consumer acceptance of this potentially disruptive technology. Therefore, further research is required, in order to understand the acceptance and use of this technology, and integrate consumer insight into a field that has been guided, most exclusively, by technological insight. To incorporate AVs in planning and policy strategies, extensive knowledge is required about this innovative technology, in order to reliably predict AVs potential impacts on mobility and, consequently, on the distribution industry (Rosenzweig & Bartl, 2015).

The main objective of this study is to collect data that contributes for the incentive of technological improvements in distribution, with a specific approach towards AVs as a disruptive technology, while additionally alerting future studies, for the psychological constraints influencing AVs acceptance and adoption, particularly in the distribution industry. In this regard, specific insights were considered, which, aligned together, seek to answer the three research questions (RQs) of this study, formed under the purpose of contributing to the achievement of the general objective (Table 1 - Specific Goals and Research Questions).

LITERATURE REVIEW

Distribution Channels

Distribution channels have become the "underground" strategy in the B2B marketing portfolio, several times forgotten and almost seen as dispensable for numerous authors, mostly marketers, who inclusively do not give much thought to distribution strategy. This contempt towards distribution can be justified from the conceptualization of the term and how it is interpreted, being commonly reduced to the movement of a physical product from one place to another. Furthermore, in small and medium sized companies, the distribution strategies are exclusively assumed and discussed by the top of the hierarchy, consequently generating a knowledge gap in this matter, which makes rare to find new case studies and findings about innovative channel design and management.

Although, as many studies and researches prove, a well-planned, implemented and executed, distribution strategy can significantly boost the top line of a business, on the other hand, the opposite, can also be verified, as a poor management of a company distribution channels, can lead to considerable losses. For many B2B service firms, distribution channels are partially intangible and take creativity to apply (Galkin, 2015). For example, it is possible to create a private-label version of a service and offer it to large partners to offer to their customers, or instead create a packaged offering, joining forces with other companies, in order to offer a larger suite of services (Andrejić & Kilibarda, 2016).

Following the previous reasoning, it is always possible to improve distribution channels performance. Specifically in the Portuguese market, distribution channels are quite inefficient in terms of technological advances and mechanisms. In order to develop the current distribution channels, several changes must occur, while some involve avid investments, others can demand a cultural change or adaption. Companies must assure distribution strategies as a priority, devoting resources to channel management, building programs and relationships to drive revenue through the different channels, avoiding pricing conflicts and addressing conflicts swiftly. Developing measurements and track performance, keeping aware of the best sales performers and better understanding the efficiency and profitability of each channel (Galkin, 2015; Andrejić & Kilibarda, 2016; Fayaz & Azizinia, 2016).

Impact of Technology on Distribution, Benefits and Drawbacks

Nowadays, more than ever, technology has been making necessary for companies to be constantly aware of innovations, changes, or trends, than can be shaped every day. The ongoing globalization, alongside with the progresses in communication and marketing strategies, implied adaptations concerning distribution and Supply Chain Management (SCM). While this change was initially demanded in physical terms, now there is also a need to adapt to the information flows, as a better relation and response to the emerging technologic necessities, can make a difference in terms of standing out from the competition. In order to guarantee a better business performance, it is necessary to assure that distribution is supported by ITs.

Hence, distribution and its channels can entirely influence the whole business performance and the connection with information systems, can be a vital differentiator in the success of an enterprise. IT within distribution and SCM can raise the efficiency of a company by making information flow more effective in and out of the business, improving competitive priorities like quality, price, time, flexibility and responsiveness of production (Şteţ, 2014; Güles *et al.*, 2012). The basic dynamics that entail businesses use of IT are technological, economic, political, cultural and environmental factors, which grants a significant contribution to companies dealing with increasing global competition.

Despite the huge positive contributions that ITs can bring to distribution, there is also a downside, or, in other words, a barrier that needs to be overcame. Every industry that required the introduction of technology in order to improve, had to face the problem of inertia and denial to change, not just from employees and other participants, but also from the protocols and working papers. Technology requires a deep change, not only in physical terms, but also in terms of environment, mind-set and, as said, willing to change. The better the general reaction to the intervention of technology and innovation, higher the probability of the company to be successful, regarding those applications.

Therefore, embracing technology and its implied changes in distribution, can reveal immensely positive for various reasons, but mostly because it strengthens the transparency regarding the process of distribution, building a trustworthy feeling beneath the client. Although, it is impossible to deny that these adjustments imply a significant investment, which can hinder and delay the acceptance from SME's (Wu *et al.*, 2017).

Acceptance and Use of Information Technology

Culturally, the human being was not ready for such an impact as the one lived in the beginning of the 21st century. In the lights of the Unified Theory of Acceptance and Use of Technology (UTAUT), it's perceptible that technology acceptance dramatically varies from continent to continent, country to country and even city to city (Venkatesh *et al.*, 2003).

UTAUT aimed to work around the traditional limitations of previous models concerning this topic, integrating and taking into account different studies, with special care towards the gaps and limitations of those exact theories. Furthermore, this theory intended to reduce subjectivity regarding technology acceptance, by trying to establish patterns and profiles. Nevertheless, this topic will always be subject to a certain level of subjectivity, in fact, technology adoption is as much a cultural issue as a rational decision-making process (Im *et al.*, 2011).

UTAUT has been serving as a base-line model, aiding in the comprehension of technology adoption and expanding the theoretical boundaries of this theory, while emphasizing the supplementary utility of a certain technology. Understanding the acceptance and adoption of technology requires different approaches, while a practical approach can be more incisive, it is indispensable to keep aware of the intrinsic influencing variables.

Many studies focused on a limited set of factors that can influence public acceptance, instead of aiming towards a comprehensive framework involving psychological theories and empirical approaches, including key aspects influencing technology acceptance. A modern methodology is required and a wide range of psychological factors must be taken into account. Characteristics such as personality, social norms, behavioural reactions and attitude are too subjective to be standardized in short measurements. It is important to keep aware of the impact that a designated technology can have, in a process, in a company, market or in society in general, nevertheless, it is vital to analyse and study people's perceived reaction towards the introduction of that same technology. Assuring public acceptance of technology is crucial and a huge step to guarantee a successful implementation of technology into society (Huijts *et al.*, 2012).

Autonomous Vehicles as a Disruptive Technology

AVs promise a complete revolution in mobility, as they are expected to make travelling more efficient in every term, from security, flexibility, comfortability, sustainability, to time and cost for both ends of the service, either in the costumer perspective, or in the business perspective. Based on its feature, AVs are expected to improve traffic flow, reduce accidents, reduce social exclusion, improve the utility of time on travel and reduce drivers stress and tedium (Schoettle & Sivak, 2014; Litman, 2017). It is increasingly accepted that the next step to the evolution of mobility and transportation is the replacement of human as the driver by the Artificial-intelligence-capable machine. The possibility of reducing operational costs, could be a game changing factor in the adoption of AVs in innumerable markets (Adnan *et al.*, 2018), fundamentally, due to the fact that a machine can perform the same task, at the same rhythm, with the same quality, during a whole time process, which is significantly longer than a human being capacity. In a scenario where AVs travel together with human-controlled vehicles in all lanes, a moderate number of AVs can lead to a 30% improvement on the traffic conditions in highly congested highways (Mirzaeian *et al.*, 2018).

Nevertheless, there are studies indicating that when confronted with the potential benefits of AVs, the most valued benefit for people is the reduction of road accidents and, on the other hand, the less valuable benefit is road traffic reduction (Bansal *et al.*, 2016). Motor vehicle collisions cause more than 1.2 million deaths worldwide and an even greater number of non-fatal injuries each year (World Health Organization, 2015). In this perspective, countless authors defend that AV's massive adoption could majorly reduce the amount of road accidents, as the likelihood of a machine committing a mistake is considerably lower comparing to a human being (Slowik & Sharpe, 2018; Fagnant & Kockelman, 2015). However, these arguments are mostly based under the assumption that every vehicle on the road would be autonomous, which is an ambitious conceptualization, as the adoption of AVs is more likely to succeed considering a gradual growth rather than an instant massive adoption, drastically occurring from a moment to another (Bösch *et al.*, 2016; Clark *et al.*, 2016).

On 2013, Morgan and Stanley defined the adoption and emergence of AVs in four phases (Shanker *et al.*, 2013). Phase 1 (2013-2016) – Passive autonomous driving. The driver is entirely responsible for driving; Phase 2 (2015-2019) – Limited driver substitution. The driver is still responsible for driving the vehicle, but has the chance, depending on the situations, to grant the driving task to the vehicle itself, in a controlled environment; Phase 3 (2018-2022) – Complete autonomous capability. Vehicles drive autonomously, although human intervention can be required, in determined situations, such as emergencies; Phase 4 (2022-2042) – Utopian Society. All vehicles on the road are completely autonomous, reaching this way the 5th level of automation, were no human intervention is required at all (Pillath, 2016).

Fully AVs have the potential to transform distribution chains. Nonetheless, the sustainable focus as two sides, on one hand the process and the technology require a proper implementation, in order to achieve the performance levels desired, on the other hand, this could create a significant cut of expendable costs, which could potentially imply the raise of the unemployment rate in many markets (Todorovic *et al.*, 2018; Stefansdottir & Grunow, 2018).

Regardless of the imminent benefits identified and predicted, various authors highlight the social dilemma about adopting the concept of AVs, as it creates barriers in the minds of potential consumers. Computer system failures, privacy issues, hacking vulnerability and the difficulty of the vehicle to answer appropriately in unexpected situations, are some of the issues used to understand the perceived barriers in consumer's minds. (Schoettle & Sivak, 2014; Bansal *et al.*, 2016; Fagnant & Kockelman, 2015). The loss of human control is another barrier to overcome, not only relating to driving safety, but also in terms of driving pleasure, as further investigations report that individuals who enjoy their driving moments, are less receptive to the concept of fully AVs (Power, 2012; Haboucha *et al.*, 2017).

Several authors point that, as AVs are an innovative technology, the overall initial investments are expected to be extremely high and hardly affordable for everyone (Oliver *et al.*, 2017; Fagnant &

Kockelman, 2015). However, this inability to purchase AVs, could create massive opportunities by adopting these vehicles in the distribution sector, in view of service performance, instead of an individual use. This technology, directly connected to transportation vehicles (Taxis, Uber and other equivalent applications), distributes operating costs over a large number of consumers making mobility services more affordable, which, consequently, could produce considerable savings for consumers (Nunes & Hernandez, 2019). However, the costs in the future, once economies of scale kick in, are expected to drop and be able to be scaled down readily, as the technology enters in mass production phases (Oliver *et al.*, 2017; Fagnant & Kockelman, 2015).

Autonomous Vehicles Acceptance and Use

AVs implicate adaptations in diverse aspects, physically and psychologically, therefore, as many disruptive technologies throughout history, need time to be accepted and furthermore implemented. In this regard, effort expectancy and performance expectancy most be correctly analyzed, as well the consumers profile, as the initial adoption of these vehicles, is deeply conditioned by the consumer mentality, even more than in terms of financial capacities, as the most probable causes for retarding AVs adoption, are imminently psychological (Leicht *et al.*, 2018).

Following the previous reasoning, some of the biggest challenges standing against AVs adoption remain especially in convincing the consumers to switch to AVs despite the apparent benefits. In the past, with the perspective of encouraging the acceptance of AVs, papers highlighted that trust and reliability towards this technology, needed to be assure, individually. Nowadays, ethical implications of the autonomous technology must be considered, in order to better analyze the acceptance of this technology. Hence, there is a need to embed ethical implications as a construct, in order to guide the users trust and reliability, relating to AV's acceptance model. There are other sociodemographic factors influencing the acceptance of this technology, either cultural or emotional, which require a certain period of time to overcome (Adnan *et al.*, 2018; Clark *et al.*, 2016; Litman, 2017; Lavasani *et al.*, 2017).

In 2013, Cisco Systems, a multinational networking hardware company, developed a global survey, in which gathered the opinion of 1,514 consumers, from 10 different countries, 18 years or older. The answers to this survey highlighted customers intention and interest regarding the concept of AVs, as 57% of the respondents would put their trust in a driverless vehicle. Although, as expected, the answers varied wildly depending on the country of origin. In emerging markets such as Brazil and India, acceptance and trust towards AVs was over 90% and 80%, respectively. On the other hand, in Japan and Germany scepticism and distrust is notably still present, as only 28% and 37% of the respondents would be willing to give up direct control of their vehicles and trust an AV. The same trend was latent when respondents were asked whether or not to let their children drive their own AVs, gathering 47% of affirmative answers, again, with higher acceptance rates in emerging countries (Cisco, 2013).

AVs adoption, will most likely occur slowly, although, as financial incentives, nowadays, are rather easily obtained, customers trust towards AVs could be a key accelerator in the adoption phase, either considering AVs as a product or as a service. Having this in mind, highlighting AVs potential benefits and by reducing and eliminating the concerns about this technological innovation, strengthening customers reliability and trust, could be decisive in the success of AVs as a disruptive technology (Leicht *et al.*, 2018; Daziano *et al.*, 2017; Litman, 2017; Lavasani *et al.*, 2017; Fagnant & Kockelman, 2015).

METHODOLOGY

Research Approach

This study combines two types of research methodologies, exploratory and explanatory research strategies. Those research strategies are not mutually exclusive and a combination of these two strategies aids in the analysis and definition of benefits and drawbacks, concerning to the desired goal. Both primary and secondary data acquisition were conducted. Primary data was gathered over explanatory research, which was based on qualitative data collection through the elaboration of an online survey with 16 questions. This survey was divided into 4 parts, in order to facilitate a connection and a better analysis between the purposes of the study and the answers obtained (table 2 - Online Survey Structure).

Furthermore, the analysis of this survey answers, implied quantitative data collection, as it was conducted through the application of statistic's methodology, with the support of SPSS program. In order to precisely analyse and conclude about the relationship between respondent's sociodemographic characteristics and their specific answers regarding the first three parts of the survey, correlation tests between ordinal variables were performed by using Spearman's rank correlation coefficient (Spearman's RHO). This correlation coefficient is not sensitive to distribution asymmetries or the presence of outliers.

Secondary data was collected through an exploratory research approach, which was reflected by obtaining data from previous research and studies, highlighted in the Theoretical Approach chapter. The conclusions for the initial research problem consolidate all types of data attained.

There are several primary data collection techniques, from experiments to interviews, depending on the type of approach undertaken, either quantitative or qualitative, which can contribute to the collection of solicited or spontaneous data. The online survey has the advantage of allowing information to be collected from a large number of respondents at the same time, contributing to obtain precise results, easier data processing and analysis. The use of the survey is justified whenever there is a need to obtain behavioural data, such as attitudes, feelings, opinions, preferences and experiences, which aids in

providing information about subjective and objective characteristics of a population, regarding a specific subject (Hox & Boeije, 2005; Wright, 2005).

Sample Characterization

The sample was defined aiming a target population of individuals over 18 years old, male and female, resident and non-resident in the Portuguese territory, with different education levels and backgrounds. Overall, the sample was fixed at 187 individuals, in which of those, 62% were male respondents (n = 116) and 38% were female respondents (n = 71).

Table 3 shows the age distribution of the individuals by age group, demonstrating that predominantly the sample consists in individuals between [18-24] - 40% and [25-34] - 36%. See table 3 - Age Group Distribution.

Regarding to the education levels, it can be inferred that most of the individuals surveyed have either a master's degree or a bachelor's degree, representing 39% of the sample (n = 72) and 33% (n = 61), respectively. It should also be noted that 14% (n = 26) have a postgraduate degree and 4% with a doctorate (n = 7), meaning that only 12% (n = 21) of the respondents did not took any higher education courses and did not attend university.

In terms of nationalities, this survey gathered answers from 16 different nationalities, mostly from European countries, 96% (n = 179). As expected the predominant nationalities are Portuguese, with 67% (n = 126), French 10% (n = 19), German 5% (n = 10) and Swiss 4% (n = 7). In addition to these, Dutch, Spanish, Italian, Indian, Angolan, Argentine, Austrian, Belgian, Croatian, Mozambican, Romanian and Vietnamese nationalities were mentioned, albeit in a small number (n = 25).

Regarding the occupational status, it is found that majorly the respondents are employed, as of the 187 individuals, 130 are employed. Approximately 18% are students (n = 33) and 8% (n = 15) are self-employed or consider themselves entrepreneurs. The employed population involve various industry, but mainly it is distributed into three industries: Management (including finance, strategy and industrial management); Pharmaceutical; IT Engineering.

ANALYSIS AND DISCUSSION OF RESULTS

The analysis of the online survey answers identified many results in accordance with the analysis of the theoretical approach, as well as, some discordant outcomes, making it possible to collect different insights and strengthen certain points of view regarding the aims of this study. Furthermore, the combined analysis of these two sources of data collection, enabled gathering findings to support the answer of the three RQ's.

The first question of the survey was to inquire respondent's acquaintance and knowledge about distribution channels. Of the 187 individuals in the sample, 78% (n = 146) were familiar with the term of distribution channels, while 21% (n = 39) admitted they were not familiar with the concept. Meanwhile 1% (n = 2), observed that they knew the term but were not totally comfortable about its meaning, nonetheless, the awareness of respondents regarding the concept of distribution channels was considerably elevated.

Forwardly, six features of a distribution process were defined and the population had to classify them, from the most valuable characteristic, to the less valuable. Three characteristics were clearly preferential for respondents, being those the "speed of the delivery", the "cost of the service" and the "condition of the product", this is, the comparison between the expectations of what was ordered, against what was actually received. On the other hand, "how it was delivered", this is, what type of the vehicle performed the delivery, and the "relationship with the distributor" were notably the less valuable characteristics. In table 4 it is possible to visualize the answer distribution regarding distribution channels characteristics. See table 4 - Distribution Channels Characteristics Appreciation.

When asked to give their opinion about the adequacy of the current distribution channels to the modern days, in terms of technological developments, the answers were rather assertive, as only 16% (n = 30) of the respondents consider that the current distribution channels are adequate to the recent technological advancements. Of the 84% individuals that think otherwise, 79% (n = 148) believe that the actual distribution channels could improve and 5% (n = 9) consider that these channels are inadequate to the modern technological outlooks.

This analysis follows the reasoning of Galkin (2015) and Andrejić & Kilibarda (2016), even considering that these results are not a precise indicator, regarding the level of technological investment required, since the answers are rather standardized. Nonetheless, it is deeply consensual that distribution channels are overdue in terms of technological developments, which means that these channels are not as efficient and optimized as they could be.

Improving distribution channels efficiency does not only indicates a need in terms of tangible assets, but also in terms of optimizing these channels, mostly in terms of speed and price, as technology can even shorten the length of a distribution channel. In this regard, these results also support Fayaz & Azizinia (2016), as assuring more efficient distribution channels, can influence the successfulness of a product, products can have a determining role in conveyance of thoughts, social norms and carrying cultural values.

After the initial approach towards distribution channels awareness, it was necessary to inquire individuals opinion concerning to AVs, whether in terms of familiarity with the concept, perceived impact, both positive and negative, and in terms of conditioning factors affecting the successful adoption of this innovative technology. It is visible that AVs are not an unknown concept, as 86% (n =

161) of the respondents had already heard about this technology, supporting the idea that, despite being a completely innovative technology and relatively recent, AVs are already on top of the spotlights and are one of the most discussed topics nowadays.

In terms of potential benefits that AVs could bring, 45% (n = 85) of the respondents chose "road safety", as the most important benefit potentially brought by AVs, and 74% (n = 138) identified "road safety" as an important potential benefit of AVs, supporting the impression from numerous authors such as Schoettle & Sivak (2014), Adnan *et al.* (2018) and Fagnant & Kockelman (2015). Another benefit highlight by the sample population is carbon dioxide emissions reduction, as 62% (n = 115) considered this potential reduction as an important factor of AVs and of these, 37% (n = 69), considered the "reduced C02 emissions" a highly important potential benefit. This statistic follows the growing awareness surrounding sustainability and green initiatives issues, supporting Schoettle & Sivak (2014) and Adnan *et al.* (2018).

"Long term costs reduction" and "reduced traffic congestion" were quite similar in terms of beneficial added value perception, as 50% (n = 93) and 45% (n = 85) of the respondents, identified considerable importance regarding these features brought by AVs. The less important benefits for the population, that AVs could carry, were "stress levels reduction" and "free time while driving".

The analysis of the main drawbacks concerning to AVs, identified, just like the potential benefits analysis, disperse answers, with the individuals of the sample having different appreciations and valuations regarding this matter. In consonance with the most important benefit, the biggest concern towards AVs for 44% (n = 83) of the sample population is "driving safety", showing that road safety is a fundamental characteristic to assure, as people are rather sceptic regarding to some AVs features. Thus, assuring that these vehicles are, indeed safe and flawless, is essential, for significantly reducing individuals concerns and, forwardly, contributing for the general receptivity of AVs, following the arguments of Schoettle & Sivak (2014), Bansal *et al.* (2016) and Fagnant & Kockelman (2015).

Furthermore, 54% (n = 101) of the respondents identified "hacking vulnerability" as highly worrying, as AVs systems are entirely developed under IT databases. The "initial costs / short term costs" and the "reduced human control" also collected an important appreciation, as 49% (n = 91) and 50% (n = 94), respectively, indicated these potential impacts as at least relevant concerns regarding to AVs. Although, only 8% (n = 15) of the population considered the initial costs as the biggest concern influencing the success of AVs and, simultaneously, only 7% (n = 14) considered the reduction of human control as their biggest concern towards AVs. The smallest concern to the population was undoubtedly the "unemployment rate", which, due to the automatic functions of AVs, is expected to grow, especially in the transportation sector, where costs with drivers, would no longer be necessary in a fully autonomous service perspective.

A considerable limitation to this study, is the lack of experience of the individuals o this sample in terms of AVs utilization, as 91% (n = 170) of the population have never tried an AV, while 7% (n = 13) have experienced it only once and merely 2% (n = 4) have tried it more than once.

Even though the sample population is considerably unexperienced in terms of AVs usage, which is rather normal due to how innovative and recent this technology is, the willingness to try AVs is imminent. In fact, 73% of the population (n = 137) answered affirmatively to their interest of trying AVs, while 23% (n = 43) were more reluctant but did not eliminated the hypothesis of trying AVs answering "maybe". Only 4% (n = 7) showed no interest in experiencing this type of vehicles, answering negatively to their willingness to try AVs.

These results are relatively superior from the ones conducted by Cisco Systems survey in 2013, presented on figure 4, although that study did not contemplated the Portuguese population, but comparing, for example, with the results from the French population, it is visible a relevant increase in terms of AVs acceptance. A possible reason for this increase is the fact that Cisco Systems survey was developed in 2013 and after six years, in 2019, the mind-set in regard of AVs, suffered some changes, motivated from cultural reasons in consequence of the visible developments of AVs technology supporting Adnan et al. (2018), Leicht et al. (2018), and Fagnant & Kockelman (2015). Additionally, these technological developments support Pillath (2016) and Shanker et al. (2013) theories, indicating that AVs are, step-by-step, getting closer from level 5 of automation and from the end of the third phase of AVs adoption, looking towards the fourth phase of AVs adoption, this is, an utopian society.

Moreover, in order to collect data regarding customers perceived value of AVs in distribution, individuals were asked, firstly, if they would opt for a distribution service based on an AV, over a regular distribution service, if both had the same time and cost. 46% (n = 86) of the respondents showed an interest in this feature, answering affirmatively, while 41% (n = 77) admitted that it was indifferent weather the service was based on AVs or regular vehicles, considering that both had the same time and cost. On the other hand, 13% (n = 24) of the population showed no interest in a distribution service performed by AVs, answering negatively.

Afterwards, individuals were asked the same question, but considering that a distribution service based on AVs would be more expensive. The answers to these questions indicated that it is significantly important for companies to assure that the price and time of a distribution service performed with AVs are similar or lower than a distribution service based on a regular vehicle. Principally considering the price of the service, as 70% (n = 131) of the respondents would not be willing to pay more for a distribution service based on AVs. However, 24% (n = 45) of the population would opt for a distribution service based on AVs even if it would be more expensive, while 6% (n = 11) indicated that their decision would be dependent on the assurance that the service would be more efficient, either in terms of time, safety, or sustainability. These results follow along Daziano et al. (2017) and Lavasani et al.

(2017), indicating individuals reluctance in facing higher costs throughout AVs adoption, which, can massively diminish, as AVs benefits are gradually validated and while AVs concerns are overcome.

In the analysis of the correlation between the variables of the statistical model, the Spearman correlation coefficient is used. Results range from -1 to 1 and the closer the results to these values, the greater the relationship between the variables. By analysing the correlation matrix, it is conclusive that there are only weak and moderate correlations between the variables under study.

This analysis indicates that there is a tendency between the age of the population and the knowledge of the concept of distribution channels, in fact, the older the respondent, higher is the likelihood of that same individual not being familiar with the concept of distribution channels. Regarding to AVs, man are more likely to be acquainted with the concept of AVs, rather than woman. Additionally, younger individuals are more willing to try AVs, indicating that older people are more sceptic of using AVs. Another significant correlation is the perceived appreciation of the beneficial impact brought by AVs in terms of safety, which is progressively more important, for people with higher education levels. See table 5 - Correlation Analysis (Age, Gender, Education Level).

The individuals who are already acknowledged with the term of AVs and who are willing to try AVs, would be more receptive to let a family member try an AV and would more likely opt for a distribution service performed with AVs over a regular vehicle, in a scenario were both type of vehicles would imply the same time and cost of the service. Moreover, the respondents who would decisively opt for a distribution service with this features, would also be likewise willing to choose a distribution service based on AVs, even if it implied higher costs. Individuals who are willing to pay more a distribution service performed by AVs, consider the type of vehicle seemingly more important in a distribution process and highlight the importance of road safety as a potential benefit brought by AVs. See table 6 - Correlation Analysis (AVs Distribution Service, Receptive to let Family try AVs, Road Safety)

The respondents who already tried AVs are withal willing to allow family members to experience AVs, valuing carbon dioxide emissions reduction as an imminent benefit brought by AVs and, inversely, give lower significance to the potential stress levels reduction implied by this innovative technology. In terms of concerns, the population who already experienced AVs, are progressively more concerned with the hacking vulnerability of the systems and, on the other hand, are less preoccupied with the driving safety risks of these vehicles, expressly for respondents who tried AVs more than once, indicating that higher AV usage is inversely proportional to the perceived driving safety concerns towards these vehicles.

The importance given to the potential road safety gains associated to AVs adoption directly converges with the concern levels regarding AVs driving safety. On the other hand, reduced stress levels, improved free time while driving, unemployment ratio increase and insufficient autonomy, vary in opposite

directions, this is, greater the perceived importance of road safety gains, smaller is the significance of these factors for respondents. See table 7 – Correlation Analysis (Already Tried AVs, Road Safety).

CONCLUSION

Both data collection methods identified a technological gap regarding distribution channels efficiency, acknowledging the need to improve distribution channels performance, as a well-planned and efficient distribution strategy can be directly connected to the success of a product or a service and, consequently, to the success or failure of a business. The way people interpret and perceive the quality of a product or a service, starts directly from the instant when it is ordered, because that is the moment where expectations start to be created.

This said, improving distribution channels efficiency does not only indicates a need in terms of tangible assets, but also in terms of optimizing these channels in all of its features, particularly focusing on the characteristics that are the most relevant for people in general, which could significantly improve with the development of IT. Assuring more efficient distribution channels can influence the successfulness of a product or service and, likewise, the success of a company. A single product can be decisive in the conveyance of thoughts, social norms and carrying cultural values. In this regard, further developments of IT can positively contribute to this psychological impact, by facilitating distribution to meet customer expectations more efficiently.

Measuring and predicting IT acceptance and use is a considerable challenge, due to the inherent subjectivity involved. In order to predict more accurately the acceptance of a determined technology by an individual, it is important to have a considerable knowledge regarding that technology and regarding the individual, in terms of motivations, opinions and expectations. A disruptive technology is more likely to substantially change an entire market, breaking routines, which involves switching costs that sometimes and for some individuals, can be more relevant, than the actual beneficial added value of that technology.

Although human beings can be categorized and standardized, each individual has specific and own psychological characteristics, formulating different opinions, making this analysis rather complex. Nevertheless, the acceptance and use of IT can be predicted more accurately, with the confrontation and further analysation of the perceived benefits and concerns, making it important to evaluate the individual awareness and knowledge in relation to a specific technology. An individual highly informed with a determined technology, is more likely to have a well-structured opinion and position towards the acceptance and use of that technology, making it less unpredictable.

In this concern, the successfulness of AVs is directly connected to the awareness of customers regarding this technology, which will be imminently higher, as soon as it reaches its full potential, this is, the full automation level. Specifically regarding to the distribution industry, AVs promise an entire revolution

in mobility, significantly improving distribution channels efficiency, by optimizing costs and time, which could be a fundamental factor regarding the introduction of these vehicles in the distribution industry.

However, convincing consumers to switch to AVs, still remains a challenge, even though the individual willingness to try AVs is considerably growing, there are steps that must be assured and demonstrated, in order to overcome the psychological barriers inherent. There is still a lot of concerns regarding to the reliability of these vehicles, which, on the other hand, is one of the most appreciated potential benefits of AVs, as the entrance in an Utopian Society (Shanker *et al.*, 2013) promises to significantly improve road safety. In this regard, assuring that AVs are infallible, is demanding, as it would allow to overcome trust issues and simultaneously closer to improve road safety.

The adoption of AVs will implicate serious adaptions, physically and psychologically, furthermore, there many factors influencing the acceptance and use of this technology, either cultural, emotional or even technological, which require a certain period of time to overcome. Nonetheless, AV technology will continuously keep developing, diminishing the barriers and the imminent concerning factors delaying its acceptance and use. Concurrently, the benefits of AVs will become increasingly more evident and assured, making it expected that AVs acceptance and further adoption and use, significantly grows during the next two decades.

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TABLES, FIGURE CAPTIONS AND FIGURES

Table 1 – Specific Goals and Research Questions

Specific Objectives	Research Questions
Acquire a global outlook of the current distribution channels and collect data in whether or not there is room for improvement	RQ 1 - Are the current distributions channels efficient?
Understand and analyse the conditioners that can influence customers mind-set towards technology	RQ 2 - How can Information Technology acceptance and use, be predicted and assured?
Analyse AVs growth and predict their impact in a global perspective and objectively in the distribution industry	RQ 3 - Can Autonomous Vehicles be a dynamic answer and assume a disruptive technology role?
Collect empirical data regarding AVs beneficial value, as well as, the drawbacks and concerns influencing the acceptance and use of this innovative technology	

Table 2 – Online Survey Structure

1st	2nd	3rd	4th
Distribution Channels Efficiency	Autonomous Vehicles Awareness	Autonomous Vehicles Adoption and Use	Sociodemographic Description

Table 3 – Age Group Distribution

Age Group	Frequency	Percentage (%)
[18-24]	75	40%
[25-34]	67	36%
[35-44]	25	13%
[45-54]	13	7%
[55-65]	4	2%
More than 65	3	2%
Total	**187**	**100%**

Table 4 – Distribution Channels Characteristics Appreciation

	1	2	3	4	5	6
Speed of the Delivery	33% (n = 62)	23% (n = 42)	18% (n = 34)	15% (n = 28)	6% (n = 11)	5% (n = 10)
Tracking of the Delivery	2% (n = 4)	10% (n = 19)	25% (n = 46)	36% (n = 68)	19% (n = 35)	8% (n = 15)
How it was Delivered	10% (n = 19)	5% (n = 9)	8% (n = 14)	12% (n = 22)	29% (n = 55)	36% (n = 68)
Cost of the Service	13% (n = 25)	37% (n = 69)	21% (n = 39)	19% (n = 35)	5% (n = 10)	5% (n = 9)
Condition of the Product	36% (n = 68)	13% (n = 25)	24% (n = 45)	10% (n = 18)	8% (n = 15)	9% (n = 16)
Relationship with the Distributor	5% (n = 9)	11% (n = 21)	5% (n = 9)	9% (n = 17)	33% (n = 61)	37% (n = 70)

1. The Most Valuable
2. High Value
3. Valuable
4. Moderately Valuable
5. Low Value
6. The Less Valuable

Table 5 – Correlation Analysis (Age, Gender, Education Level)

	Distribution Channels Knowledge	Heard about AVs	Willing to try AVs	Road Safety
Age	-0,253		-0,192	
Gender		-0,259		
Education Level				-0,163

Legend

Correlation is significant at the 0.05 level (2-tailed).
Correlation is significant at the 0.01 level (2-tailed).

Table 6 – Correlation Analysis (AVs Distribution Service , Receptive to let Family try AVs, Road Safety)

	Heard about AVs	Willing to try AVs	Distribution Service with Higher Costs
AVs Distribution Service	0,204	0,250	0,443
Receptive to let Family try AVs	0,153	0,483	
Road Safety			-0,172

Legend

Correlation is significant at the 0.05 level (2-tailed).
Correlation is significant at the 0.01 level (2-tailed).

Table 7 - Correlation Analysis (Already Tried AVs, Road Safety)

	Already Tried AVs	Road Safety
Receptive to let Family Try AVs	0,166	
Reduced CO2 Emissions	-0,146	
Stress Levels Reduction	0,198	-0,453
Time on Travel Utility		-0,262
Hacking Vulnerability	-0,196	
Driving Safety	0,174	0,301
Unemployment Ratio		-0,156

Legend

	Correlation is significant at the 0.05 level (2-tailed).
	Correlation is significant at the 0.01 level (2-tailed).