IMPACTO DE LOS CAMBIOS SOCIOTÉCNICOS EN EL SECTOR AUTOMOTRIZ EN COLOMBIA Y VIETNAM

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MAESTRÍA EN ADMINISTRACIÓN DE EMPRESAS

SANTIAGO DE CALI

AÑO 2021

TRABAJO DE INVESTIGACIÓN

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Trabajo de grado presentado como requisito parcial para optar por el título de Magíster en administración de empresas

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AÑO 2021

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Santiago de Cali, 18 de Junio de 2021

Doctor

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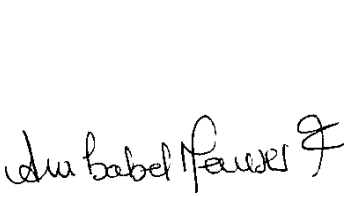

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Por medio de la presente me permito comunicarle, que en mi calidad de director de trabajo de grado he leído detenidamente el informe final del estudio titulado "IMPACTO DE LOS CAMBIOS SOCIOTECNICOS EN EL SECTOR AUTOMOTRIZ EN COLOMBIA Y VIETNAM", realizado por los estudiantes de la Facultad de Ciencias Económicas y Administrativas de la Universidad Javeriana nombres: ANA ISABEL MENESES FRANCO cédula 1.107.035.479 de Cali y CARLOS ALBERTO GIRALDO GONZALEZ 94.459.921 de Cali, considero que cumple con todos los requisitos requeridos para ser presentada a evaluación.

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Aprobado por el Comité de Trabajos de Grado en cumplimiento de los requisitos exigidos por la Pontificia Universidad Javeriana para optar por el título de Magíster en Administración de empresas

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ABSTRACT

The objective of this research is to examine the impact of sociotechnical changes in the autonomous vehicle segment in Colombia and Vietnam, for this we have included an analysis of the behavior of the automotive industry in each country and the trend in purchase intention was determined in the face of changes. Socio-technical in the countries under study.

A total of 800 car drivers with more than 18 years old that lives in Colombia and Vietnam participated in personal questionnaire through a Polling Firm. The methodological contribution is related to study variables related to consumer preferences and considering environmental variables at different levels that affect the adoption of this type of new technologies. Among the results, it is found that culture have a direct influence on the adoption of new technologies that have a lesser impact on the environment in terms of indulgence. A low degree of indulgence is directly related to the success of adopting new technologies. While in the case of psychological risks and performance risks are the restrictions that have a more direct impact on the purchase intention.

INTRODUCTION

The automotive industry in is one of the drivers of economic development, for Colombia it represents 6.2% of Gross Domestic Product (GDP) and 19.1% of employment (DANE, 2020). The automotive industry in Vietnam has been growing rapidly at more than 300% over the budget of the Ministry of Industry and Commerce of this country (ASIA PRESPECTIVE, 2021). The Vietnam Institute for Industrial Policy and Strategy predicts that between 750,000 and 800,000 vehicles will be sold annually by 2025, up from 288,683 in 2018 (Vietnam-briefing, 2021).

The choice of Vietnam and Colombia is associated with the need to carry out a comparative analysis between study objects that allows collecting aspects of diversity and similarity (Malhotra, et al., 1996; Sintonen, et al., 2016). The diversity is due to the difference between the levels of leniency reported in Hofstede's knowledge. These levels in this dimension can influence decision-making related to the acquisition of products such as an autonomous car.

Regarding similarity, Colombia and Vietnam are countries with intermediate economic levels (developing countries with growth potential) that could generate perceptions of technical knowledge and social development. In addition, Colombia and Vietnam are statistically different and obtained an acceptable level to understand this issue.

At a global level, the automotive sector presents a growth trend of autonomous vehicles, an example of this is the case of the introduction of hybrid and electric cars, which according to the sales data for Europe from plug Hybrid and electric vehicles (PHEV) was 507,000 units in 2020. For UK, the total of Hybrids and electric vehicles is around the 30% of total cars sold (Reuters, 2021; IADB, 2016).

To facilitate the adoption of this type of vehicle, there are regulations and financial support from governments, however there are infrastructure, culture and technology limitations. Therefore, it is necessary to explore those factors that influence consumer acceptance, in such a way that preferences and main limitations can be clarified (Mingyang, et al., 2020). In relation to autonomous vehicles, there are studies referring to developed countries such as Japan, the United States, Sweden, Norway (McLeay, 2018), however, studies are needed that compare different countries with diverse cultural contexts in order to analyze the sociotechnical system in the automotive industry, specifically related to autonomous vehicles.

In this manner, the present study aims to investigate the impact of sociotechnical changes in the automotive sector in Colombia and Vietnam. The present works is structured in a first part on the conceptual elements, then the methodology, the analyze the dynamics of the automotive sector in Colombia and Vietnam in the last decade and finally, we related to the discussion of the results and the conclusions and recommendations of the study.

1. PROBLEM

For many countries in Europe, Asia and America, concern about reducing polluting emissions has become a priority objective in future plans. One of the alternatives is the replacement by less polluting technologies that allow the reduction of the environmental impact. An example of this is the case of the introduction of hybrid and electric cars, which according to the sales data for Europe from plug Hybrid and electric vehicles (PHEV) was 507,000 units in 2020. For UK, the total of Hybrids and electric vehicles is around the 30% of total cars sold (Reuters, 2021; IADB, 2016). It is estimated that car electrification plans range with investments of approximately $ 200 billion between 2020 and 2024 (Nasdaq, 2021).

The above is established as a response to the problems that arise due to the high consumption of energy from non-renewable resources and the significant increase in polluting emissions (Yang, Wong, & Szeto, 2018). In this way, governments of different countries come in a process of applying policies that allow the regulation and operation of environmentally friendly vehicles (Mingyang, Cheng, Xuefeng & Jingzong, 2020; Sohu, 2018).

Despite the considerable number of regulations and financial support from governments for the implementation of this type of technology, it is possible to find limitations of infrastructure and immature technology. To facilitate the adoption of this new type of technology, it is necessary to explore those factors that influence consumer acceptance, in such a way that the preferences and main limitations can be clarified (Mingyang, et al., 2020). One perspective that allows investigating this type of interaction between new technologies and consumers is the area of socio-technical transitions.

According to McLeay, Yoganathan, Osburg & Pandit (2018), the literature in the field of sustainability, technology and innovation has been considered the perspective of socio-technical

transitions as a perspective that allows to clearly investigate the interactions present in the adoption of new technologies that aim to reduce environmental impact. This perspective allows considering not only the dynamics present in the adoption processes but also the interactions with the different activators present in the consumption of certain types of products. According to the above, the sustainability context presents a scenario where it is necessary to consider not only the characteristics of the demand but also design more effective policies. (Falcone, 2014; Sheldon, Desharzo, Carson, 2017).

On the other hand, the literature indicates the need to focus efforts on analyzing consumer decision-making processes, including those conditions that may affect acceptance of adaptation to this type of less polluting technologies (Axsen, Bailey & Castro, 2015; Barbarossa, Beckmann, De Pelsmacker, Moons & Gwozdz, 2015; Morton, Anable & Nelson, 2016). Other studies indicate the existence of a considerable number of factors that directly affect the adaptation that a consumer can make with the product of their choice, specifically in environmentally friendly technologies. This type of study makes use of a multidimensional concept that measures the perception of risk in obtaining this type of product.

Among the factors associated with risk, it is possible to find those related to the financial, psychological, social, physical, time and those related to performance (Hirunyawipada and Paswan, 2006; Stone and Grønhaug, 1993). Some studies derived from this type of risk have focused on those directly related to consumer perception in terms of social, financial, time and psychological. While, on the other hand, those related to health such as performance and physical risk have not been considered (McLeay, Yoganathan, Osburg & Pandit, 2018).

Another gap found in the literature is related to the need to consider analyzes that can be carried out in other countries with characteristics different from those considered developed

countries where adoption rates are higher. Additionally, there is a need for longitudinal studies that identify the way in which consumers and their preferences change over time, finding a relationship with interventions in public policy. In relation to autonomous cars, it is possible to find studies referring to developed countries such as Japan, the United States, Sweden, Norway (McLeay, 2018). Similarly, topics such as disruptive tech (Tan & Taeihagh, 2021), Historical Analysis (Szenasi, 2021), Economic and technological context (Trager, Kalova & Pagany, 2021), computing (Ravikumar & Kavitha, 2021), transportation (Li, Yang & Zhang, 2021). However, there is a need for studies that compared different countries with diverse cultural context (McLeay, et al., 2018).

Colombia and Vietnam were selected in order to perform a comparative analysis that brings together aspects of diversity and similarity in the object of study. The similarity is consolidated in to be developing countries, with an intermediate economic level and the diversity lies in the difference between the levels of indulgence reported in Hofstede's vision, which are more associated with cultural aspects that could generate perceptions of technical knowledge and significant social development. The present study aims investigate how elements of the cultural context moderate the relationship between various consumer perceptions of risk and their relationship with the intention to purchase autonomous vehicles in Vietnam and Colombia under sociotechnical theory.

2. OBJECTIVES

2.1 General objective

Identify the impact of sociotechnical changes in the autonomous vehicle segment between Colombia and Vietnam.

2.2 Specific objectives

• Analyze the dynamics of the automotive sector in Colombia and Vietnam in the last decade.

• To analyze the risk related to the acquisition of autonomous vehicles in the face of socio-technical changes in Colombia and Vietnam.

3. THEORETICAL FRAMEWORK

3.1 Hofstede Cultural Dimension Indulgence/ Restraint

Despite the considerable number of cultural studies carried out in different sectors and topics such as Covid-19 (Oey & Rahardjo, 2021; Wang, Y. (2021), National culture (Svetlana & Grant, 2021; Pucheta- Martinez, Gallego-Alvarez & Bel-Oms, 2021; Braithwaite, Tran & Ellis, 2020), Luxury brand (Wang, Kuah & Lu, 2021), entrepreneurship (Achim, Borlea & Vaidean, 2021), Tourism (Kumar & Dhir, 2020), sustainability (Pelau, Sarbu & Serban, 2020). Studies on the adoption of new technologies and the influence of cultural contexts are scarce. The gap found in the literature is related to the influence of cultural dimensions on consumer purchasing decisions.

The present study considers only one dimension of Hofstede called indulgence/restraint. This dimension, unlike the others, was considered because it is the dimension that shows different behavior for each country. According to Hofstede's insight (2021), the indulgence for a country with Vietnam is in the range of 35 considered low, which is why it is considered to be a country characterized as a restraint. These types of societies tend to show cynicism and pessimism. They also do not emphasize leisure time and control the gratification of desires. The perception that their actions are restricted by social norms is quite high. On the other hand, Colombia shows a score of 83. This dimension shows that Colombia is a country where people tend to show the need to fulfill their impulses and desires regarding the enjoyment of life and fun. It is also a society characterized by a positive attitude and a tendency towards optimism. They place leisure time in a place of significant importance.The indulgence dimension is related to the level at which people have the tendency to prioritize the enjoyment of life and everything that produces satisfaction of the

moment. In the same way, it is related to the hedonistic consumption of diverse types of products (Wang, Kuah, Lu, Wong, Thirumaran, Adegbite & Kendall, 2021). According to the above, to the extent that an individual pursues hedonistic values, he responds directly to the cultural values of indulgence, a sensation that extends to trying to control the desires and impulses to acquire a product. According to Goodell (2019), indulgence / Restraint also includes the degree to which a society feels comfortable with the gratification of basic human stimuli related to fun. This definition contrasts with the suppression of rewards that are aligned with social norms. In the same way, Hofstede relates this dimension to the so-called free will.

3.2 Socio-technical transitions theory

The theory of socio-technical transitions studies the changes that one system undergoes to transform into another, where the result is a technological innovation (Geels & Kemp, 2007; Muñoz, 2019). Studies from different fields have tried to analyze the technological transitions associated not only with changes in technology but also including changes in practices, regulations, infrastructure, social conditions, etc. (Bertram et al, 2015; Geels, 2002).

Nielsen and Karlsson (2007) affirm that the analysis of technological transitions must be accompanied by including levels such as micro (analysis at the individual, family or company level), meso (it is the intermediate level and connection between the micro and macro levels), macro (analysis of conditions at the country level associated with unemployment, inflation, wealth, etc.) and meta level (analysis of social organization, production and economic policy).

According to Geels (2002), the multi-Level perspective is one of the most used to analyze socio-technical transitions, allowing to analyze the interactions and articulations within the stakeholders or the micro, meso and macro levels of analysis. This trend is due to the recognition

that a disintegration of levels can drive changes in the socio-technical system (Schot and Geels, 2007). All this seeks to gather the necessary elements to answer the question Why does change occur and how does change occur? (Wang & Wells, 2020).

From a multilevel perspective, sociotechnical systems are made up of a combination of technologies, supply chains, infrastructures, markets, companies, labor organizations, legal frameworks, government, practical user regulations, cultural meanings, prevailing social norms and behaviors, as well as of interdependence connections. The socio-technical system is defined as an open system that integrates the human being and technology, organizations are made up of people (social system) who use tools (technical system) to produce goods and services valued by customers, who are part of the external context of the company (Velázquez Pompeyo & Quintero Ramírez, 2015). Socio-technical systems are composed of companies, organizations, markets, social behaviors, legal components and elements of government that interact with each other (Wang & Wells, 2020). A socio-technical system can also be defined as a production and consumption system with constituent elements that largely reinforce themselves (Geels & Kemp, 2007; Muñoz, 2019).

Additionally, the socio-technical system recognizes the existence of a context that is a set of external elements that influence the socio-technical system and the transition process between one system to another (Geels & Kemp, 2007). Changes in context can be of two types: slow-changing trends or exogenous shocks. The former can occur due to changes in demography, ideologies, structures or geopolitics, while the latter occur through wars, economic crises, major accidents or political upheavals (Geels et al., 2017).

From these changes, pressures are created on the established socio-technical system that generates problems to be solved and, consequently, the actors of the system must react with

adjustments to it. When this is not enough, a gap arises that indicates that the system must develop structural changes and a window of opportunity for innovation is created, called niches (Geels & Kemp, 2007).

Changes in socio-technical systems originate in the context and in the ideal of society to build new realities from the emergence of technological innovation niches and novel behaviors of companies (Hoogma et al., 2002; Kemp et al., 1998). To evaluate socio-technical transitions, it is important to determine what are the elements of the current system and what are the elements that are expected from the new system; as well as establishing the context and the innovation niches that arise in response to the multiple changes that are driven through the interactions of the system itself (Geels et al., 2017).

New technologies, new business models, new social practices generate crisis events that pressure the socio-technical system towards change. The elements that generate crisis events come from new technologies, new potential practices, new business models and impact the current socio-technical system. This interaction causes the generation of new actors in the socio-technical system, new challenges in the market and new government policies so that the crisis has a lesser impact.

These new elements in the socio-technical system make it disintegrate to the point of having to generate new paths, new initiatives, not only from the technical point of view, but from the social component. The success of the transition to the new system will depend on the implementation time of the new initiatives. In this way, the system will once again be as robust as it was before the crisis.

According to Geels et al. (2017), the evaluation of socio-technical systems can be carried out through the analysis of elements that constitute the system and that can influence the new system. The foregoing can be considered from the perceptions of individuals based on the risks in obtaining the new technology. These risks are associated with five dimensions that allow the identification of behavior patterns assumed by the implementation of new technology.

3.3 Risk perception

According to the literature, the perception of risk associated with obtaining new products is defined as a multidimensional concept (Hirunyawipada and Paswan, 2006; Stone and Grønhaug, 1993). Additionally, studies carried out in the automotive industry make use of this concept to identify consumer preferences in obtaining new products. However, the results found show a latent need to identify behavior patterns between developed and developing countries that handle different contexts. McLeay, et al., 2021). Within the set of identified risks are financial, social, time, psychological and network externalities risk.

Financial risk, it is related to the negative potential result that is associated with the adoption of a product with novel characteristics (Stone and Grønhaug, 1993). It should be mentioned that even though the context provides financial benefits to stimulate the adoption of new technologies, these tend to be characterized by high prices in obtaining them (Soon et al.,

2013). This can become an important barrier when obtaining a product with innovative characteristics. Therefore, this type of risk will have an important influence on the intention to buy autonomous vehicles. Although this relationship has been studied previously, there is still a need to investigate the influence of cultural dimensions in the relationship.

The psychological risk is defined as the anxiety and the feeling of dissatisfaction that are generated from emotions after the purchase in terms of stress. In the same way, this could strongly influence the obtaining of this type of product (Dholakia, 2001; Hirunyawipada and Paswan, 2006; Wang et al., 2016). It should be noted that another part of the literature has considered hedonic attributes. However, the relationships with emotions in the exploration have been relatively explored (McLeay, et al., 2018). On the other hand, if emotions can be decisive in the achievement of certain types of products, this would be a determining factor in autonomous vehicle purchase intentions.

Time risk, it refers to the perception in the use of a product in time, which can be perceived as a waste of time. Similarly, in obtaining this, the time necessary to carry out an evaluation of the functionality of the product and the attributes that it has is considered. In the same way, it is possible to consider what is related to the characteristics of environmental friendliness that can influence the purchase intention (Forsythe et al., 2006; McGuire et al., 2010; Roselius, 1971).

Social risk, it relates to the unfavorable consequences in the opinions that people may have of a product (Dholakia, 2001). Similarly, this type of risk is also related to elements of an affective nature. According to McLeay, et al. (2018), the emotions generated by consumers become a key element that influences the purchase decision of other consumers, even more so in the acquisition of high-tech cars. Similarly, in the literature it is possible to find studies where social values and

norms are related as influential when making purchases, such is the case of the USA, Korea, China, Sweden (Oliver and Lee, 2010; Wang et al., 2016; (Jansson et al., 2017)

Performance risk is considered a factor that acts as a barrier between consumers depending on the type of categories in question. On the other hand, this type of risk is also associated with the need to obtain technical information on a product. Studies that consider this factor mention that depending on the generational characteristics of consumers, the perception of risk also changes, because younger generation tend to have greater information processing capacity than previous generations (Amirtha, Sivakumar, & Hwang, 2021).

Research Hypothesis

H1. High degree of indulgence negatively influences the relationship between the perception of financial risk and the purchase intention.

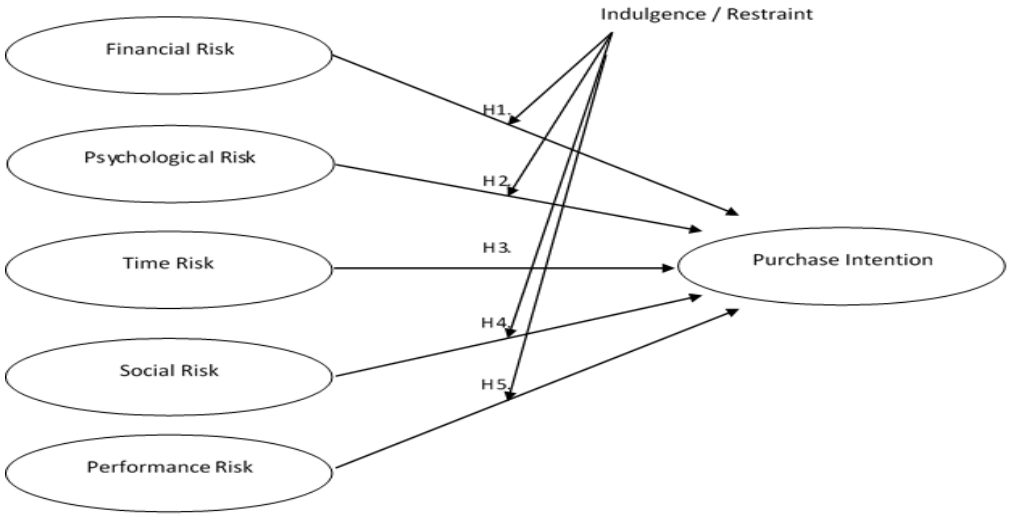
H2. High degree of indulgence/ positively influences the relationship between the perception of psychological risk and the purchase intention.

H3. High degree of indulgence/ positively influences the relationship between the perception of time risk and the purchase intention.

H4. High degree of indulgence/ positively influences the relationship between the perception of social risk and the purchase intention.

H5. High degree of indulgence/ positively influences the relationship between the performance risk and the purchase intention.

Figure 1. Theoretical Model.



Source: Own elaboration (2021).

4. METHODOLOGY

The choice of Vietnam and Colombia is associated with the need to make a comparative analysis between study objects that allows gathering diversity and similarity aspects (Malhotra, et al., 1996; Sintonen, et al., 2016). In the present research, the diversity is getting due to the difference between indulgence levels reported in Hofstede insight. These levels in this dimension can influence in the making decision process related to product acquisition like an autonomous car.

Regarding to the similarity, Colombia y Vietnam are countries with intermediate economic levels (developing countries with growth potential) that could generate technical knowledge perceptions and social development. Additionally, Colombia and Vietnam are statistically different and obtained acceptable level to understand this topic. The F-Value was 6241 and it was significantly different from 1. Therefore, in this study is possible to reject H0 related to average equality.

A total of 800 car drivers with more than 18 years old that lives in Colombia and Vietnam participated in personal questionnaire through a Polling Firm. In Colombia, this questionnaire was applied in four main cities: Bogota, Cali, Barranquilla and Medellin. In Vietnam, the questionnaire participated consumer of main cities: Hanoi, Hai Phong, Da Nang and Can Tho. The sampling was representative of statistics of car divers associated with age, gender, socio-economical level. The questionnaire included photos, general information and a short video about autonomous electronic car to familiarize everyone participants with this kind of car and they can understand the questions.

The Scales used in this paper were developed by Stone and Grønhaug (1993) to comprehend the barriers to adopt new technology. The perceived risk of the adoption of new technologies or products is a multidimensional concept that was developed by Stone and Gronhaug (1993) and it included: financial, social, time, psychological, performance and physical risks.

In this paper, the emphasis is financial, social, time, psychological and performance. The physical risks were not considered because this product did not evidence with health concerns and previous studies reported that it was non-significant in similar product (Petsching et al., 2014; Jansson et al., 2011). Other concept included was network externalities developed by Hirunyawipada and Paswan (2006).

1. **Financial**: This scale was four items to determine the risk in personal finance by adopt new technologies such as: Initial prices by new products, presential of high cost, overall financial risk and concerns may not get value for money
2. **Social**: This scale was four items to analyze the risk inside the social dynamic such as if this technological product may represent more status, create positive or negative opinions, emotion and self-image.
3. **Time**: This scale evaluates the time in different moments of adoption process, such as: Time for adoption, use and diffusion.
4. **Psychological**: This scale evaluates the risk related with issues in consumer behavior such as Anxiety, uncomfortable feeling and cognitive dissonance.
5. **Performance:** This scale evaluates the risk associated with quality and fulfillment of product.
6. **Indulgence:** Based on the Hofstede Theory, we included two countries with high degree of Indulgence (Colombia) and other with low degree (Vietnam). In the

questionnaires was included all items recommended by Hofstede. Subsequently, this scale was reduced to unidimensional item through factor analysis.

All scales were measured with Likert scale, where 1 was disagreed and 7 was agree with the statement included in the questionnaire. Subsequently, we used factorial model to reduce the number of items followed by multi-level model was run following the tendency of earlier papers that included interaction between different levels (Giskes and Bentley, 2021; Escandon et al., 2016).

4.1 Method

Multi-group model was created based in the Theorical model. The specification of the model included latent variables related to risk and the groups are associated with dree od indulgence of each country.

Table 1 shows the information of the constructs for the total sample used in this model. The values of the mean and the standard deviation (SD) was included and the interrelationships between constructs through of the correlation matrix. The average value of the different constructs is 5.34, with a standard deviation of 1.23, allowing to confirm that there is variability of responses. Additionally, correlation values are suitable for doing a structural equations mode.

Table 1. Mean, standard deviation, and correlation matrix.

Constructs	**Mean**	**S. D.**	*1*	*2*	*3*	*4*	*5*
1. Financial	*6.41*	*1.31*	*1.0000*				
2. Social	*5.97*	*1.27*	*0.1633*	1.0000			
3.Time	*4.05*	*1.09*	*0.6593*	*0.1687*	*1.0000*		
4. Psychological	*5.36*	*1.10*	*0.0217*	*0.0454*	*0.0133*	*1.0000*	
5. Performance	*5.13*	*1.22*	*0.0161*	*0.10000*	*0.0191*	*0.4052*	*1.0000*

Source: Own elaboration

The CFA indicates that the information presents an adequate adjustment and all of the measures of reliability had adequate measures (Salas, Escandon and Rialp, 2021). Similarly, the composite reliability index (CFI) exceeds 0.6 (Bagozzi & Yi, 1988), the average extracted variance (AVE) is greater than 0.5 (Fornell & Larcker, 1981), and the Cronbach's alpha (α) is higher than 0.8 (Hair, 1999). This can be seen in Table 2. The resulting statistical adjustments were made for the total sample: $\chi 2$ (400) = 173.31; RMSEA = 0.062; CFI = 0.94; TLI = 0.93; and SRMR = 0.05. The Colombia questionnaire had the following statistical adjustments: $\chi 2$ (390) = 137,12; RMSEA = 0.05; CFI = 0.93; SRMR = 0.06; and TLI = 0.923. The Vietnam questionnaire had the following statistical adjustments: $\chi 2$ (410) = 153.91; RMSEA = 0.06; CFI = 0.93; SRMR = 0.06; and TLI = 0.91

The Cronbach's alpha exceeds the Nunally and Bernstein's (1994) recommendation of 0.7. The composite reliability index is higher than 0.6 in every variable in this model, allowing to satisfy the level that was recommended by Bagozzi and Yi (1988). The extracted variance test is higher than 0.5 in every construct (Fornell and Larcker;1981). Therefore, the scales present an adequate level of reliability.

The discriminant validity was controlled with the AVE indicator in each latent variable with level higher that 0.5 (Fornell & Larcker, 1981). In general, there is discriminant validity and was evidence through confidence intervals (there are not confidence intervals that includes the value of 1) (Anderson & Gerbing, 1988).

5. CONTEXT

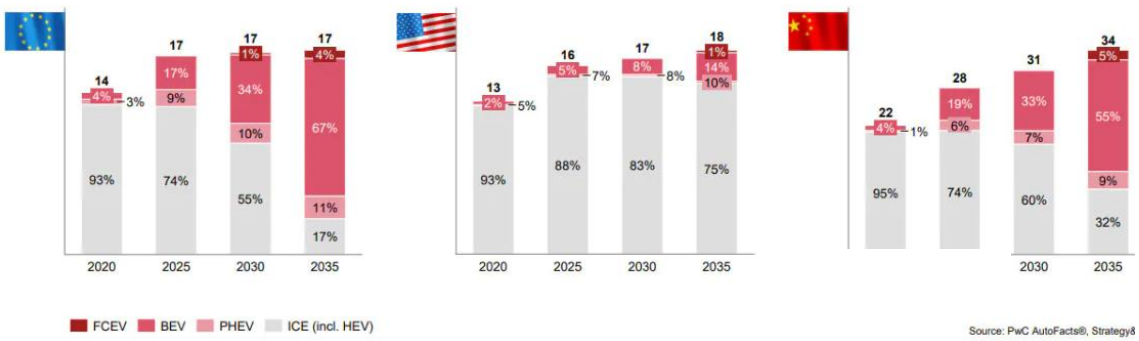
5.1 Analysis of the automotive sector in Vietnam

In the last two decades, countries leading ranking in vehicle production has changed, with Asian countries taking a greater role. One of the prominent countries is China, it country that went from number 8 to number 1 worldwide between 2000 and 2010, a position that it maintains until 2020. Progress in 5G technology will enhance the use of information for communication. massification of the use of applications and the development of platforms in the automotive sector. (Deloitte, 2020).Starting in 1995, when vehicle assembly companies began to invest in the country, the number of cars assembled went from 3,500 units to 240,000 units in 2017. The manufacturers and assembly association were established in 2000 with the objective of sharing experiences and allow the growth of the sector, initially had 10 members currently has more than 20 (Develoment, 2019).

The evolution of autonomous vehicle sales has a growth perspective to 2035 in the 5 levels of this category. On the level of Fuel Cell Electric Vehicle-. FCEV, the most advanced level within the autonomous vehicle classification, will see growth of 4% in the European Union, 1% in the United States and 5% in China. Battery Electric - BEV vehicles will have an estimated growth of 67% in the European Union, 14% in the United States and 55% in China. The next category represented by the Plug-in Hybrid Electric Vehicle- PHEV has a growth outlook of 11% in the United Kingdom, 10% in the United States and 9% in China. With respect to traditional internal combustion cars in China, they have a decrease perspective with a reduction from 95% in 2020 to 32% in 2035, which is relevant since China is the leader in the sector (PWC, 2020).

The automotive sector has had sustained growth in the last years, which includes all types of vehicles marketed in the Asian Country in Vietnam there has been a sustained growth in sales in the last 15 years, going from 35,264 units sold in 2005 to 280,742 in 2020. Despite the effect generated by the COVID 19 pandemic, Vietnam managed to reach 240,811 Units in 2020, representing a reduction of 14% compared to the immediately previous year (Carsalesbase, 2021).

Figure 2. New Vehicle Sales by Autonomous Driving Development Level 2020-2035



Millions of units over the total in EU, USA and China

Source. Own elaboration based on (PWC 2021).

Considering the figure 2, for the Chinese market is estimated to 2040 approximately 14.5 million autonomous vehicles, focused on public transport, it will be driven by the regulations that the government currently has against gasoline-powered vehicles and the incentives for the manufacture of vehicles with new technologies that are friendly to the environment (Electrics, 2018).

The ranking of the 10 of the countries that are the preparation for the adoption of this type of technology are: Singapore, the Netherlands, Norway, Finland, Sweden, South Korea, the United Arab Emirates, the United Kingdom and Denmark. In Latin America the best positioned are Chile and Brazil; in this regard, KPMG insure that the preparation for this type of technology is based

on the analysis of 4 key indicators: Policy and legislation, Technology and innovation, infrastructure and consumer acceptance (Semana, 2020).

According to experts, countries such as Vietnam, China and India have very specific driving patterns compared to other countries in the world. It is precisely in this type of culture where the main challenges for the sector are found, however, they have the resources and public policies necessary to carry out the transformations that allow them to implement this type of technology (Insider, 2016). In order that context a decade later, Vietnam becomes one of the first manufacturers of autonomous cars with prototypes that will provide an adaptation not only of this type of vehicle but also of the technology necessary for its implementation (Vietnamnews, 2021). In this sense, university institutions such as Phenikaa University, make a call for the creation of joint investigations that allow to unveil the different factors that intervene in the processes of adoption and implementation of the technology of autonomous vehicles.

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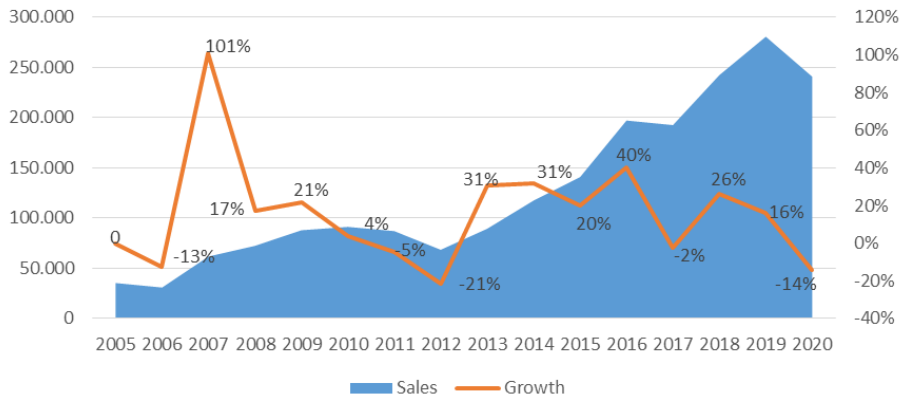
Figure 3. Vietnam automotive sector growth



Source. Own elaboration based on (Carsalesbase, 2021).

It is noteworthy that the most used means of transport in Vietnam is the motorcycle, however, the middle class has driven the change in the means of transport. For 2019, Vietnam imported more than 100,000 cars, which represents a growth of 267% compared to 2018, the government plays an important role in this sector since it has promoted the signing of a free trade agreement with the European Union. which will increase the competitiveness of the sector.

Vehicles registered in Vietnam in 2011 reached 112,254 units and in 2019 they reached 280,742 units, this represents an increase of 168,568 units that is equivalent to 150% compared to 2011. Although Vietnam is a country with very particular conditions to other countries in Asia, it is carrying out actions taken between 2015 and 2016 to enable the adoption of this technology, so much so that a goal was established 10 years to not only be a manufacturer - as can be seen today that they are already debuting with prototypes, but also for the implementation of the type of technology necessary for use on the streets. It is precisely these conditions that have led to the realization of studies that allow us to understand the behaviors of consumers that influence the success in the adoption of disruptive technologies for a country like Vietnam.

According to Asia perspective magazine, the automotive industry in Vietnam has been growing rapidly at more than 300% above the budget of the Ministry of Industry and Commerce of Vietnam. For the year 2019, the Vietnamese group VINGROUP inaugurated the car manufacturing plant called VINFAST FACTORY, this plant is not only at the forefront in terms of technology, but it is aligned with industry 4.0 standards.

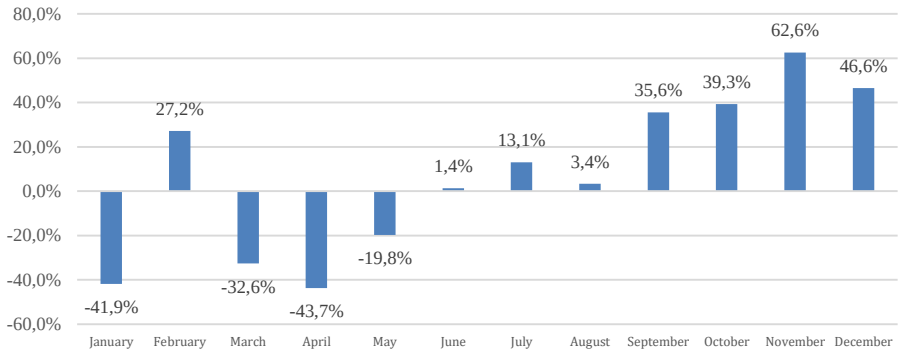
This plant has a great purpose and is to compete with multinationals such as Toyota, Ford, Nissan, Honda, the installation of this type of plant in the country has allowed investment in spare parts suppliers which has given the sector a boost to society additional within the country. (Perspective, 2020).

Another project that this company has been developing under the head of its founder PHAM NHAT VUONG is to open an electric vehicle manufacturing plant in the United States by 2022, this plan arises after opening a research office in California. The Drivers for this goal of the company is the recent permission it has by the California regulators to test autonomous vehicles on the streets, as well as the executive order that is in process to stop marketing gasoline-based vehicles by 2035, this would further strengthen the company's strategy. (Actualidad, 2021)

For the year 2020, the growth of the automotive sector in Vietnam could have a growth despite the pandemic, it obtained an increase of 8% compared to the immediately previous year, although the beginning of the year had an unexpected behavior, in February a positive change was observed which predicted a record year similar to those obtained in the years 2012 to 2016, but the pandemic slowed that expectation that was had For the year 2020 the growth of the automotive sector in Vietnam could have a growth despite the pandemic it obtained an increase of 8 % compared to the immediately previous year, although the beginning of the year had an unexpected behavior, in February a positive change was observed that predicted a record year similar to those

obtained in the years 2012 to 2016, but the pandemic stopped that expectation that was I had. (Focus2Move, 2021).

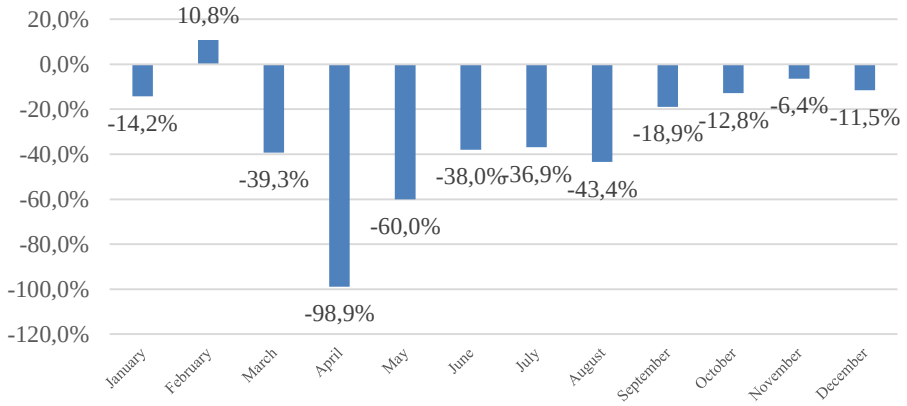
Figure 4. Vietnam monthly sales variation 2020



Source: Own elaboration based on (Focus2move, 2021)

The same did not happen with Colombia since sales were affected during 2020 by the Covid 19 pandemic, the year started with a good trend that showed growth of up to double digits, the market quickly collapsed with the pandemic entering into fury having decreases in sales for the month of March of more than 98%. Next, we show the behavior of the sector for 2020. (Focus2move, 2021)

Figure 5. Colombia Montly Sales Variation



Source: Own elaboration based on (Focus2move, 2021)

Vietnam is focused on starting the production of autonomous driving, one of these initiatives is led by Phenikaa Group an industrial automation company which recently presented a level 4 autonomous model, this vehicle has the ability to move lane automatically, adjust its speed depending on the route it is traveling as well as detecting traffic signals and pedestrian traffic, it is important to note that the driver can takes control of the vehicle at any time. This prototype arises after six-month joint work led by Phenikaa Group with the support of Phenikaa University and Phenikaa-X Joint Stock Company.

The company focuses all its expectations on this first vehicle manufactured in Vietnam to promote the development of the autonomous industry, in addition to this I managed to satisfy the technological needs and services that this type of products can offer not only in Vietnamese but also to be able to promote development at the level worldwide of the Vietnamese industry in this sector, this prototype will continue to carry out safety tests before going to the market (business, 2021).

Vietnamese company Finance and Promoting Technology - FTP has operated autonomous vehicles around its complexes in the central city of Da Nang, the campus of. Ho Chi Minh, roads in high-tech zones and software parks in Vietnam with the authorization of the Ministry of Transport. It also advances the installation and testing phase in real vehicles for the commercialization of a low-cost car model with an autonomous driving system. (vietnamplus, 2021). Competition for autonomous vehicles is growing, with the potential to expand rapidly in Southeast Asia as the region's upper and middle classes grow. FPT recorded a 14% increase in total sales equivalent to $ 1.76 billion in 2016, the figure is expected to grow to $ 47 trillion (vietnamplus, 2021).

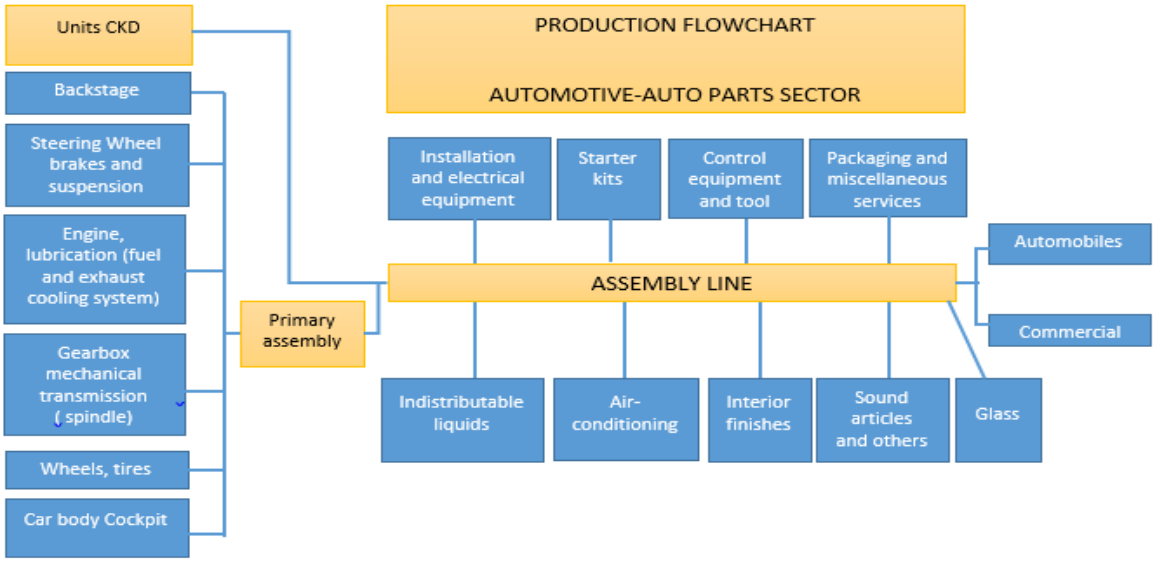
In relation to the above, the Vietnamese government since 2018 supports the FPT plan because it fits with global trends and the agenda of Industry 4.0 and 5.0 in Vietnam. The government has requested an FTP report on the results of the tests carried out with the driverless car, as well as solutions to address potential problems that may arise once it is put to the test on public roads; This shows the government's firm intention to support the massification of autonomous vehicles in this country, despite legal and infrastructure difficulties (Internacional, 2018). From the academy, the world's experts in autonomous vehicles suggest that the integration of these with telephones and the regulation of the countries will be key to reducing the implementation gap of this technology, especially in developing countries that do not have the characteristics of developed countries where aspects such as infrastructure or road culture is advanced (Insider, 2016).

5.2 Analysis of the automotive sector in Colombia

The automotive sector plays a fundamental role in the Colombian economy, represents 6.2% of industrial GDP, and generates more than 25 thousand highly trained and well-paid direct jobs that are equivalent to 19.1% of total employment. Additionally, the more than 100,000 indirect jobs generated in the manufacture of a great variety of automotive components through different production processes should be highlighted (ProColombia, 2019) (DANE, 2020)

This sector is classified as a “spearhead” for its contribution to the economy and its contributions to innovation and technology transfer for the country (ANDI, 2020) . The automotive sector in Colombia ranges from the assembly of vehicles and motorcycles to the production of parts and auto parts the figure 7 illustrates the production of the automotive flowchart which appeared in impacting other sectors such as electrical equipment, accessories and packaging among others, which shows the impact to other sectors.

Figure 6. Productive flowchart of the automotive and auto parts sector.



Note: Source: (ANDI, 2020) Accessed September 1, 2020 figure translated into English

In Colombia there are 8 vehicle and 7 motorcycle assemblers, which are shown in Table 2.

Table 2. Assembly companies operating in Colombia.

VEHICLE ASSEMBLERS	**MOTORCYCLE ASSEMBLERS**
General Motors Colmotores (Isuzu, Volvo and Chevrolet brands)	Autotécnica Colombiana SAS - AUTECO (BAJAJ, KTM, HUSQVARNA)
Automotive Manufacturing Society - SOFASA	Auteco Mobility (KAWASAKI, KYMCO, VICTORY)
Hino Motors Manufacturing SA (Hino brand - Toyota group)	AKT (AKT, TVS and ROYAL ENFIELD
Photon	INCOLMOTOS - YAMAHA
Non Plus Ultra bodies (own brand, CKD Volkswagen)	SUZUKI (SUZUKI)
Nissan Self-Assembly Company (Nissan brand)	FANALCA - HONDA
Navistrans SA (Agrale brand)	HERO MOTORS
Daimler (Mercedes Benz brand	

Source: Own elaboration based on (ANDI, 2020)

The production and commercialization of auto parts are part of the automotive sector and in Colombia, according to the ANDI (2020) , the following are produced: suspension systems, steering systems, exhaust systems, transmission systems, cooling systems, friction material electrical parts such as batteries and wiring, chemicals, wheels, tires, air filters, lubricants and fuels, fabric and leather upholstery, tempered, laminated and armor glass, chassis frames, air conditioners, rubber and metal parts and accessories, among others that in turn mobilize other sectors of the economy.

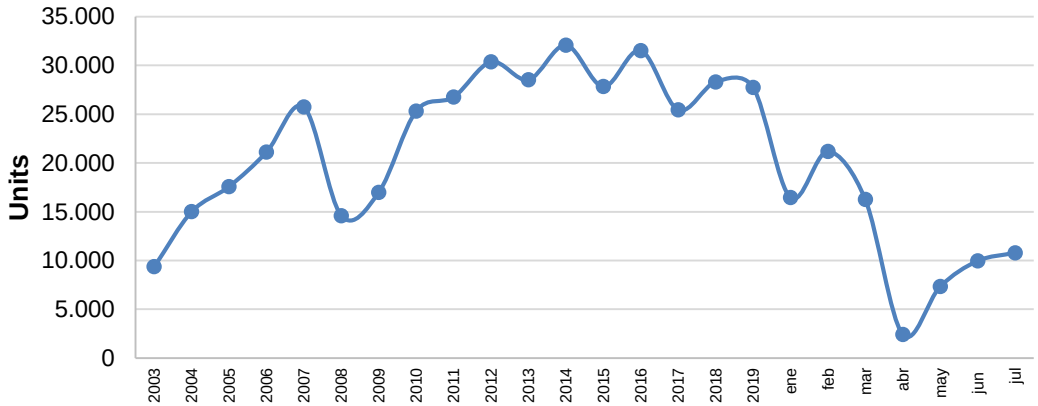
As stated, (FEDESARROLLO, 2014) the importance of this sector goes beyond production and consumption, it is significant for economic development due to the participation of the production chain in other businesses such as insurance companies, driving schools and products for production.

Vehicle sales in Colombia during the last 12 years have had a generally growing trend, however the economic environment has generated fluctuations; The Figure 6 shows that until 2007 an increase of the average turnover of 30% occurred during the 2008 period due to the global economic crisis there was a reduction of 43% reaching sales of 14,000 units, a situation was gradually improving during the period 2009-2012, for 2010 the sales level of 2007 was recovered and an average growth of 21% was presented, that is, 9 percentage points less than the trend before the crisis of 2008.

During 2012-2019 there was an ascending and descending behavior with a difference period of one year, since during 2013 there was a decrease of 6% and in 2014 an increase of 12%; This fluctuating behavior was maintained until 2019, the year in which there was a reduction of 2% compared to 2018, that is, prior to the Covid -19 pandemic, there were already periodic

fluctuations with a downward trend. However, sales levels remained between 25,000 and 32,000 units.

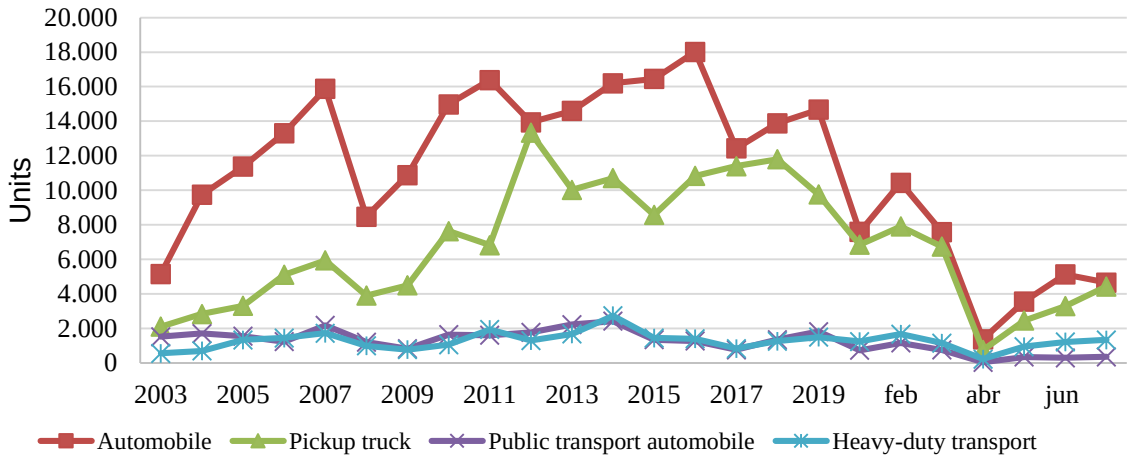
Figure 7. Units sold of motor vehicles.



Source: DANE, Monthly Survey of Retail Trade and Vehicles - EMCM 2003-2020.

The year 2020 began with a reduction in units sold of 41%, reaching the sales levels of 2008, there was a recovery of 29% in February but between March and April there was the highest drop in sales in the last 15 years with a reduction of 85%, this situation presents a slight recovery until July, which presented an average increase of 22%, which is a reasonable value for the sector.

Figure 8. ***Vehicle sales by sector***



Source: Dane, Retail Trade and Vehicle Monthly Survey - EMCM 2003-2020

Regarding the type of vehicles sold, the figure shows that private cars, trucks and vans are the vehicles that make the difference during the evaluation period, since public transport and cargo vehicles remain constant over time. The segment of vehicles most affected during the 2008 crisis was that of private cars, which had a negative variation of 47% and trucks 34%

After the crisis, the segment that started the recovery was automobiles and vans with 25%; In the case of automobiles, this behavior was maintained until 2012 where there was a reduction of 15%, which again began to improve until 2016 since in 2017 there was a reduction of 31%, maintaining the trend until 2019 where Between 10,000 and 15,000 units were sold, which is the range that was the level of units that were sold before the 2008 crisis.

It is worth mentioning that during 2012 there was a considerable increase in camper vans and vans where it reached a growth of 95% with respect to the crisis year of 2008, however, the behavior of sales had a negative trend that, although it had recoveries in the years 2016 to 2018, it did not exceed 1200 units.

During the first quarter of 2020 there was an average reduction of 13%, a situation that worsened in April, the month in which car and camper sales were reduced by 82% and 89% respectively. During the months of May, June and July there has been a slow recovery, however, pickup truck barely reach the sales levels of the 2008 crisis and cars sell 50% less than the units that were reached during the same period, which allows us to infer that in this segment the impact has been two times greater than in 2008.

In general, although the first half of the year represented a severe blow to the automotive industry, the second half has demonstrated the sector's resilience in the face of the crisis. According to the latest report of the Andemos (2020), the recovery of the sector, especially in October, it has been due to the need for consumers to have safe transportation, the reopening of economic activity and efforts commercials to leave the inventory of the 2020 models. Among the efforts made, the greater presence of brands in electronic marketing channels and their greater digital presence both for the promotion and for the shopping experience, in addition to government incentives for the purchase of electric and hybrid vehicles, have been keys. (Rate Analitik, 2020).

According to an article in the money magazine, the CEO of Frontier Car Group -FCG Colombia Felipe Garcia, states that in the context of the COVID -19 pandemic and therefore companies in the automotive sector must reinvent themselves, be more efficient in their operation, digitize their processes with the objective of providing innovative experiences to its clients, favoring virtual tools rather than face-to-face. Likewise, consumers are expected to migrate to low-cost vehicles, with the aim of improving mobility and preventing infections as a result of the COVID-19 pandemic; Likewise, another segment of customers with a greater willingness to pay will demand vehicles with new biosecurity features that motivate product innovation in this sector,

for example Hyundai has recently incorporated a purification system in vehicles and the trend of autonomous vehicles is increasing.

Regarding the perspectives of autonomous vehicles in Colombia, it is considered that in technological and infrastructure aspects there are still important gaps. Challenges are presented around uncertainty about the business model they will have, cybersecurity, legal viability and the availability of 5G networks (Dinero, 2021). It is expected that the first autonomous cars to arrive in Colombia will be the least complex, configured to use specific roads and will be focused on replacing transport vehicles in closed areas such as airports, later shared circulation vehicles will be introduced whose development and testing stage will take time more (Time, 2021).

Advances in 5G technology for wireless communication are the required partner to promote the development of autonomous vehicles in Colombia. This type of vehicle is classified in 5 levels, where level fifth is completely autonomous, it is noteworthy that some companies have vehicles in third level that send and receive information, as well as remote orders; Such is the case of the firm Anglo Gold Ashanti the case of the test of the first autonomous vehicle in Colombia in April 2021 developed with 5g technology. The test was carried out in the mining sector for cargo transportation; These initiatives demonstrate the importance of autonomous driving not only in cities but also applied to different productive sectors with the aim of increasing the competitiveness of developing countries such as Colombia (Semana, 2021)

Moovit, a company of Israeli origin aimed at collecting information to improve mobility in cities is another case of application in Colombia. In 2012, this company made its first alliance with foreign firms or entities with the mass transportation company of the city of Bogotá ¨Transmilenio", in which they continuously worked on the design and creation of routes.

Additionally, this alliance will get to Moovit to know the Potential demand in autonomous driving for Latin America and to be a platform for other projects of this type in Chile.

The penetration potential of this type of company in Latin America is confirmed with the recent acquisition of Moovit by Intel, which reached an approximate value of 900 million dollars. This acquisition aims to strengthen and accelerate the supply of mobility for theft taxis, which estimates a market by 2030 of 160 million per year. Likewise, in 2017 Intel acquired ¨Mobileye¨, a pioneer firm in the development of autonomous vehicles, the acquisition of these two companies will allow it to have allies for the development of these technologies.

Although Colombia is a developing country and the implementation of autonomous driving technologies is perceived as distant, there are already industrial and public applications that are the basis for the development of the private autonomous vehicle market in Colombia (Tiempo, 2020).

6. RESULTS

6.1 Trend of purchase intention in the face of socio-technical changes in the automotive sector in Colombia and Vietnam.

The invariance of the measurement model is evaluated. The first step was reversed all items and the order is counterbalance within questionnaires (Podsakoff, MacKenzie, Lee, y Podsakoff, 2003). Subsequently, there was a control in the format of each scale and their items (MacKenzie & Podsakoff, 2012). The Equal Factor Loading is evaluated to check that questionnaire did not change the form of measure in each country which was evident when the changed in $\chi 2$ Indicator is not significantly different.

The Table 3 shows the relationship between our latent variables. Then the multi-group model is the reference to explain our hypotheses because when was compared to total sample, the multi-group reported more liberty degrees, but it was better in the level of Chi Squared (difference between $x2 = 12$, $p< 0{,}001$). In other indicators, the differences were not significate between these models. Therefore, the globally significant differences are accepted for the analysis in Colombia and Vietnam.

Table 3. ***Model relationships***

		Colombian		Vietnam	
	Parameter	Coefficient	*T Value*	Coefficient	*T Value*
Financial Risk	β_{31}	0,21	1,34	0,54	4,59***
Social Risk	β_{13}	0,43	2,97***	0,23	1,10
Time Risk	β_{21}	0,47	3,01***	-0,29	2,70***
Psychological Risk	β_{32}	0,33	1,97*	0,45	3,04***
Performance Risk	β_{42}	0,34	1,86*	0,42	2,86***

Source: Own elaboration

Hypothesis 1 is confirmed, where it is stated that country with high degree of indulgence (Colombia) the perception of financial risk has not influence on the purchase intention. ($\beta = 0.21$; $p > 0.01$) and for the sample in Vietnam ($\beta = 0.54$; $p < 0.01$). In this sense, it is possible to show the existence of significant differences in the results of this relationship with respect to the two samples ($t = 2.40$ $p < 0.01$).

Regarding Hypothesis 2, it is established that Country with High degree of indulgence (Colombia) negatively influences the relationship between the perception of psychological risk and the purchase intention ($\beta = 0.33$; $p < 0.10$) while it is not managing to confirm in the sample in Vietnam ($\beta = 0.43$; $p > 0.1$).Additionally, Hypothesis 3 is verified where it is stated that Country with high degree of indulgence (Colombia) the relationship between the perception of time risk and the purchase intention is not significative ($\beta = 0.47$; $p < 0.1$) But, for Vietnam is ($\beta = 0.29$; $p < 0.1$).

For Hypothesis 4 that affirms the country with High degree of indulgence, the perception of social risk affected positively on the purchase intention. For Colombia ($\beta = 0.43$; $p < 0.1$) but Vietnam this relationship between social risk and purchase intention is not significative ($\beta = 0.45$; $p < 0.1$), being able to detect significant differences in this relationship for the two different countries ($t = 10.05$; $p < 0.01$).

Finally, Countries with high degree of indulgence (Colombia), the performance risk influence positively the purchase intention (β 22 = 0.34; $p < 0.1$) and Vietnam (β 22 = 0.42; $p < 0.01$)

CONCLUSIONS

The main objective of this study is to examine the effects of moderation of the cultural dimension "indulgence" in the relationship between perceptions of risk (financial, social, time, psychological and network externalities risk) and purchase intention of autonomous car in two countries with different degrees of indulgence (Vietnam and Colombia). Vietnam being a non-indulgent Society, its planning processes are more structured, some return is always expected beyond the well-being generated by the product. While in the most indulgence societies the corresponding return analysis is not made. Given the current conditions to stimulate the adoption of purchase, subsidies are started to be established for its purchase. In addition, the inputs of traditional vehicles decrease, resulting in an increase in their cost. In the Colombian case, financial risk is not considered an important decision factor, because the people do not make a detailed analysis of the purchase due to its tendency to buy products for emotional reasons. The above describes those purchases are more impulsive and there is no exhaustive planning of the same.

In the case of psychological risk, it can be observed that there is an influence in both countries (Vietnam and Colombia), this is considered for the decision to purchase this type of vehicle. For less indulgence countries, the relationship is stronger due to their high frustration capacity in the results that can be obtained with this type of technology. The foregoing can be explained considering that in regulatory contexts the guarantees that users have are greater, while in less regulatory countries the uncertainty in the purchase may be greater.

In countries with a low degree of indulgence such as Vietnam, a high time risk can mean a waste of time and can negatively influence the purchase intention. The above, due to the emphasis on the obsolescence and durability of the product. For more indulgence countries, no relationship

is found since the analysis of the durability of the product is less because purchases are more emotional.

For societies with a high level of indulgence, the social risk is significant because purchases are emotional, and the opinions of other people are very important for the purchase intention. However, for fewer indulgence countries such as Vietnam, this will not be a significant factor in the purchase intention of this type of product due to its regulatory nature. On the other hand, in countries with a high degree of indulgence, emotions become a highly influential factor in the acquisition of high-tech cars, as is the case in Colombia.

In the case of performance risk, for countries like Colombia, it is significant, but it is more important for countries like Vietnam with lower indulgence. The above can be explained by the need for more normative populations to have relevant information on the functionality of the products. In countries with more indulgence, information is less important as a purchasing factor for this type of product.

Academic contributions

From a theoretical perspective, this study aimed to approach social technical theory that allows us to analyze the elements of the risk of technology adoption in societies with different level of indulgence. Colombia is associated to weak control of their desires and impulses in every aspect of their life. While Consumers in Vietnam are less indulgence and their decisions tend to analyze aspects such as performance, financial and psychological aspects.

Managerial Contributions

The managers of the organizations must carry out technological surveillance and analysis of trends about new products, services and social changes in the environment of their sector, therefore analyzing the changes in trends in the intention to purchase autonomous vehicles provides timely information so that the sector automotive companies in developing countries design strategies for the future production and / or commercialization of autonomous vehicles.

Analyzing trend changes from the perspective of sociotechnical systems, allows managers to understand the multi-level interactions between the company and its context (processes, people and technology) and in this way consider a consumer vision that allows them to generate relevant strategies to better meet the needs of its customers in the adoption of new technologies.

Future research lines

Our research has important contributions; at the same time, we recognize its limitations. First, our data is limited to data from consumer in two countries: Colombia and Vietnam and their data were collected for 2019 (transversal model). Future research can confirm these relationships with data of other countries such as Latin-American countries that reported high degree of indulgence or countries when indulgence is low compared with other dimensions. Other future studies could conduct comparative research with more Hofstede dimensions to obtain cultural analysis with more details.

One of the limitations of this research is the focus on countries where autonomous vehicles will not be commercialized in the short term, however the theory allowed us to carry out an analysis that opens up a panorama for the application of autonomous vehicles in developing countries.

Therefore, the future line of research is to make a comparison between countries that have the option of applying the technology in the short term with others that have the option in the long

term. Likewise, it is proposed to carry out studies around the limitations in infrastructure, regulations and civil liability in the countries that are the object of this study.

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