Universidad
Rey Juan Carlos

TESIS DOCTORAL

Generation of Dynamic Capabilities through Digital Transformation in organizations within the automotive sector

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ABSTRACT

Purpose: The objective of the thesis is to validate the generation of dynamic capabilities through digital transformation in the automotive sector. Secondly, to validate the influence that digital transformation through the generation of dynamic capabilities have into customer satisfaction, financial results, and creation a sustainable competitor advantage.

Methodology: From an analysis based on a literature review, a model is built. Later, a SEM analysis to validate the model created is done.

Findings: This study reveals the rapid evolution of digital transformation in organizations, specifically in the automotive industry, which has evolved towards autonomous driving, connectivity, and mobility. It also evidences the expectations of the positive effects of digital transformation on the creation of organizational value and competitive advantages, with the consequent improvement in financial results and customer satisfaction. Findings contribute to the literature on empowering leadership and innovative firm performance results by highlighting those competitive advantages act as mediator to improve dynamic capabilities and enhance the firm performance results.

Research limitations: This is a preliminary attempt to demonstrate the influence of the dynamic capabilities in the automotive industry under digital transformation into customer satisfaction as well as financial results acting competitive advantages as a mediator that transmits the effects of Dynamic Capabilities to Finance results. The most representative limitation is the difficulty of obtaining a larger sample, because out of 142 surveys, 42 responses were obtained as valid.

Practical implication: The results of this research are intended to benefit executives and managers of organizations so that they can perform a quick analysis of their market conditions, based on the effects of their dynamic capabilities on their customer satisfaction as well as financial results creating a sustainable competitive advantage. Furthermore, this research emphasizes the influences of competitive advantages as mediator of dynamic capabilities and firm performance results.

Originality/value: First, the automotive industry is continuously impacted with the introduction of new technologies, which makes it necessary for organizations to adapt to the fast pace of growth. Moreover, there is a need within the automotive sector at critical and unexpected moments, such as the one we are currently experiencing because of the Covid-19 pandemic to create dynamic capabilities to influence the operating profit margin as well as improving the customer satisfaction of the company.

Keywords: Digital transformation, dynamic capabilities, financial results, competitive advantage, automotive industry, SEM analysis.

RESUMEN

Objetivo: El propósito de la tesis es evaluar la actuación de la transformación digital en la generación de capacidades dinámicas en el sector de la automoción. En segundo lugar, validar la influencia que la transformación digital a través de la generación de capacidades dinámicas tiene en la satisfacción del cliente, los resultados financieros y la creación de una ventaja competitiva sostenible.

Metodología: A partir de un análisis basado en una revisión bibliográfica, se construye un modelo. Posteriormente, se realiza un análisis SEM para validar el modelo creado.

Resultados: Este estudio revela la rápida evolución de la transformación digital en las organizaciones, específicamente en la industria de automoción, que ha evolucionado hacia la conducción autónoma, la conectividad y la movilidad. También evidencia los efectos positivos de la transformación digital en la creación de ventajas competitivas, con la consiguiente mejora de los resultados financieros y la satisfacción del cliente. A su vez, los resultados contribuyen a la literatura destacando que las ventajas competitivas actúan como mediadores para mejorar las capacidades dinámicas y mejorar los resultados de la empresa.

Limitaciones de la investigación: Se trata de un intento preliminar de demostrar la influencia de las capacidades dinámicas en la industria de la automoción bajo transformación digital en la satisfacción del cliente, así como en los resultados financieros actuando las ventajas competitivas como mediador que transmite los efectos de las Capacidades Dinámicas a los resultados financieros. La limitación más representativa es la dificultad de obtener una muestra más amplia, ya que, de 142 encuestas, se obtuvieron 42 respuestas validas.

Implicación práctica: Los resultados de esta investigación pretenden beneficiar a los ejecutivos y gerentes de las organizaciones para que puedan realizar un análisis rápido de sus condiciones de mercado, basado en los efectos de sus capacidades dinámicas en la satisfacción de sus clientes, así como en los resultados financieros creando una ventaja competitiva sostenible. Además, esta investigación destaca las influencias de las ventajas competitivas como mediadoras de las capacidades dinámicas y de los resultados de la empresa.

Originalidad/valor: En primer lugar, la industria del automóvil se ve continuamente afectada por la introducción de nuevas tecnologías, lo que hace necesario que las organizaciones se adapten al nuevo entorno. Además, en dicho sector, existe la necesidad en momentos críticos e inesperados, como el que estamos viviendo actualmente por la pandemia de Covid-19, de crear capacidades dinámicas que influyan en el margen de beneficio operativo, así como en la satisfacción al cliente.

Palabras clave: transformación digital, capacidades dinámicas, resultados financieros, ventaja competitiva, satisfacción al cliente, industria del automóvil, análisis SEM.

ACKNOWLEDGEMENT

This thesis would not have been completed without the contribution, encouragement, and support from many people.

So, I would like to express my gratitude to all those who supported me in writing this thesis.

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To my wife, Rebeca and my three kids: Gema, Pablo and Alejandra. Their tolerance and support enabled me to accomplish this work.

Besides, I would like to thank all those who have participated by sharing their views on what was asked to carry out the study. Thanks to them, I've got answers to work with.

Finally, to all those who made this success possible.

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To my wife, Rebeca and my three kids: Gema, Pablo and Alejandra

To my parents Pablo, Teresa, Victor and Charo for their love, teachings, and advice

A very special dedication to my mother whom I always carry in my heart.

To my sisters, Patricia and Barbara whom I adore.

FROM

"Any customer can have a car painted any color that he wants so long as it is black."
Henry Ford

TO

"It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is the most adaptable to change"

Charles Darwin

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THEORETICAL PART

CHAPTER 1.

RESEARCH PRESENTATION

This chapter aims to provide a brief description of the problem identified in this study. Besides, it details the objectives of this research and raises specific research questions to achieve the proposed objectives.

This chapter also includes the structure of the research work that has been undertaken to carry out this study.

CHAPTER 1. RESEARCH PRESENTATION

1.1 INTRODUCTION: GENERAL CONSIDERATIONS

The Spanish automobile industry is a benchmark worldwide. The companies of automobile and component manufacturers form a tandem of recognized prestige in terms of competitiveness and results. The sector is an example of success both inside and outside of our country for its dynamism and its ability to generate growth in an environment as complex as the one we are going through (Sernauto, 2020).

With the emergence of new digital technologies, the ongoing digital transformation is argued to heavily impact core business with the companies. This has generated unique challenges and introduced an increasing need or organizations to take steps towards innovating their business models. Therefore, a disruptive change through business model innovation is via the dynamic capability framework- consisting of sensing, seizing as well as transforming micro-foundations (Rof, Bikfalvi and Marqués, 2020).

Furthermore, an organization's business model illustrates the design or architecture of value creation, delivery, and capture mechanisms (Teece, 1986; 2006). The main purpose of a business model is correspondingly to define the way the firm delivers value to customers, attracts customers to pay for value, and converts those payments to profit (Teece, 2010). Digitalization increases the opportunities for organizations to interact with customers, which has led to new and unexpected business model innovations (Amit and Zott, 2001; Aspara, Lamberg, Laukia and Tikkanen, 2013; Chesbrough, 2010; Khanagha, Volberda, Oshri, 2014; Wirtz, Schilke and Ulrich, 2010).

For sure, one sector that has experienced enormous change within the year to come is the automotive industry (Gao, Müller, Kaas, Mhor, Wee, Hesnley, Guan, Möller, Eckhard, Bray, Beiker, Brotschi, Kohler, 2016). The international environment has changed, the competition has moved from a regional level to a global level in which plants compete internationally to capture new models as well as new parts and components.

To this phenomenon, it must be added that the industry faces a change of production model, in which to be adapted with greater flexibility and speed to the new disruptive models characterized by connectivity, alternative energy vehicles, digitization and automation (Hanelt, Piccinini, Gregory, Hidelbrandt and Kolbe, 2015) will be necessary. Finally, the environment and changes in the consumer, a new formula of urban mobility, must be served from industry and marketing, offering new business models (Berman and Bell, 2011).

The automotive industry is a strategic sector of the Spanish economy, having become one of the pillars of our economy (Asociación Sernauto, 2020). Without a doubt, one of the factors that most contributes to its success is the high competitiveness of the Spanish industry in the auxiliary automotive sector, specifically components and spare parts.

In 2020, the Automotive Equipment and Components sector billed 32,127 million euros (Anfac, 2021). Of this amount, 62% corresponded to exports. Spain occupies a prominent place in the European manufacturing ranking by number of vehicles, being the second European producer of passenger cars and the first of industrial vehicles. Worldwide, Spain is the eighth largest vehicle producer (Anfac, 2021). The agents that make up the auxiliary sector have been classified as First Equipment Market and Replacement Market.

Dynamic capabilities enable business enterprises to create, deploy and protect the intangible assets in a sustainable performance (Teece, 2004). For analytical purposes in the thesis, we are going to disaggregate dynamic capabilities into the capability of sensing and shaping opportunities and threats, seizing those opportunities and to maintain competitiveness through innovation. Considering the investments that the automobile industry has done in digital transformation in the last decades (Faconauto, 2019 special edition about mobility and connectivity), determining whether the degree of digital transformation produces an improvement in financial results, greater customer satisfaction and therefore allows obtaining a sustainable competitive advantage over time is key.

The objective of the thesis is to identify relations between digital transformation (IoT, Big Data and Artificial Intelligence) and the micro-foundations of the dynamic capabilities within the automotive sector. Besides, to explore digital transformation through the framework of dynamic capabilities. The study is aimed at investigating the nature of building dynamic capabilities for business model innovation towards the ongoing digital transformation.

In a nutshell, if automotive enterprises with strong dynamic capabilities they do not only adapt to business ecosystems but also create a long-run competitive advantage.

The choice of our work is due, on the one hand, to the interest of the researcher based on his professional experience, the lack of conclusive results on the subject, and the growing evolution in digital transformation that companies have been carrying out in recent years oriented to connectivity, autonomous driving, and mobility.

What is new is that customer expectations have also changed. People everywhere are using social networks to find jobs and restaurants, lost friends, and new partners – and, as citizens, to achieve common political goals (Dentzel, 2014). They are using the Internet for entertainment, shopping, socializing and household management. How can businesses best respond to this shift? How can they take advantage of the opportunity to innovate, differentiate and grow? And how can they do all this cost efficiently, leveraging and optimizing the newest information technologies as part of their overall physical operations? In our analysis of leading companies and our work with clients, we will find companies with a cohesive strategy for integrating digital and physical elements oriented to successfully transform their business models – and set new directions for entire industries.

1.2. PROBLEM IDENTIFICATION

Considering the research gap, the market evolution, and the importance of the digital transformation within the automotive sector, the purpose of this thesis is to explore the digital transformation through the framework of dynamic capabilities.

The research question that will drive our study is:

How do organizations in the automotive industry build dynamic capabilities through digital transformation?

1.3. JUSTIFICATION OF THE OBJECT OF STUDY

The choice of topic for this research is mainly motivated by the following reasons:

- The limited existence of conclusive studies on the influence generated by digital transformation in the automotive sector, in comparison with the abundant studies related to the incorporation of information technologies in organizations and their implications.
- The proactive attitude that companies are developing towards digital transformation. Above all, due to the pressure of the objectives and increases in productivity year after year.
- The belief in the possibilities that digital transformation allows greater efficiency in personnel, processes, communication, customer satisfaction, better financial results to achieve a sustainable competitive advantage.
- The lack of studies and indexes that make it possible to relate, concisely, digital transformation processes with greater capabilities and in the lack of an exact percentage per year.
- The interest aroused by this study for all Managers, General Directors, etc. They are analyzing the fastest way to reach differences with their competitors without having to increase their personnel costs.
- The need for companies at critical and unexpected moments, such as the one we are currently experiencing because of the Covid-19 pandemic, to develop processes that allow operating in the virtual context.

1.4. OBJECTIVES

The main objective of the thesis is to validate the generation of dynamic capabilities through digital transformation in the automotive sector.

Starting from the previous paragraph, we determined a series of specific objectives, which could be grouped as follows:

Choose and describe, based on a previous bibliographic analysis, the measures, and reasons for the evaluation of the different variables to be analyzed for the subsequent design of the research.

Analyze the relationship of each of the variables with the results obtained from the empirical study. Determining whether the degree of digital transformation produces an improvement in financial results, greater customer satisfaction and therefore allows obtaining a sustainable competitive advantage over time within the automotive sector.

Offer and describe a model for measuring results, as well as empirical validation of the different hypotheses proposed.

Examine whether the digital transformation is associated with any characteristic result and thus conclude that it has an impact on the business model with similar behaviors in companies in the automotive industry.

Finally, customers keep changing dramatically in the way they shop and try to outperform their expectations continuously. In addition, organizations in the automotive sector, increasingly competitive companies try to optimize resources, restructure themselves, and find their competitive advantage. Further, there is a need that companies have at critical and unexpected moments, such as the one we are currently living because of the Covid-19 pandemic of having developed processes that allow operating in the virtual context.

1.5. STRUCTURE

The doctoral thesis is structured in four parts and six chapters, as can be seen, synthesized in Table 1. In addition to the introduction, the conclusions, the bibliography, the glossary of terms and finally the annexes, the thesis is divided into a theoretical and an empirical part.

THEORETICAL PART:

- Chapter 1: Presentation
- Chapter 2: Conceptual framework
- Chapter 3: Field of research.

EMPIRICAL PART:

- Chapter 4: Design and methodology:
  - Research model
  - Hypothesis approach
  - Information sources
  - Methodology
- Chapter 5: Results
- Chapter 6: Discussion/ Conclusion and future lines of research.

Table 1. Structure

THEORETICAL PART

CHAPTER 1 : INTRODUCTION
Background
Objectives
Structure
Chapter summary

CHAPTER 2: CONCEPTUAL FRAMEWORK

CHAPTER 3: FIELD OF INVESTIGATION

EMPIRICAL PART

CHAPTER 4: DESIGN AND METHODOLOGY
Field of Investigation model
Hypotheses approach
Information sources
Methodology

CHAPTER 5: RESULTS
Validation of the hypotheses
Results presentation

CHAPTER 6: CONCLUSION
Limitations and constraints
Open future investigations

Source: Author´s own (2019)

1.6. CHAPTER SUMMARY

As it has been observed in the previous table, the present doctoral thesis is made up of six chapters grouped into four parts, in addition to the beginning, an explanatory statement is introduced and it ends with the bibliography, a glossary of terms, a list of the tables used and annexes.

In summary, we would like to reflect the most important aspects of each of the parts:

PART I

Chapter 1 includes general considerations, the objectives we seek, in addition to preparing the structure of the doctoral thesis and containing this summary.

PART II

In the second chapter, the "conceptual framework" appears where the reasons for choosing the Dynamic Capabilities Theory are reasoned for being the most appropriate framework for the validation of this doctoral thesis and what the digital transformation consists of. The most important section of this part is the exhaustive review of the literature that has been carried out over the years.

In the third chapter, the scope of the investigation, the automotive sector, the components, and spare parts of the sector are defined, as well as the characteristics of these companies that will later be used through the questionnaires.

PART III

In the fourth chapter, the proposed analysis model is presented, in which the type of approach for the study is indicated, accompanied by the corresponding graphic representation and description.

In addition, the approach of the different hypotheses raised in this research work is included, ending it with the description of the information sources (data collection, the questionnaire and the techniques and procedures for data analysis) and the methodology used. Chapter five presents the results obtained in this research.

PART IV

Part IV is made up of the sixth chapter where the fundamental conclusions, the observed limitations and the future lines of research are stated.

To end the doctoral thesis with a glossary of terms, the bibliography used, the list of tables used, and the various annexes are presented.

CHAPTER 2.

CONCEPTUAL FRAMEWORK

This chapter provides a comprehensive review of the relevant literature. Specifically, research in relation to key concepts such as digital transformation, dynamic capabilities, and the relationship within the automotive sector.

CHAPTER 2.
CONCEPTUAL FRAMEWORK

2.1 THEORETICAL BACKGROUND

The fourth industrial revolution, more broadly, has technologies divided into the categories: physical, digital, and biological (Schwab, 2016). The digital category includes Internet of things (IoT), Artificial Intelligence and Big Data, which are part of the so-called Digital Transformation, which is a perspective of the use of information and communication technology (ICT), where it comes to act as a preponderant element in the transformation and reconfiguration of organizational elements, such as: strategy, processes, culture, and structures (Hess, Matt, Benlian and Wiesböck, 2016).

Organizations need to be able to reconfigure themselves in the face of such a competitive market. These Dynamic Capabilities (DC) allow organizations to feel and shape opportunities and threats; seize opportunities and maintain competitiveness through the enhancement, combination, protection, reconfiguration of intangible and tangible assets (Rotjanakorn, Sadangharn and Na-Nan, 2020).

The popular term "digital transformation" has become a crucial element on every leader's agenda. Fitzgerald et al. (2014, p. 2) have defined digital transformation as "the use of new digital technologies [...] to enable major business improvements such as enhancing customer experience, streamlining operations, or creating new business models". Just recently, Warner and Wäger (2018, p. 19) have contributed with conceptualizing the scope of this definition by adding that "Digital transformation is an ongoing process of strategic renewal that uses advances in digital technologies to build capabilities that refresh or replace an organization's business model, collaborative approach, and culture".

Firms' competitiveness and economic performance have been influenced by innovation capability. For this reason, numerous investigations have been devoted to the study and understanding of the innovation process and the innovative capability of companies (Amit and Zott, 2001; Aspara *et al.*, 2013)

Digitalization increased the opportunities for organizations to interact with customers, which has led to new and unexpected business model innovations (Chesbrough, 2010; Wirtz *et al.*, 2010).

One key aspect of digital transformation is thus business model innovation (Khanagha *et al.*, 2014). Successful digital transformation requires enterprises to develop a wide range of capabilities while implementing digital technology in the center of business operations, aligning as well as creating a digital transformation strategy, and more importantly, potentially re-thinking or re-inventing their business models to sustain competitive advantage (Zinder and Yunatova, 2016).

As firms have high expectations linked to business model innovation and start a number of initiatives to change the way they create value, it seems clear that the academic research agenda needs to move forward to develop a better understanding of these complex transformations (Matt, Hess and Benlian, 2015; Warner and Wäger, 2018).

While digital transformation is becoming a popular topic for the ongoing changes within society and organizations, the current state of literature is lacking substantial conceptual and empirical research that outlines how organizations are becoming digitally transformed (Fitzgerald, Kruschwitz, Bonnet and Welch, 2014; Hess *et al.*, 2016; Singh and Hess, 2017). Digital transformation is different from traditional forms of strategic changes in a way that digital technologies have increased the speed of change processes – resulting in an environment that is much more volatile, uncertain, complex and ambiguous (Matt *et al.*, 2015; Schoemaker, Heaton and Teece, 2018).

On the other hand, dynamic capabilities are primarily represented through a micro-foundation's perspective. This is a view that consists of (1) sensing opportunities and threats, (2) seizing opportunities, and (3) transforming/innovation of the organization's business model (Teece, 2007; Arndt and Pierce, 2018; Salvato and Vassolo, 2017), by maintaining competitiveness through enhancing, combining, protecting, and when necessary, reconfiguring the enterprise's tangible and intangible assets (Teece ,2007).

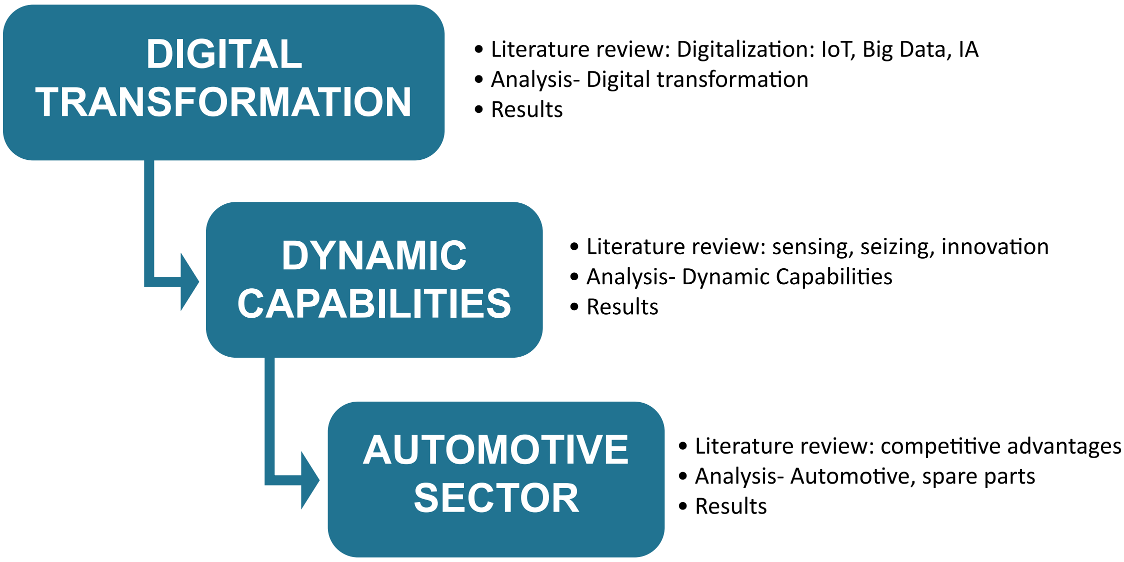
However, recently, Warner and Wäger (2018) have initiated research of implementing both topics, by redefining digital transformation and building up a process model based on the observations of senior executives' experiences on how incumbent firms in traditional industries create dynamic capabilities for digital transformation (Warner and Wäger, 2018).

Additionally, they reveal that digital transformation is an ongoing process of using new digital technologies in everyday organizational life, which recognizes agility as the core mechanism for the strategic renewal of an organization's (1) business model, (2) collaborative approach, and eventually the (3) culture (Warner and Wäger 2018).

The analysis of the literature carried out in this chapter allows us to corroborate that there are few previous written works that relate the digital transformation and the dynamic capabilities applied to the automotive sector. However, there are studies that show that digital transformation helps to create value (Reddy and Reinartz, 2017), and academic articles that confirm the influence that digitization has on innovation processes in companies (Rachinger, Rauter, Ropposch, Vorraber and Schirgi, 2018).

Based on this, we propose the following research design that will be addressed in the following paragraphs:

Table 2. Research design



Source: Author´s own (2020)

To know the studies that previously maintain this relationship, we investigated if there are previous works in the literature. The terms searched are: "Digital Transformation and Dynamic Capabilities", "Digital Transformation and Automotive Sector", "Dynamic Capabilities and Automotive Sector". The most important databases used were ABI Research, Econlit, Academic Search Premiere, Google scholar, Springer, Science Direct from the period between years 2001 and 2020.

In the following table, a synthesis of the found literature is made, that is interesting for this study. The results are presented in the following table.

Table 3. Research result. Digital Transformation, Dynamic Capabilities and Automotive sector

Section	Subsection	Reference
Digital Transformation		Cohen and Schmidt (2013).; Gaiardelli et al. (2014).; Schaible and Bouée (2015.); Warner and Wäger, (2018).; Loonam et al (2018); Reis et al. (2018); Fitzgerald et al. (2014); Ross et al. (2017); Matt et al. (2015); Bharadwaj et al. (2013); Li et al. (2018); Kaufman and Horton (2015); Schuchmann and Seufert (2015); Hess et al. (2016); Abdelaal and Zaki (2018); Venkatraman (1994); Sjödin et al. (2016); Vendrell-Herrero et al (2017); Nochta, Badstuber, and Noura, (2019); Zhou (2013); Kowalkowski et al. (2013); Hanelt et al. (2015); Schaible and Bouée (2015); Rijswijk, (2020)
	Digitalization, digitization and digital transformation	Kääriäinen et al (2017); Brennen and Kreiss (2014); Csik (2014); Bloomberg, (2018); Stolterman and Fors (2004); Kääriäinen et al. (2017); Henriette, Feki and Boughzala, (2015); Jacobi and Brenner (2017); Schwertner (2017)
	Elements of the Digital Transformation: IoT, Artificial Intelligence and Big Data	Ashton (2009); Gubbi et al. (2013); Mukherjee et al. (2017); Makridakis (2017); Schwab (2016); Rich (2012); McAfee and Brynjolfsson, (2012)
Dynamic Capabilities		Henderson and Cockburn, (1994); Kogut and Zander (1992); Teece, Pisano and Shuen (1997); Qaiyum and Wang (2018) Bendig et al. (2018); Roy and Khokle (2016); Karimi and Walter (2015); Kevill et al. (2017); Rotjanakorn, Sadangharn, and Na-Nan (2020); Helfat et al. (2007); Ambrosini et al. (2009); Huang and Li (2017); Cezarino et al. (2019) Prange et al. (2018) Wang et al. (2018); Akram and Hilman (2018); Wang et al. (2018); Tondolo, Tondolo, Puffal, and Bittencourt (2015); Schwerter (2017); Wagner y Wäger (2019); Bastanchury-Lopez, De-pablos-heredero, García-Martínez and Martín-Romo Romero, S. (2019); Eisenhardt and Martin (2000); Bharadwaj et al. (2013) Teece (2007); Yeow, Soh and Hansen (2015),; Kindström, Kowalkowski; And Sandberg (2013); Fisher et al. (2010); De Pablos Heredero, Fernández Valero and Blanco Callejo (2017); De Pablos Heredero and López Berzosa (2012)
	Micro-foundations	Bendig et al. (2018); Roy and Khokle, (2016) Kevill et al. (2017); Teece (2007); Dixon et al. (2014) Bendig et al. (2018); Kindström et al. (2013) Helfat and Peteraf (2015); Battisti and Deakins (2017)
	Sensing	Teece, (2007); Helfat; Peteraf, (2015); Roy and Khokle (2016); Akram and Hilman (2018) Zhao et al. (2019); Bendig et al. (2018); Battisti and Deakins (2017); Teece (2014); Jacobi and Brenner (2017)
	Seizing	Matysiak *et al.,* 2018; Teece, (2007); Roy and Khokle (2016); Helfat and Peteraf (2015); Teece et al. (2016); Rigby et al. (2016); Kindström et al. (2013); Wang et al. (2018); Yeow, Soh and Hansen (2015); Karimi and Walter (2015)
	Innovation/ transformation	Teece (2007); Helfat and Peteraf (2015); Bendig et al. (2018); Kindström et al (2013); Hodgkinson and Healey (2011); Yeow, Soh and Hansen, (2018); Eisenhardt and Martin (2000); Rotjanakorn, Sadangharn and Na-Nan, 2020; Teece, Pisano and Schuen, (1997)

Section	Subsection	Reference
Digital transformation and Dynamic Capabilities		Jacobi and Brenner (2017); Daniel y Hugh (2003); Schwertner (2017); Helfat et al. (2007); Jacobi and Brenner (2017); Teece, Pisano and Shuen, (1997); Matt, Hess and Benlian (2015); Eisenhardt and Martin (2000)
Automotive sector		Llopis, Rubio and Valero (2021); Fichman et al. (2014); Yoo et al. (2010); Wijnen (2013); Simonji-Elias et al. (2014); Hanelt et al. (2015); Gao et al. (2016); Letiche et al. (2008); Perrott (2008); Möller et al. (2011); Berman and Bell (2011); Matt et al. (2011); Chanias and Hess (2016); Hildebrandt et al. (2015); Keller and Hüsig (2009); Piccinini et al. (2015); Fitzgerald et al. (2013); Lucas et al. (2013); Gregory et al. (2015); Remane et al. (2016); Weill et al. (2005)
	Digital transformation and Automotive Sector	Fichman, Dos Santos and Zheng., (2014); Gao et al. (2016); Yoo, Henfridsson and Lyytinen, (2010); Hanelt *et al.,* (2015); Letiche, Boeschoten, Dugal and Eriksen. (2008); Perrott (2008);; Möller, Legner and Heck (2011); Fitzgerald, Kruschwitz, Bonnet and Welch (2013); Lucas et al. (2013); Berman y Bell (2011); Matt, Hess and Benlian (2015); Riasanow, Galic and Böhm(2017); Böhm Koleva, Leimeister, Riedl and Krcmar (2010).; Remane, Hildebrandt, Hanelt and Kolbe (2016); Hildebrandt, Hanelt, Firk and Kolbe, (2015); Llopis, Rubio and Valero (2021); World Economic Forum (2016); CCOO (2018); Farahani, Meier and Wilke (2017).; Llopis, Rubio and Valero (2021); Keller and Hüsig, (2009); Ben-Zeev, Sharma and Ginodia (2017); Rubio et al. (2019); Rubio and Llopis-Albert (2019); Piccinini, Hanel, Gregory and Kolbe (2015); Kern y Wolff (2019); Pfleeger and Pfleeger (2003);
	Dynamic capabilities and Automotive sector	Rotjanakorn, Sadangharn y Na-Nan (2020); Leite, Borges, Dos Santos, Yutaka y Castro (2017); Tondolo, Tondolo, Puffal, and Bittencourt (2015); Leite (2013); Teece and Leih (2016); Camuffo and Volpato (1996); Leite (2013); Christensen (2011); Alves (2011); Mesquita, Borges, Sugano, and Santos (2013); Lee (2012); Maynez, Valles and Hernández (2018); Nakano, Akikawa, and Shimazu (2013); Makkonen, Pohjola, Olkkonen and Koponen (2014); Mamun, Muhammad and Ismail (2017)

Source: Author´s own (2019)

2.2. DIGITAL TRANSFORMATION

The boom in digital connectivity will bring gains in productivity, health, education, quality of life and myriad other avenues in the physical world and this will be true for everyone, from the most elite users to those at the base of the economic pyramid (Cohen and Schmidt 2013).

Nowadays, digitalization touches almost every aspect of the society and business transactions. Digital transformation is a process of reinventing and re-engineering a business to digitize a company. This transformation is the deliberate and ongoing digital evolution of a company's business model, strategically, tactically, and operationally (Gaiardelli, Pezzota, Resta and Songini, 2014).

The main aim of the digital transformation is to change the way people think. Leaders of the large, long-term organizations and industries must be always creative and discover new opportunities in the modern world of digitalization if they do not want their companies to be replaced by the next hot startups (Schaible and Bouée 2015).

Organizations are pressured to go digital before other market players move forward and thus forces the organization to develop a wide range of capabilities to successfully lead and implement digital transformation initiatives (Warner and Wäger, 2018).

It is only recently, after 2014, that a growing body of research emerged around the term "digital transformation", which is yet rather fragmented (Reis *et al.,* 2018). Because digital technologies are expected to revolutionize the everyday operations of modern organizations within the next few years, "digital transformation" is expected to become one of the most terms around the internet, which is why several academic scholars endeavor to define and discuss the exact concept of it (Reis, Gonçalo, Lapuente, Kretschemer and Vasconcellos, 2018).

With the rise of new digital technologies such as artificial intelligence (AI), internet of things (IoT), mobile and social internet, blockchain and big data, firms in almost all industries are conducting multiple initiatives to explore and exploit the benefits of these technologies (Fitzgerald, Kruschwitz, Bonnet and Welch, 2014; Ross, Beath and Sebastian, 2017). This necessarily entails transformations of key business operations and affects products and processes, as well as organizational structures and management concepts to conduct these complex company-wide transformations (Matt *et al.*, 2015). Meanwhile, the society is facing fast and radical changes due to the maturation of digital technologies and their power to penetrate markets rapidly, while customers' demands are increasing, and organizations face tougher competition due to globalization (Bharadwaj, Sawy, Pavlou and Venkatraman, 2013; Li, Cheng and Guo, 2018).

Warner and Wäger, (2018) have remarked that digital transformation is inconsistently used by leaders within and across the industries to describe various strategizing and organizing activities, which reaffirms the importance of defining this concept, as no formal categorization exists in academic literature and the boundaries of the term are often blurred (Reis *et al.*, 2018)

The table below shows a full overview of typical definitions according to the literature.

Table 4. Definitions of Digital Transformation

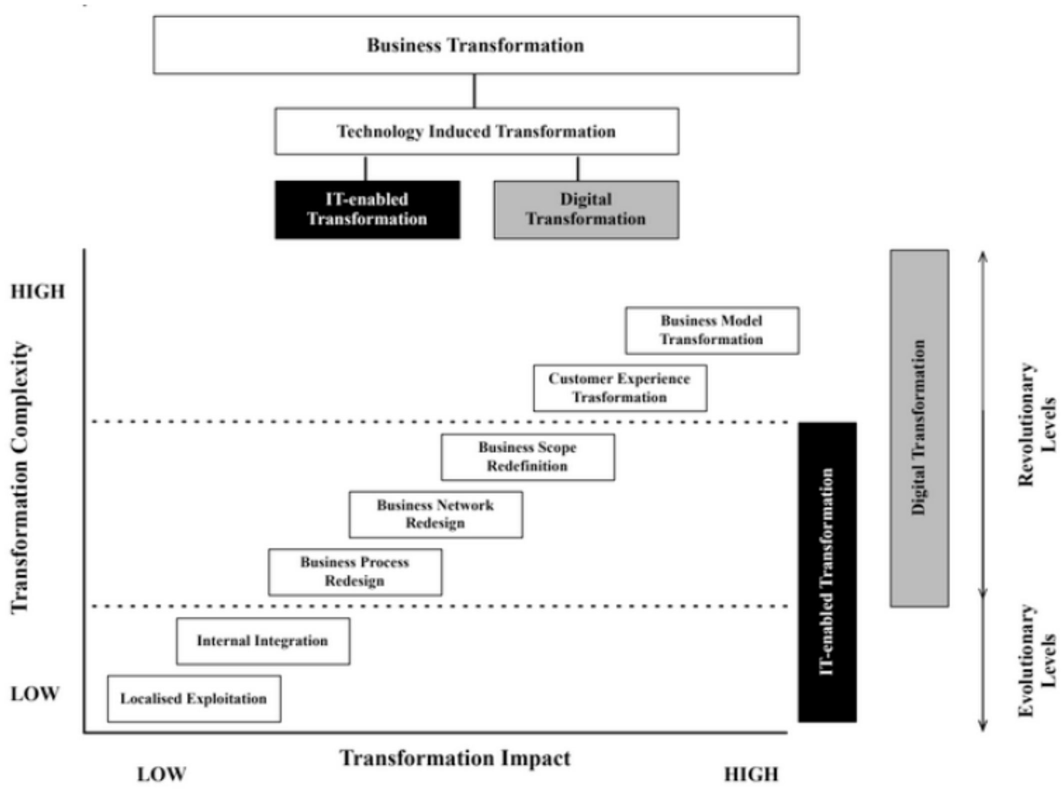
Author	Definition
Gaiardelli et al. (2014)	Digital transformation is a process of reinventing and reengineering a business to digitize a company. This transformation is the deliberate and continuous digital evolution of a company's business model, strategically, tactically, and operationally.
Schaible and Bouée (2015)	It is a process of changing the way people think, in which organizations must discover the opportunities provided by the modern world in terms of digitalization.
Matt, Hess and Benlian, (2015)	Transformation strategies focus on the transformation of products, processes, and other organizational aspects, including user interaction with technology as an integral part of the product or service. Organizational aspects, which include user interaction with technology as an integral part of the product or service and allows defining products, services and business models jointly.
Heilig, Schwarz and Voß, (2017).	It is only an application of ICT to the organization's processes.
Crespo y Pariente (2018)	It is the management process that directs the culture, strategy, methodologies, and capabilities of an organization based on digital technologies.
Linares (2018); Sánchez (2015)	It arises with a change in the way of thinking, which requires a modification in the culture, structure and operations of the organizations.
Skog, Wimelius. and Sandberg, 2018)	It is total disruption and chaos in the business world

Source: Author´s own (2020)

A further elaboration understands digital transformation as the use of these technologies to impact three organizational dimensions: externally, with a focus on digital, enhancing the customer experience and changing the entire life cycle; internally, shaping business operations, decision-making and organizational structures; and holistically, where all business segments and functions are affected – often leading the entirely new business models (Kaufman and Horton 2015; Schuchmann and Seufert 2015; Hess *et al.,* 2016). Conclusively, scholars have agreed that digital transformation is connected to an elemental shift in reaching a competitive advantage by considering internal, external and holistic firm dimensions (Abdelaal and Zaki, 2018).

Building upon the findings of Venkatraman (1994), Abdelaal and Zaki (2018) have highlighted the scheme below, which positions digital transformation within the revolutionary levels of transformation due to its transformation complexity and impact.

Table 5. Classification of digital transformation



Source: Abdelall and Zaki (2018)

This classification shows, that in contrast to i.e., localized exploitation or business network redesign, which are considered as previous IT-enabled transformation efforts, business model transformation is located within the revolutionary levels of organizational transformation and is thus considered the one with the highest transformation complexity.

Digital technologies have become increasingly important in all firms for achieving competitive advantages (Schroer, 2019). They are embedded in the current discussion of Internet of Things (IoT), connecting the physical and digital worlds through layers of sensors and actuators, connectivity, and analytics (Vendrell-Herrero, Bustinza, Parry and Georgantzis, 2016). Digitization and digital transformation are contemporary phenomena, which are explored through a rapidly growing field of research contributions. This growing number of contributions can be structured into the general discussion of the digital transformation, digitalization in sales force, digitalization into efficiency (Nochta, Badstuber and Noura, 2019).

The emergence of digitalization and smart products (Zhou, 2013) have introduced new pathways through which services can be provided, giving rise to a wide range of new application spheres (Vendrell-Herrero *et al.,* 2017). Within this context, organizations have begun to introduce digital technologies to bridge products and services and to expand the scope of their offerings (Koch and Windsperger, 2017).

Today, digitalization is changing value networks and affecting physical products. Due to digitalization, the digital and physical world are merging (Hanelt *et al.,* 2015). The significance of the successful digital transformation hides in enabling industry players to visualize critical cost benefits, discover profit opportunities and implement potential business models (Bouée and Schaible, 2015).

It is important to mention that digital transformation is going to be always an ongoing process in the workflow of a certain firm. For the company, it is vital to activate and implement digital solutions that will bring operations to the whole new level and will keep the organization on the path of innovation and evolution. The solutions can range from the adoption of an integrated payment tool, posting relevant information on the social media and storing data from customers (Rijswijk, 2020).

2.2.1 Digitization, digitalization, and digital transformation

One common way of distinguishing and structuring the digital world is by the intention of digital efforts. With this perspective, the focus lies on the concepts of digitization, digitalization, and digital transformation. This area is debated in literature, and a final definition has not yet been widely accepted. Most authors agree that there is a difference between digitization and digitalization (Brennen and Kreiss 2014), claiming that digitization refers to the act of transforming analogue data to digital form. Only information can be digitized, not processes (Bloomberg, 2018).

More complicated is the difference between the two terms digitalization and digital transformation, if there is one at all, Stolterman and Fors (2004) define digital transformation as the change that digital technology causes in all aspects of human life. This is, however, what others (Henriette, Feki and Boughzala, 2015) refer to as digitalization.

Jacobi and Brenner (2017) argue that digital transformation does not only require strong leadership and a clear strategy, but it is also necessary to combine these with an experimenting and flexible culture and new organizational structures and processes.

This is similar to the definition by Schwertner (2017) claiming that digital transformation means using digital technology to build new business models, processes, software and systems that in turn will generate more profits, greater competitive advantage and more efficient business. This, he claims, will be achieved by empowering the workforce and create new business models, but also by being more customer-driven and personalize the customer experience.

Based on the different definitions above, the three terms will be separated and defined in this paper accordingly:

- digitization: the transformation of information from analogue to digital
- digitalization: the transformation of business processes with digital technology
- digital transformation: the transformation of business and strategy through digital technology and organizational changes.

2.2.2 Elements of Digital Transformation: IoT, Artificial Intelligence and Big Data

As cloud computing (CC) is combined with technologies such as embedded systems, microelectronics, communication and sensors, the concept of Internet of Things (IoT) arises. Today's definition is broader, as it encompasses a range of applications such as health services, public services, transportation, etc. (Gubbi, Buyya, Marusic and Palaniswami, 2013). In addition, it is considered the new technological and economic wave (Mukherjee, Matam, Shu1, Maglaras, Amine, Nikumani and Vikas, 2017).

For Makridakis (2017) the impact of industrial and digital or information revolutions has substantially affected society, but there is a new revolution shaped by Artificial Intelligence (AI) that will generate a strong impact on companies and jobs. Today's AI is present in everyday life for people and businesses. An example of which are voice recognition features, face recognition, and writing suggestions available on today's smartphones.

According to Schwab (2016) artificial intelligence and robotics, will generate a turnaround in organizations with respect to the administrative functions. The author also states that by 2025 there will be an inflection point where 30% of the corporate audits will be performed by AI robots, and this will happen because AI finds it easy to match standards and automate processes, which makes the adoption of this technology be recommended.

Apart from this, Big Data is emerging as a relevant topic among scholars and professionals, and it is defined as a holistic approach to managing, processing, and analyzing data in five dimensions, and which aims to deliver sustained value, measure performance, create skills and improve the decision-making process (Rich, 2012). The big data makes it possible to improve the efficiency and effectiveness of organizations, and it allows the process of decision making to be based on evidence and not intuition (McAfee and Brynjolfsson, 2012).

2.3. DYNAMIC CAPABILITIES

The perspective of dynamic capabilities is currently one of the main theoretical approaches in strategic management. It has its origins in the spirit of Schumpeter's innovation-based competition (1934) where competitive advantage is based on the creative destruction of existing resources and recombination into new operational capabilities. The literature also identifies other ideas, such as competency configuration (Henderson and Cockburn, 1994), and combined capabilities (Kogut and Zander, 1992).

Extending these studies Teece, Pisano and Shuen (1997) developed the notion of dynamic capabilities, and their paper is regarded as the theory that has influenced different researchers to use it as a theoretical framework. Therefore, the concept of dynamic capabilities was arguably first introduced by Teece et al. (1997) with the purpose of trying to explain how successful firms manage to reconfigure and reaffirm expertise in pursuance of conformity towards transformative business environments (Qaiyum and Wang, 2018).

The concept initially appeared from an external perspective, with a focus of analyzing macro-level factors, such as market dynamics (Qaiyum and Wang, 2018). Yet, recent studies have consistently argued for a micro-level perspective towards the concept, by investigating internal organizational activities for building dynamic capabilities (Bendig, Strese, Flatten, Da Costa and Brettel, 2018; Roy and Khokle, 2016; Kevill, Trehan and Easterby, 2017).

Furthermore, as a part of organizational capabilities theory, dynamic capabilities are distinguished from a firm's ordinary capabilities (Qaiyum and Wang, 2018; Karimi and Walter, 2015). Subsequently, whereas ordinary capabilities involve the exploitation of current resources to achieve the desired result, the literature describes dynamic capabilities as an organization's ability to change and modify the current resource-base by means of exploration (Rotjanakorn, Sadangharn, and Na-Nan, 2020).

For instance, in comparison to theoretical research, which argues that dynamic capabilities can only be built and developed internally within an organization (Helfat et al. 2007), empirical findings suggest otherwise (Ambrosini and Bowman, 2009). Yet, in many cases similar factors are indeed discussed, such as: strategy, culture, learning- knowledge- and information processing abilities, as well as what we will refer to as "routine innovation" (Huang and Li 2017; Cezarino, Alves, Caldana and Liboni, 2019; Wang *et al.,* 2018; Akram and Hilman, 2018).

To clarify, routine innovation is the process through which organizations generate or modify their existing routines (Huang and Li, 2017). As such, most of the recent literature tends to focus on the internal factors of dynamic capabilities (Kevill *et al.*, 2017; Roy and Khokle, 2016; Wang and Ahmed, 2018).

Since this term emerged, different authors have carried out research that brings new points of view. At present, it can be said that there is a consensus on the definition of dynamic capabilities. Different definitions of dynamic capabilities have been identified in the reviewed literature (see table)

Table 6. Definitions of Dynamic Capabilities

Author	Definition
Collins (1994)	Ability to innovate and develop quickly.
Helfat (1997)	Competencies or capabilities that the company must create new products and thus respond to changing market demands.
Teece, Pisano y Shuen (1997)	Ability of the organization to integrate, build and reconfigure internal and external competencies for immediate application to changing environments.
Eisenhard y Martin (2000)	Strategic habits of the organization by means of which it makes new configurations of its resources to keep pace with the market.
Lee, Lee y Rho (2002)	It represents a new source of competitive advantage in that it defines how organizations adapt to changes in the environment.
Zahra and George (2002)	These are the capabilities of organizations to re-deploy and reconfigure their resource bases to meet customer demands and to cope with competitive demands.
Winter (2003)	Capabilities to act and thus expand, modify, or generate extraordinary capabilities.
Vivas (2005)	These are complex, high-level organizational processes that create the appropriate conditions for modifying and renewing the organization's assets.
Peláez, Melo, Hofmann y Aquino (2008)	Coordination of internal and external competencies, to adapt the organization to a rapidly changing environment
Tondolo, Tondolo, Puffal, and Bittencourt, (2015)	It is the creation, renovation or integration of resources, assets, capabilities, competencies, and routines that will allow the company to keep pace with the changes offered by the competitive environment.
Teece and Leih, (2016).	These are high-level activities that allow a company to focus on the production of goods and services that already have or may have a high market demand.
Rotjanakorn, Sadangharn, and Na-Nan (2020)	The ability of an organization to change and modify the current resource base through exploration.

Source: Author´s own (2020)

In a dynamic marketplace, resource advantages might become disadvantages when the environment and the market conditions change (Ambrosini, Bowman and Colliers, 2009). This means that companies ought to continuously develop their resources and their businesses and not expect one good investment or idea will be enough to achieve a long-term competitive advantage (Tondolo, Tondolo, Puffal, and Bittencourt, 2015).

To remain sustainably competitive in a dynamic market environment, where digitalization creates a high-velocity aspect even to traditionally more stable markets, the ability to adapt and be flexible to new opportunities is crucial (Schwerter, 2017). This is yet another reason for why applying the concept of dynamic capabilities onto digital transformation is highly relevant, as all industries regardless of their market pace, are facing changes due to the new digital era (Wagner and Wäger, 2019).

The traditional view of dynamic capabilities framework as especially important in strategy development for organizations that are part of a dynamic market (Teece, Pisano and Shuen, 1997; Ambrosini, Bowman and Colliers, 2009; Helfat *et al.*, 2007) is challenged by Eisenhardt and Martin (2000) who argue that even when competing in relatively stable markets, the need to gain, release, integrate and reconfigure resources in response to changes in the marketplace indicates the need for dynamic capabilities.

In addition, Bharadwaj et al. (2013) suggest that the two concepts of dynamic capabilities and digital transformation go hand in hand, as digital technologies enable the development of dynamic capabilities by fundamentally reshaping traditional business. For analytical purposes, dynamic capabilities can be disaggregated into three different capabilities: the capability to sense and shape opportunities and threats, the capability to seize these opportunities and the capability to maintain competitiveness by reconfiguring the organization's tangible and intangible assets (Teece, 2007).

Yeow, Soh and Hansen (2015), Kindström, Kowalkowski and Sandberg (2013) and Fisher et al. (2010) all based their studies off this disaggregation by Teece (2007), which is also the definition that this study will be structured by.

2.3.1 Micro-foundations

Within dynamic capability research, the term micro-foundation relates to internal organizational factors that serve as a foundation for developing dynamic capabilities (Bendig *et al.,* 2018; Roy and Khokle, 2016; Kevill *et al.,* 2017). Yet, given the ambiguous nature of the term, it has been a subject of theoretical clarification. Additionally, Teece (2007) clarifies the term through a framework of sensing, seizing and transforming. As such, the framework allows micro-foundations to be categorized into 3 different process components and has been the widely used as a guideline in dynamic capability studies (Roy and Khokle, 2016; Dixon, Meyer and Day, 2014; Bendig *et al.,* 2018; Kindström, Kowalkowski and Sand, 2013; Helfat and Peteraf, 2015).

To explain further, it is argued that building dynamic capabilities correlate to entrepreneurial management activities (Teece, 2007). The author claims that developing dynamic capabilities is principally about sensing, seizing new opportunities, as well as transforming or reconfiguring resources accordingly, to increase performance, rather than analyzing and optimizing the current resource base. Subsequently, results indicate that dynamic capabilities do not necessarily have a direct effect on performance, but rather an indirect effect via their influence on a firm's resource base (Battisti and Deakins, 2017).

Teece (2007) continues to argue that although sensing, seizing, and transforming activities are entrepreneurial by nature, they are not limited to start-ups, but are equally applicable to larger enterprises. In conclusion, the author clarifies that significant favorable outcomes can be interchangeably (Teece, 2007), however adding that micro-foundations for sensing, seizing and transformation are unlikely to be found within single individuals. Therefore, he suggests that teams or groups of individuals are needed to leverage dynamic capabilities (Teece, 2007; Helfat and Peteraf, 2015).

2.3.2 Sensing

The first process of dynamic capabilities is referred to as sensing (Teece, 2007; Helfat; Peteraf, 2015; Roy and Khokle, 2016). In his theoretical contribution, Teece (2007, p. 1322) defined the process as a "[...] scanning, creation, learning, and interpretive activity". This is further corroborated by empirical findings. For instance, Helfat and Peteraf (2015) found that top managers who are attentive and perceptive are more likely to sense emerging transformative changes.

Similarly, Roy and Khokle (2016, p.5) describe the process of sensing as (1) becoming familiar and acknowledging that a rapid change is occurring and (2) integrating "[...] all the information in a meaningful manner". The authors continue explaining that effective information integration from exploration is critical to identify possible utility approaches for seizing different opportunities. This may be given by dedicated resources and involve, for instance, simple activities such as carrying out presentations with a purpose of informing as well as "sensitizing" others in the organization of transformative changes (Roy and Khokle, 2016).

These results confirm the findings of Akram and Hilman (2018) and Bian, Yang and Zhao, Zhao (2018), who emphasize the continuous need for learning and integrating activities to build dynamic capabilities. It is argued that learning activities cultivate and improve internal skill sets, as well as being regarded as a core foundation for increasing individual and organizational performance (Akram and Hilman, 2018; Bendig *et al.,* 2018).

These learning capabilities include activities such as (1) knowledge sharing, (2) knowledge acquisition from internal and external sources, as well as (3) knowledge creation, which can include internal projects, programs other attempts to cultivate new knowledge (Akram and Hilman, 2018).

Bendig et al. (2018), whose findings indicate that the ability to manage knowledge internally as well as accumulating experience are two necessary factors for building dynamic capabilities, further support learning capabilities as an important micro-foundation. The researchers continue stating that although such foundations may not lead to competitive advantage directly, they contribute to employees' abilities to explore and identify new opportunities and threats (Bendig *et al.,* 2018).

Finally, Battisti and Deakins (2017) make a closing remark arguing that the current body of literature has focused primarily on learning foundations, and less focus has been given to knowledge integration foundations.

The sensing (and shaping) new opportunities is very much a scanning, creating, learning and interpreting activity (Teece, 2007) which involves "identification, development, co-development and assessment of technological opportunities in relationship to customer needs" (Teece, 2014, p. 332).

According to Jacobi and Brenner (2017), knowing when to pursue what changes and how to manage the changes is fundamental for digital transformation. To have this knowledge and the ability to make those tough decisions, the company needs dynamic capabilities to sense new opportunities.

2.3.3 Seizing

The second process of dynamic capabilities refers to the activity of addressing opportunities and threats (Matysiak, Rugman and Bausch, 2018). In his theoretical contribution, Teece (2007) describes seizing as the process in which substantial investments are devoted to address new opportunities and threats, which are found by means of sensing. More specifically – with support from empirical findings – it is argued that this can be through the introduction of new products and services (Teece *et al.,* 2007; Roy and Khokle, 2016), as well conducting incremental changes to existing business models (Helfat and Peteraf, 2015).

Furthermore, Roy and Khokle (2016) emphasize the importance of seizing, claiming that the act of deploying dedicated resources towards opportunities and threats has a large impact on how organizations manage dynamic environments.

In their study focused on cognitive capability foundations, Helfat and Peteraf (2015) argue that foundations such as favorable problem-solving as well as reasoning capabilities from top management have a positive influence on activities related to investment choices and designing business models. Besides, the authors state that managers can help build dynamic capabilities for seizing, by encouraging cooperation, investing in new skills and assets, as well as lowering the intransigence for change (Helfat and Peteraf, 2015).

Additionally, Teece et al. (2016) have argued that organizational agility is often treated as an abiding aspect, entailing that firms need to continuously transform. They framed agility as "the capability of an organization to efficiently and effectively redeploy/redirect its resources to value creating and value protecting (and capturing) higher-yield activities as internal and external circumstances warrant" (Teece *et al.,* 2016, p. 17).

Thus, they argue that strong dynamic capabilities are a necessity to advance a firm's agility to address deep uncertainties, such as that generated by innovation and dynamic environments (Teece *et al.,* 2016; Rigby, Sutherland and Takeuchi, 2016)

Alternatively, Kindström et al. (2013) present additionally foundations that help shape dynamic capabilities for seizing. In their study focused on the service industry, Kindström et al. (2013) particularly put emphasis on the need for external interactions. For instance, the authors claim that interaction and co-development with customers and other stakeholders may aid with seizing opportunities.

The authors also indicate that the main challenges of seizing are a part of a firm's organizational arrangements, which is further corroborated by Wang et al. (2018). This relates to an organization's scheme, structure, and hierarchy. It is argued that firms may need to update their organizational arrangement to receive a clearer picture of what direction to take the company (Wang *et al.,* 2018; Kindström *et al.,* 2013).

When the new business opportunities or needs are sensed, they must be addressed through new products, processes, or services (Teece, 2007). The seizing capability allows organizations to capture the value of new business opportunities, not only understanding them, by deciding what specific changes to make across the different components of the organization to seize this value (Yeow, Soh and Hansen, 2015).

Teece (2007) points out that it is not unusual for companies to sense an opportunity but then fail to capture it because of a lack of commitment, budgeting, or risk aversion. He continues by stating that, to overcome these biases, companies must improve routines, decision rules, strategies, and leadership to evaluate and capture opportunities.

Karimi and Walter (2015) acknowledge the capability gap that occurs when new technology is introduced to incumbent organizations. They claim that dynamic capabilities related to hanging, extending, or adapting an organization's resources, processes and values are important to capture value from the new opportunities.

2.3.4 Transforming/Innovation

The final step in the process of building dynamic capabilities is referred to as transforming or reconfiguration (Teece, 2007; Helfat and Peteraf, 2015). From sensing, followed by addressing new opportunities and threats with seizing capabilities, Teece (2007) describes the process of transforming as the ability to configure organizational assets with the purpose of not becoming static and passive to future changes.

The author further adds that transformation involves costly activities of altering and modifying organizational routines, thereby stating that it is not, and should not, be regarded as involving effortless and impromptu activities (Teece, 2007).

Instead, it calls for an extensive structural change towards organizational operations and assets (Teece, 2007; Helfat and Peteraf, 2015). Therefore, although the combination of sensing and seizing may lead to reach temporary competitive advantage (Bendig *et al.,* 2018), it is argued that transformation as process serves the purpose of sustaining competitive advantage over time through continuous reconfiguration (Kindström *et al.*, 2013; Teece, 2007).

In their findings, Helfat and Peteraf (2015) state that communication and social cognitive foundations from top management attribute to superior prospects of accomplishing reconfigurations of strategic resources are key. Alternatively, Kindström et al. (2013) found that restructuring internal norms, values and business philosophies influenced organizations in the service industry to reconfigure their organizational operations.

Viewed from an alternative perspective, the highly cited theoretical contribution from Hodgkinson and Healey (2011), explored the psychological aspects of transformation. They state that resistance to change in individuals of all levels in an organization can become a significant barrier that prevents new strategic reconfiguration initiatives. As such, it can threaten strategic renewals, as individuals – or groups of individuals – adhere to past organizational activities and philosophies (Hodgkinson and Healey, 2011).

The authors conclude stating that necessary steps to mitigate resistance to change involves addressing the potential identity threat perceived from change by cultivating a "psychologically secure emotional climate" (Hodgkinson and Healey, 2011, p. 1510). This consist of coaching and training employees to become further familiarized with change but also the ability to present change as an opportunity to mitigate potential identity threats from employees (Hodgkinson and Healey, 2011).

Reconfiguring refers to continuous renewal and transformation of the organizational routines (Yeow, Soh and Hansen, 2018). The ability to recombine and to transform organizational structures and assets as 35 the company grows and as the environmental changes are keys to maintain sustained profitable growth (Teece, 2007).

According to Yeow, Soh and Hansen (2018) the dynamic capability of transforming plays an important role when it comes to reconfiguring existing resources to align with new strategies, as well as building new resources to supplement current gaps in the resource base of the organization.

Eisenhardt and Martin (2000) describe dynamic capabilities as the activities of leveraging, creating, accessing, and releasing. The leveraging activity regards putting existing resources to new uses, creating in this case refers to the creation of new resources, accessing involves the use of external resources; for example, from vendors or partners, and finally releasing refers to the activity of letting go of existing resources that are no longer optimal for the new strategy (Rotjanakorn, Sadangharn and Na-Nan, 2020).

These activities are very similar to Teece's (2007) description of the activities involved in the reconfiguring capability. Yeow, Soh and Hansen (2018) also point out the previously mentioned capability gap by claiming that because of the relative novelty of digitalization, many companies might not have the essential internal resources, like digital expertise, needed to succeed with the digital transformation. Therefore, having the ability to access and build new resources, through the reconfiguring of dynamic capabilities, would be significant for these companies.

To sum up, the theme of Dynamic Capabilities (DC) has been seen as an event in organizations and arousing interest in the academic environment, as well as in the corporate environment in its most diverse segments, ranging from the strategic area to human resources management, marketing, innovation, entrepreneurship and information and knowledge management.

In short, the dynamic capability is the grouping of organizational skills, behaviors and organizational capabilities, as well as processes and routines that lead the company to differentiate itself in the competitive market in face of its competitors. Moreover, as Teece (2007) states, although the long-term performance of the firm is determined by the way the (external) business environment rewards its assets, the development and exercise of dynamic (internal) capabilities are at the center of the business success or its failure.

For our investigation, we are going to adopt the following definition and will select three primary clusters. Dynamic capabilities are defined as "the firm´s ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments" (Teece, Pisano and Schuen, 1997, p.516). Dynamic capabilities thus define the firm´s capability to innovate, adapt to change and create change that is favorable to customers and unfavorable to competitors. Dynamic capabilities fall into three primary clusters:

Identification, development, co-development and assessment of technological opportunities (and threats) in relationship to customer needs (the "sensing" of unknown futures).

Mobilization of resources to address needs and opportunities and capture value from doing so ("seizing") and continued renewal ("transforming/innovation").

2.4. DIGITAL TRANSFORMATION AND DYNAMIC CAPABILITIES

The objective of the part was to identify as relations between IoT, Big Data and Artificial Intelligence with the micro-foundations of the dynamic capabilities. In addition to this digital transformation, organizations need to be able to reconfigure themselves in the face of such a competitive market. These Dynamic Capabilities (DC) are being analyzed as an event in organizations and arousing interest in the academic environment, as well as in the corporate environment and in its various segments. This article aims to identify the relationships between elements of digital transformation and the micro-foundations of dynamic capabilities.

Jacobi and Brenner (2017) argue that, for the digital transformation to create sustainable value and competitive advantage for companies in a digital world, the internal conditions of the organization need to continuously evolve and adapt to market changes. Hence, the identified critical factors for digital transformation should be dynamic in their nature to allow the company's internal resources to adapt to changing demands. Therefore, applying the theory of dynamic capabilities to the critical factors for digital transformation is found to be relevant (Daniel and Hugh, 2003).

The increasing pace of digital technology development affects and brings major changes to all industries (Schwertner, 2017). As having and developing a suitable strategy matters, most during times of change (Helfat *et al.*, 2007), the changes linked to the digitalization of our society, places entirely new demands on companies regarding their digital strategy as well as the overall business strategy (Jacobi and Brenner, 2017). This allows distinguishing traditional change from complete digital transformation because the latter also includes changes to strategies and culture. Therefore, they argue, we cannot study digital transformation by looking only at the literature on organizational change.

The dynamic capabilities' framework seeks to identify the firm specific capabilities that can be sources of competitive advantage and to define how combinations of resources and competencies can be developed, deployed, and protected over time when responding to changes in the business environment (Teece, Pisano and Shuen, 1997).

Matt, Hess and Benlian (2015) argue that companies often wait for incentives to perform a digital transformation, and the risk is that if they wait too long, they may not be able to perform the changes needed. Therefore, they claim, companies ought to continuously evaluate their options and needs for digital transformation, which is in accordance with the dynamic capability framework. This can be achieved by having routines for evaluating opportunities and identifying possible actions.

Likewise, Eisenhardt and Martin (2000) use the term routines when discussing dynamic capabilities. They claim that the dynamic capabilities by themselves are identifiable and specific routines and that some of these routines aim to attain and release the organizational resources, others integrate these resources while still others focus on the reconfiguration of these resources.

2.5 DIGITAL TRANSFORMATION, DYNAMIC CAPABILITIES IN THE AUTOMOTIVE SECTOR

The emergence of digital innovations is accelerating and intervening existing business models by delivering opportunities for new services. Drawing on the automotive industry, leading trends like self-driving cars, connectivity and car sharing are creating new business models. These are simultaneously giving rise for innovative market entrants, which begin to transform the automotive industry (Llopis, Rubio and Valero, 2021).

New technologies accelerate digital innovations, which fundamentally transform the daily lives of consumers, companies, and the structure of entire ecosystems (Fichman *et al.,* 2014). Today, the digital transformation is even changing the value creation of industries where value is generated exclusively through physical materiality (Yoo *et al.,* 2010), most visible in the automotive industry.

Recent digital innovations like self-driving cars, connectivity, big data, and social networks are fundamentally revolutionizing the automotive industry (Wijnen, 2013; Simonji-Elias, Collyer and Johnston, 2014; Hanelt *et al.,* 2015; Gao *et al.,* 2016). Companies need to be aware of these technologies' disruptive character and adjust their business models to deal with new actors in the ecosystem (Letiche, Boeschoten, Dugal, . and Eriksen, 2008; Perrott, 2008; Möller, Legner and Heck, 2011).

Due to the rising number of new market entrants, original equipment manufacturers (OEMs) are no more alone in the market and must align their strategies to compete with these new market entrants, which provide customer-centric mobility for their customers and substantially intervene the current value network (Berman and Bell, 2011; Matt *et al.,* 2015; Gao *et al.,* 2016). Digital transformation strategies are important, because they "reflect the pervasiveness of changes induced by digital technologies throughout an organization" (Chanias and Hess, 2016: pp3).

For the automotive industry, literature focused on different aspects of the digital transformation, starting from an overview of the different business model change types (Hanelt *et al.,* 2015) for specific transformation strategies have been considered. Hanelt et al. (2015) combine the phenomena of digital and physical world and explore the impact of digital trends on the business model of the automotive industry. Their findings show four different business model change types: extension, revision, termination, and creation.

Examples for business model extension are interactive elements with customers, e.g., through social media. Business model revision is required through self-driving cars, which reflects a combination of physical and digital components. Termination of business models may occur through virtualization, i.e., virtual showrooms for sales distribution may terminate the business of car dealers.

Finally, business model creation can be achieved through new driver services and new data services. Investigating the strategy for digital transformation, Chanias and Hess (2016) examined existing challenges of the digital transformation in the automotive industry. Therefore, they conducted a case study for the formation of strategies due to digital transformation according to the activity-based process model (Chanias and Hess, 2016).

Their findings show, digital transformation primarily begins through a multitude of organizational activities from a bottom-up perspective, even before top management initiated a holistic strategy. Hildebrandt et al. (2015) found that digital technology-related merger and acquisitions (M&A) have a positive impact on digital business model innovations.

OEMs must acquire external knowledge by M&A to capture the potential of digital innovations (Henfridsson and Lind, 2014). The emerging digital ecosystem, an OEM is surrounded by, is a "key success factor of IT-enabled business models" (Hildebrandt, Hanelt, Firk and Kolbe, 2015). Their results show that openness towards external market players and knowledge will support the digital innovations (Hildebrandt *et al.,* 2015).

According to the theory of disruptive innovations, digital innovations increase business performance and result in better user experience (Keller and Hüsig, 2009). As external knowledge plays therefore an important role, it is crucial to analyze the entire ecosystem of the automotive industry. Piccinini et al. (2015) conducted a Delphi study with industry experts to grasp the emerging challenges which come in line with digital transformation of the physical automotive industry.

For digital ecosystems, among these are: competing with an expanding range of new rivals and non-industry rivals and entrants; building complementary partnerships among different ecosystem players (business and IT) to design new business models; bridging gaps between previously separated business units and ecosystem players to create new digital value; improving information flows and exchange between business ecosystem partners to enable a seamless customer experience (Piccinini *et al.*, 2015).

New technologies accelerate digital innovations, which fundamentally transform the daily lives of consumers, companies and the structure of entire ecosystems (Fichman *et al.*, 2014). Today, the digital transformation is even changing the value creation of industries where value is generated exclusively through physical materiality (Yoo, Boland, Lyytinen and Majchrzak, 2012), most visible in the automotive industry.

Recent digital innovations like self-driving cars, connectivity, big data, and social networks are fundamentally revolutionizing the automotive industry (Wijnen, 2013; Simonji-Elias *et al.*, 2014; Hanelt *et al.*, 2015; Gao *et al.*, 2016). Companies need to be aware of these technologies' disruptive character and adjust their business models to deal with new actors in the ecosystem (Letiche *et al.*, 2008; Perrott, 2008; Möller *et al.*, 2011).

With the emergence of these technologies, platforms and innovative digital services are offered by a plethora of new market entrants, like Tesla, Uber, or ZipCar that threaten the established ecosystem of the automotive industry (Gao *et al.*, 2016). Due to the rising number of new market entrants, original equipment manufacturers (OEMs) are no more alone in the market and must align their strategies to compete with these new market entrants, which provide customer-centric mobility for their customers and substantially intervene the current value network (Berman and Bell, 2011; Matt *et al.*, 2015; Gao *et al.*, 2016).

Digital transformation strategies are important, because they "reflect the pervasiveness of changes induced by digital technologies throughout an organization" (Chanias and Hess, 2016). Hence, organizations have to change traditional business models, which have been robust for many decades, and transform their organizations to adapt these trends, i.e: car sharing platforms, or new telematics services (Fitzgerald *et al.*, 2013; Lucas, Agarwal, Clemons, El Sawy, and Weber, 2013).

Drawing on organizational ambidexterity, they show organizations need to simultaneously exploit current resources while exploring promising capabilities (Gregory, Keil, Muntermann and Mähring, 2015). Most recently, Remane, Hildebrandt, Hanelt and Kolbe (2016) analyzed the business models of emerging and current startups in the mobility sector. They used Crunchbase data to classify startups by business model types according to Sarantopoulos, Villarroel and Zaki (2020). They identified 27 different business model types and organized them in four clusters: creator, distributor, landlord and broker.

However, in my opinion it has focused solely on organizations' business models. It misses the impact on profitability, and competitive advantage that the digital transformation might have within the organization.

2.5.1. Digital transformation in the automotive industry

Digital innovations intervene in the existing market models by offering new service options, with the consequent arrival of new competitors in the market, which promotes the transformation of the industry. Likewise, these digital innovations modify the structure of ecosystems because they transform daily life (Fichman, Dos Santos and Zheng., 2014).

The irruption of digital technologies in the market has caused the transformation of the way the market and businesses in general have been operating (Fichman, Dos Santos and Zheng, 2014). This disruptive effect, a product of digitalization, has also reached the automotive industry, where the effects of digital transformation, globalization and severe competition can be seen (Gao *et al.,* 2016).

Consequently, digital transformation changes the value creation of companies, specifically in those where value is generated by physical materiality, as is the case in the automotive industry (Yoo, Henfridsson and Lyytinen, 2010). The automotive industry is mainly revolutionized by digital innovations such as social networks, autonomous cars, connectivity and big data (Hanelt *et al.,* 2015; Gao *et al.,* 2016), which requires them to adjust their business models to keep pace with technological advances and their effects (Letiche, Boeschoten, Dugal and Eriksen, 2008; Perrott, 2008; Möller, Legner and Heck, 2011) those manifested for example with car sharing platforms or telematics services (Fitzgerald, Kruschwitz, Bonnet and Welch 2013; Lucas *et al.*, 2013).

In view of the increasing number of new entrants in the market, the original equipment manufacturer (OEM) must align its strategies to compete in the market against new entrants that are focused on customer-centric mobility (Berman and Bell, 2011; Matt, Hess and Benlian, 2015; Gao *et al.*, 2016).

According to Halnet et al. (2015), the impact of digital trends on the automotive business model is reflected in four primary changes such as extension, revision, completion, and creation. Extension is achieved with interactive elements with customers, for example through social networks; revision involves the business model through autonomous vehicles involving digital and physical components. Completion would be achieved by virtual reality, for example with virtual showrooms for sales, which would eliminate dealerships, and finally the creation of business models through new driver and data services.

These digital innovations in the automotive industry are leading to the emergence of new characters or players in the value market. The players are the groups affected by the digital transformation. In this regard, Table 1 shows the roles of actors in the automotive industry value chain according to Riasanow, Galic and Böhm (2017, p. 3195).

Table 7. Roles of the actors in the automotive value chain

Role	Description	Example(s)
OEM	The original equipment manufacturer (OEM) produces automobiles. We assume that an OEM manufactures traditional combustion engines as well as electric vehicles (EVs). The OEM value proposition may include direct sales, RandD, manufacturing, aftermarket and service (Kang *et al.,* 2009).	Ferrari, Tesla, Cadillac, BMW, Daimler, Bolt Motorbikes
Consumers	Consumers request mobility, which can be fulfilled in many ways, such as driving one's own car, borrowing or sharing a car, as well as using public transportation or a specific mobility service such as Uber. Customers may use products or services before, during or after transportation. In some contexts, a consumer is a prosumer, by simultaneously using and creating a service. An example is sharing personal data via a smartphone with Google Maps while using aggregated real-time traffic information from other users for navigation. Consumers can pay for services with money, data or a combination of both.	
Supplier Tier 1-3	The traditional automotive industry is characterized by a one-sided supplier-buyer relationship (Turnbull *et al.,* 1992). Vehicle manufacturers rely heavily on first-tier suppliers, which supply approximately 85 percent of the parts. The first-tier supplier may provide product development, design, and technology, and many rely on subcontractors, i.e., second-tier suppliers. These, in turn, may rely on third-tier contractors, who, for example, supply press, cutting, welding, forging or casting work.	Bosch, Continental, Faurecia, China Automotive Systems, Hyundai Mobis, ABC Group
Public Transportation provider	This role represents traditional public transportation, which includes metro station, buses, urban bicycles and trains (Hoffmann *et al.,* 2016).	New York MTA, citibike
Car rental supplier	A car rental provider offers different models for renting a car (Moeller and Wittkowski, 2010).	Sixt, Hertz
Car dealership (parts)	In addition to buying directly from OEMs, consumers can buy from auto dealers (or auto parts). Automobiles and spare parts can also be sold through the online platforms of the respective dealers (Applegate, 2001).	LUEG, Amazon (Fiat), carparts.com
Disruptive Technology Supplier	Disruptive technology providers offer disruptive innovations to OEMs in the form of software and hardware, such as sensors for assisted driving. Following Christensen (1997), disruptive technologies may be inferior to established technologies at the outset. However, disruptive technologies ascend relentlessly in the market, leading to the elimination or replacement of established technologies (Christensen, 1997).	Savari, Intel, Mobileye

Role	Description	Example(s)
Mobility service Platform	We distinguish between different mobility service platforms, such as private or commercial car sharing, P2P lending or service platforms.	Uber, VRide, DriveNow, Tesloop, Taxify, Car2Go
Movilidad Servicio Agregador	OEM (Lee *et al.,* 2016). Mobility services can be accessed and distributed through these platforms, e.g. Uber provides the platform that allows drivers to provide their mobility services to registered users.. This function aggregates different mobility services, including public transport services and car sharing platforms, which may also involve intermodal mobility services (Plummer and Kenney, 2009).	Moovel, Flare
Smart Infrastruc-ture Pro-vider	This role represents the connection of physical and digital infrastructure. Due to connectivity and new technologies, e.g., sensors and electric vehicles (EV), infrastructure, e.g., including traffic signals or parking lots, can be connected to cars and consumers. Electric ve-hicle charging stations (EVCS) are such a smart infrastructure. Providers allow access if they are currently in use or free of charge, for example.	ChargeNow, CarCharging, Chargerlink
Cloud Infrastruc-ture Pro-vider	A cloud infrastructure provider (IaaS) consists of a shared pool of configurable Internet-based computing resources (e.g., servers, stor-age, applications, and services), which can be rapidly provisioned and released with minimal management effort (Youseff *et al.,* 2008).	Amazon Elastic Compute Cloud (Amazon EC2)
Cloud plat-form pro-vider	The cloud platform provider (PaaS) offers a digital marketplace of various cloud infrastructure services. The key objective is to connect customers and service providers. The former can search for suitable value-added services, telematics services and automotive applica-tions, while the value-added provider can advertise its services. The platform is built on an underlying cloud infrastructure (Youseff *et al.,* 2008).	Google Cloud Platform, Micro-soft Azure
Added value Service Supplier	Value-added services can be accessed before, during or after transport. There are two types of value-added service (SaaS) providers. First are telematics services or technical information about the vehicle, safety features or intelligent driver assistance software. Second are services, which offer complex digital services to the customer, e.g. entertainment, security, location-based information services or concierge services.	Spotify, Data Crossover, Auto-linked, ParkNow, On- Star, BMW Con- nected Drive
Automotive service provider	These services can be accessed through cloud platforms (Youseff *et al.,* 2008).	Washtec
Electronic payment provider	Automotive services include all traditional services such as maintenance, insurance or stationary services such as car washes (Remane *et al.,* 2016).	MercedesPay

Source: Riasanow, Galic y Böhm (2017, p. 3195)

However, a company can have different roles in different business models. Roles provide value within the value network because they provide data, services, and physical products. In this regard, Riasanow, Galic and Böhm (2017) have identified the following value streams in relation to services, thanks to information obtained from company websites: car as a service (CaaS), software as a service (SaaS) and mobility as a service (MaaS), additionally, the cloud computing approach is integrated (Böhm Koleva, Leimeister, Riedl and Krcmar, 2010). The consumer is the center of the value network, who demands the services, buys, or leases the vehicle.

The automotive industry has transformed its value network from generic to a multi-stage one, where there is no longer only the traditional supplier-buyer relationship, but new roles are emerging, such as mobility service platforms or smart infrastructure providers (Remane, Hildebrandt, Hanelt and Kolbe, 2016). Nevertheless, this can be a threat to the value creation of OEMs, because the point of contact with the customer may be gradually lost. Therefore, it is necessary for OEMs to have the willingness to collaborate with emerging players to gain new insights from them with which they can be integrated into innovation (Hildebrandt, Hanelt, Firk and Kolbe, 2015).

This transformation of the automotive industry by digital technologies has changed traditional business models, to give rise to new business opportunities associated with Industry 4.0. This means that companies must adapt to the new reality of the context; so according to Llopis, Rubio and Valero (2021), it is necessary to invest in measures so that companies manage to adapt to the digital transformation and obtain benefit from it in terms of productivity and competitiveness. On the other hand, consumers also benefit by having greater access to services and obtaining greater satisfaction from them.

The factors involved in the digitalization of the automotive industry are diverse, including globalization, which gives manufacturers the opportunity to participate in new markets, consumer diversification and product diversification. Consumer diversification contributes to the presence of new consumer behavior patterns and, therefore, to the need to satisfy particular tastes. As for the diversification of products, these forces to continuously renew the models to adjust to the demand due to consumer tastes due to innovations that are continuously emerging (World Economic Forum, 2016).

2.5.1.1 Advantages of digital transformation in the automotive industry

Today, 50% of the total value of a vehicle is represented by digital technologies (CCOO, 2018). The key aspects that have accelerated the digitalization of the automotive sector are driver connectivity, location services based on driver preferences, autonomous driving (vehicles capable of moving by themselves in specific conditions) and assisted driving (driver assistance) as expressed by Farahani, Meier and Wilke (2017).

Digital transformation means advantages for the automotive industry, among which the following can be highlighted (Llopis, Rubio and Valero, 2021):

- Improvements in the value chain by promoting efficiency, cost reduction, collaboration, and innovation.
- Development of new ways in which companies can interact with customers and partnerships with suppliers that interact through data.
- Changing commercial strategies for selling a product, this time focusing on the customer experience.
- In manufacturing, digitization enables the development of new generations of robots, artificial intelligence, and the internet.

According to the theory of disruptive innovations, business performance and user experience improve with digital innovations (Keller and Hüsig, 2009). In the same vein, Ben-Zeev, Sharma and Ginodia (2017) opine that, digital supply chain enables automation of two-way exchange of critical business information, which accelerates material delivery, optimizes inventory planning, replenishment, and visibility. However, digital collaboration requires a change in the mindset of industry decision makers.

The effects of the automotive industry's digital transformation on the retailer and consumers must also be considered. Interconnected maintenance and services will facilitate diagnosis and preventive treatment; in terms of accessory sales, connectivity facilitates hardware and software upgrades; besides, customers will expect seamless communication when purchasing a product.

On the other hand, the digital transformation of the automotive industry has effects on a much larger scale than production or the market, and these are the effects on the environment. The progressive introduction of electric cars means the reduction of greenhouse gases, a process driven by environmental protection policies on climate change and the promotion of renewable energy. In this sense, the automotive industry is obliged to adapt to government policies that require the reduction of the emission of these gases and the sustainable use of resources (Rubio *et al.,* 2019; Rubio and Llopis-Albert, 2019).

According to Llopis, Rubio and Valero (2021), it is necessary for the automotive industry to invest in appropriate measures for digital transformation to gain competitive advantage in the global market, which may involve capital for infrastructure such as for research, development, and innovation. However, in the research conducted by these authors, some Spanish companies are not won to invest in such efforts, considering it a risky investment, as they do not perceive immediate reward, so its implementation has only been observed in a small number of organizations. Furthermore, small and medium-sized enterprises (SMEs) do not have digital transformation strategies, because they involve high demands on capital and human resources.

2.5.1.2 Challenges of adopting digital transformation in the automotive industry

Digital ecosystems compete with many rivals and non-industry participants. Consequently, the automotive industry has the need to build complementary partnerships between its different actors to create new business models and new digital value, to improve information flows and achieve better communication with the customer (Piccinini, Hanel, Gregory and Kolbe, 2015).

In this vein, Kern and Wolff (2019) are of the opinion that technology adoption varies according to the actors in the automotive supply chain. Multinational companies promote digitization because they know its advantages and have the resources to do so; they have infrastructure and employees with the necessary skills for the implementation of new technologies, they may even adopt new technologies, although the benefits of this decision are not immediately perceived.

Besides, small, and medium-sized companies along the supply chain, generally do not have the ability to transform business models, increase efficiency or revenue with digital technologies;

on the contrary, they see it as a high cost that does not generate sufficient positive impact; therefore, this is rarely an option, and in any case, the investment is made based on the business impact.

However, the pressure exerted by customers for the digitization of the automotive industry is high and if this remains the case, companies that do not resist can make one of two decisions: accumulate the know-how and make the necessary investments or readjust the customer, portfolio and focus on other industries. This digital transformation also requires employees to acquire the skills to understand data and interpret it to generate economic value from it, and interpersonal cooperation skills are becoming increasingly important to take on new ideas and changes that accompany the digital transformation.

In this sense, the challenges for the digital transformation of the automotive industry according to Kern and Wolff (2019) are:

- Assuming the high costs involved.
- Standardization, currently there are several competing standards in the automotive industry, but these can always be improved because they are developed by regional associations. Standards are the guidelines for SMEs to know which technologies to invest in. To encourage standardization in the automotive industry, policy makers could consider:
  a) creating standards bodies to develop, coordinate and promulgate standards,
  b) supporting international cooperation of standards bodies to harmonize standards,
  c) developing free data conversion tools.
- Data security to protect company secrets, but also some data must be shared with supply chain partners. Data security must be throughout the supply chain; this is a basic requirement for digital transformation. Data security can only be ensured when people, processes, and technologies act together (Pfleeger, 2003).
- Employee skills: Some advanced OEMs employ people with the right skills to convince the rest of the staff of the need to implement the changes. They also invest in advanced training programs for their employees. This training process is generally not possible for small companies, which keeps them out of the competitive market. In this sense, for automotive

employees to participate in the digital transformation, policymakers must provide incentives for the company to invest in its human talent, for example, by sponsoring training days or access to educational platforms. The skills that employees should have in the area are skills with software, for example, to manage data.

In conclusion, although the digitalization of the automotive industry is a complex and costly process, there is no doubt that with the technological advances that are happening every day, the way that is emerging as the guarantee of sustainability of companies is structured, because it does not only consider the interrelationships that occur within the industry, but also with consumers and in general with the planet.

2.5.2 Dynamic capabilities in the automotive industry

As discussed earlier in this paper, dynamic capabilities refer to an organization's ability to use its existing resources to create new products to cope with the changes imposed by the environment. Consequently, these capabilities are essential to promote creativity and performance, and when they are strong, they make any company able to cope with the uncertainty of innovation and competition (Rotjanakorn, Sadangharn, and Na-Nan, 2020).

In relation to this point, it is worth noting that the automotive industry is continuously impacted with the introduction of new technologies, which makes it necessary for organizations to adapt to the pace of rapid growth. Consequently, it is necessary to take into account the dynamic capabilities that these companies have, which also exceed the basic skills, in order to be in continuous observation of the changes in the environment to ensure the permanence of the industry in the market.

According to Leite, Borges, Dos Santos, Yutaka and Castro (2017) the mere accumulation of technological assets does not give the industry the security of obtaining competitive advantages. In this sense, one of the most important results of dynamic capabilities is the creation, renewal, development of competencies and capabilities that allow the company to be constantly updated according to the changes that occur in the market (Tondolo, Tondolo, Puffal, and Bittencourt, 2015).

Under this approach, dynamic capabilities consider that the center of action is the external context; consequently, such capabilities are built according to the opportunities and threats presented by the market (Leite, 2013). Thus, dynamic capabilities focus on the production of goods and services that are highly demanded, or could be highly demanded (Teece and Leih, 2016).

An example of the development of dynamic capabilities in the automotive industry is highlighted by Camuffo and Volpato (1996), mentioning Fiat's initiative in creating a robotic system to assemble its automobiles. This example shows that the development of dynamic capabilities depends to a large extent on the demands and pressures imposed by the context, which in this case was the increase in production. Another example of context pressure for the automotive industry is the demand to reduce its environmental impact by manufacturing cars that use cleaner energy (Christensen, 2011).

In this regard, Leite et al. (2017) in their research address the issue of dynamic capabilities in the automotive industry in Brazil, taking as a basis the challenge of reducing the use of fossil fuels, increasing efficiency, and achieving the satisfaction of this new market. This scenario requires promoting the renewal of the way operations are carried out in the automotive industry, leading to the transformation of production patterns, consumption and related legal regulations. Consequently, electric vehicles are presented as an option that will gradually replace vehicles with internal combustion engines with the possibility that in the future there will be hybrid ethanol vehicles (Alves, 2011; Mesquita, Borges, Sugano, and Santos, 2013) and electric vehicles, i.e., that there will be the existence of various technological standards.

Besides, Lee (2012) believes that if there is no technological development in engines that do not depend on fossil fuels, the automotive industry will face pressure from both consumers and regulators; for this reason, strategic behavior is important for organizations in the automotive industry regarding the generation of technologies to reduce the emission of polluting gases. The development of dynamic capabilities in this area by these companies arises as a response to governmental pressure and market competition, which establishes new production, marketing and innovation parameters.

As well as Maynez, Valles and Hernández (2018) expressed that dynamic capabilities are learned models of collective activity that are created or modified to be able to adapt to technological opportunities and customer changes, which leads to the company being more effective, as expressed by Nakano, Akikawa, and Shimazu (2013) and Makkonen, Pohjola, Olkkonen, and Koponen (2014). Therefore, they are skills that each company has or can create according to its reality and that they can use them in a particular way to adapt to the demands of the environment.

For this reason, innovation capability has a positive effect on the competitive advantage of companies. For example, in the research developed by Maynez, Valles and Hernández (2018) it was found that automotive companies that manufacture auto parts located in Ciudad Juarez, Mexico, innovation capability was related to their business patterns, aimed at being at the forefront in terms of the use of technology and anticipate discovering the potential of new manufacturing practices. This thinking contributes to implementing working technology, which favors companies as participants in the supply chain. Specifically, the agility of these companies is due to the common goals they have with their customers and suppliers, performing joint activities such as those related to purchase orders, supply chain improvement and new product introduction plans. In short, innovation is key to achieving sustainable competitive advantage (Mamun, Muhammad and Ismail, 2017), a fundamental aspect for leveraging the dynamic capabilities of an industry such as the automotive industry.

From the review of the dynamic capabilities in the automotive industry, it should be noted that not much literature was found that spoke specifically of these capabilities in this type of industry. This, however, allows us to assume that the dynamic capabilities of each company are specific to each one, because they depend on the conditions of the context. In this sense, these capabilities focus on the opportunities and threats offered by the environment and hence the importance of having the ability to use their resources to innovate and transform the way they have performed their operations if necessary.

In addition, some automotive companies focus their dynamic capabilities on developing new technologies to reduce environmental impact, while others use them to improve the supply chain and others to improve their assembly systems. The important thing for the industry is to be able to identify the demands or needs of the environment and use its creativity to produce new forms of products or services that result in increased performance and benefits for both the company and its customers.

CHAPTER 3.

FIELD OF INVESTIGATION

The objective of this chapter is to contextualize the scope of the study through a theoretical approach to the state of the automotive sector and spare parts, describing and providing research with relevant data for further processing in future chapters.

CHAPTER 3.
FIELD OF INVESTIGATION

3.1. INTRODUCTION

A car is a very complex product, resulting from the assembly of infinity of parts, many manufactured by the own company assembler or manufacturer of vehicles -main industry-, and many others by the industry of automotive equipment and components, also called auxiliary automotive industry (Ortiz, 2010).

In Spain, the automotive equipment and components industry has also had a notable and growing weight throughout the 20th century, to the point that it is currently the third industrial sector in the country (Sernauto, 2020).

Competitiveness, innovation, and skills are the main strengths of the sector. So, they must be driven to meet the challenges arising from new concepts such as automation, connectivity, vehicle electrification and Industry 4.0 (Horváth and Szabó, 2019).

The Spanish sector of manufacturers of automotive components and equipment supports its strengths abroad. The sector is among the world's leading producers, where the business fabric is made up of both a powerful domestic industry and foreign multinationals. In 2019, this sector had a turnover of around 35,000 million euros, of which close to 60% corresponded to exports. Also, among the large Spanish groups, they concentrate more than 350 factories in 35 countries, and in recent years they have settled in the main productive centers of the world. Therefore, it is a sector of great importance within the global value chain, where some Spanish companies occupy a referent place (Sernauto, 2020).

This sector is enriched by its heterogeneity and complementarity. On the one hand, there are large and widely diversified Tier 1 global companies that stand as the main tractor in the sector, with pioneering companies in technological investment and excellent productivity and efficiency rates (Faconauto, 2019).

On the other hand, mid-caps companies, mainly concentrated in Tier 2, build a broad business fabric that contributes to root a sector characterized by its local capability and proximity to its customers. And finally, the SMEs, characterized by being local family businesses that energize their immediate environment generating a productive economy, which know how to compete under the maximum requirements of quality and cost (Faconauto, 2019).

3.2. BACKGROUND

The Spanish automotive equipment and component industry has grown a lot since its inception in the first third of the 20th century, so that, despite its limitations and problems, it has reached the top ten in the world (Ortiz, 2010).

The auxiliary automotive industry emerged in Spain at the beginning of the 20th century, at the same time as the first vehicle manufacturers. During the first three decades, the sector developed slowly like the main industry, but over time many component companies were formed -mainly located in Catalonia and the Basque Country-, so that already before 1930 the sector had acquired a significant size and laid the foundations for its further expansion. In the 1930s, it took important steps thanks to the dynamism of the assembly plants of Ford and General Motors, around which a large group of component manufacturers was formed in Barcelona, with the assistance of the multinationals, were technically and organizationally modernized.

But the Civil War interrupted that process. During the 1940s car production remained low, as did the auxiliary industry, which largely survived the demand for spare parts. The sector began its reactivation in the second half of the 1940s, although the real take-off occurred in the early 1950s, when the factories of SEAT, FASA-Renault and the new ENASA plant in Madrid began to operate. The growth of the automotive industry during the 1950s can be described as spectacular: from 637 vehicles produced in 1950 to 79,859 in 1961, and from 429 component manufacturers to 1,329 in the same period.

In the 1960s, car production continued to increase very rapidly, reaching 530,780 units in 1970. In that year, the auxiliary industry employed about 90,000 people (40% more than the main industry) and was composed of about 1,700 companies, distributed mainly between Catalonia (37.4%), the Basque Country (32%) and Madrid (11.3%). Despite the obvious progress of the sector, during the 1950s and 1960s it had problems both due to technical and organizational limitations and to the policy of a protective court that did not favor its competitiveness (Catalán, 2000).

In the 1970s the automotive industry continued to progress despite the crisis, so that by the end of the decade Spain had more than one million manufactured vehicles and was beginning to rank among the world's leading producers. There is very little data on the ancillary industry at this time, but it is clear that it continued to grow as the number of employees continues to increase. But, in addition to growing, the sector began a process of transformation after the entry into the country of Ford and General Motors (Ortiz, 2010).

These multinationals led to the dismantling of the policy of protecting the national auxiliary industry, which for the first time was exposed to international competition at a time when the automotive sector was undergoing major technical and organizational changes because of the impact of the oil crisis and the irruption of Japanese manufacturers. This involved, inter alia, the gradual introduction of new methods of organizing production and the relationship between the auxiliary and the main industry (the adjusted production system) (Ortiz, 2010). This, together with the staff readjustments in the main industry imposed by the economic crisis, resulted in a progressive increase in employment in the auxiliary industry and a decrease in that of the main one, so that the weight and protagonist of the latter have increased.

At the same time, the establishment of new automotive plants has favored the development of this sector in other regions such as Valencia, Aragon and Navarre, so its geographical concentration has decreased. In parallel with these structural changes, especially following Spain's accession to the EEC (1986), the sector has become drastically internationalized.

From having a very small weight in the sixties, the imports of components have increased until far surpassing the national production in the supply of the domestic demand. Similarly, local production has shifted from domestic production to export for the most part. Along with this, since the seventies many foreign companies were established in Spain, which in a few years became the domain of the auxiliary industry. However, there have also been a few Spanish capital companies that have opted for internationalization and have become multinationals achieving comparative advantages in certain components, although not in those of greater technical complexity.

The selection process of suppliers developed by car manufacturers establishes criteria limiting the entry of new suppliers, since it is carried out in accordance with the ability to participate in the development of the product together with the assembler (Estapé, 1997). This leads to the assessment of various aspects of the main suppliers, in a selection that is usually restricted to traditional suppliers:

- Supplier dimension and integration capability in a multinational strategy.
- Organizational structure that ensures the ability to coordinate and meet supply commitments.
- Quality requirement continues in processes and products.
- Logistics operations capability to ensure "just in time"

These requirements are difficult for most Spanish manufacturers not integrated into multinational groups to meet. In the transition from part supply to component or system supply and project collaboration, most companies in the sector have specialized as second-tier suppliers, having neither the technological capability nor the goodwill to intervene in project contracts.

In this sense, the dependence of large international groups on the auxiliary industry has been an important element for the sector, since they rely on subcontracting or second-tier suppliers, where the price element or cost control, continues to have greater relevance than the value to be added in the manufacture of the product.

In any case, the constant increase in turnover and employment in recent decades indicates that the Spanish auxiliary industry has been able to survive in a free and highly competitive market, although it faces the challenge of keeping up with the strength of emerging industrial countries.

3.3. CARACTERISTICS

The main players in the automotive sector are:

- Vehicle manufacturers
- Manufacturers of equipment and components
- Distributors
- Vehicle dealers, repair shops and after-sales services
- Scrapping and recycling enterprises

These actors are increasingly interlinked and, as a result of the forces acting on the sector, the roles of vehicle manufacturers, equipment and component manufacturers, distributors, of vehicle dealers and repair and after-sales workshops are undergoing a process of change that will be consolidated in the coming years (International Labour Office Geneva, 2005).

Vehicle manufacturers, on the other hand, tend to concentrate their activity on the manufacture of engines and major sub-assemblies, the assembly and design of the vehicle and mainly on the marketing of the vehicle and the relationship with the customer; outsource their production processes and delegate greater responsibilities in manufacturing, assembly and research and development. In this sense, it is considered that a job in a vehicle manufacturing plant is accompanied by four jobs in the equipment and components industry (Consiglio, Seliger and Weinert, 2007).

This transformation is due to the current strategy of large multinationals, which use outsourcing techniques to reduce production costs, transfer responsibilities and increase their flexibility by reducing fixed assets and inventories to the subcontracted task, and by focusing on other activities that are more advantageous to them.

The agents that constitute the sector of Equipment and Components are classified, according to the following scheme, according to the market to which their products are destined:

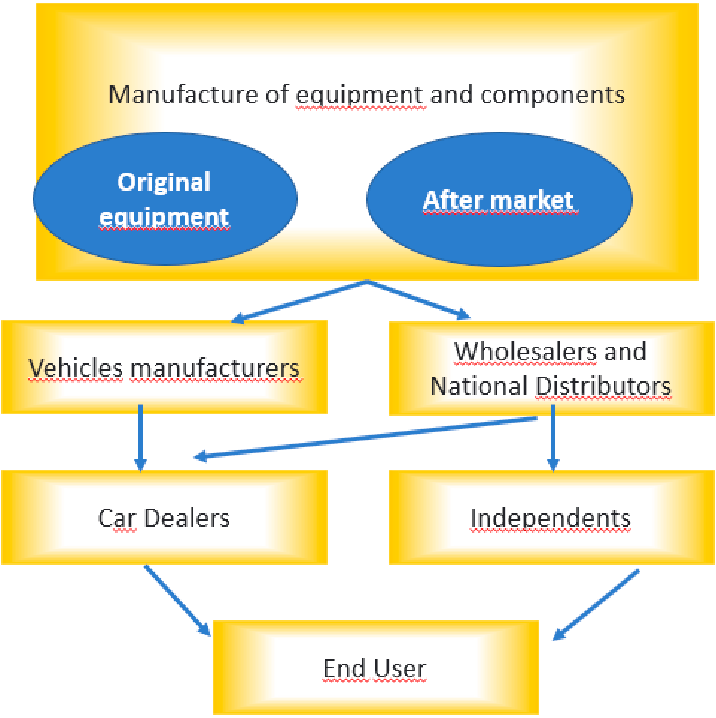
Market of first equipment:

- First-level manufacturers (TIER-1): manufacturers of systems, subsystems and components that are usually fully finished. They have high technology and supply directly to the vehicle manufacturer.
- Second-level manufacturers (TIER-2): manufacturers of high-tech systems, subsystems and components for installation in TIER-1 systems or subsystems.
- Third level manufacturers (TIER-3): manufacturers of semi-finished products or raw materials supplied to component manufacturers.

Market for spare parts:

- Original spare parts: spare parts, which are of the same quality as those used for the assembly of vehicles and are manufactured according to the specifications and production standards established by the vehicle manufacturer. Spare parts manufactured on the same production line are included.
- Spare parts of equivalent quality: spare parts manufactured by any company that can always certify that the spare parts are of the same quality as the components used for the assembly of vehicles.
- Accessories: parts for mounting on vehicles that are not generally incorporated as standard in vehicles, here are also included all those manufacturers of parts for the customization of vehicles.
- Commercial: companies that develop an exclusively distribution activity, without having factories in Spain.

Table 8. Agent Scheme of equipment's manufacturers



Source: Sernauto (2020)

The automotive aftermarket is operated by a variety of agents who interact with each other. The objective of this section is to make a brief introduction of the same, following the value chain of the car's spare part and the five levels that have been identified, from the manufacture of spare parts to their consumption by users.

Depending on these levels, the different actors in the sector have positioned themselves in a pyramid, where the base would be occupied by the manufacturers of equipment and components, and the top, by the consumer.

The key agent in the value chain is the user. He decides whether to carry out repairs or maintenance of his vehicle in an official service, in specialist chains (fast services and coaches), or in an independent workshop. The final consumer determines the positioning of the rest of the sector agents.

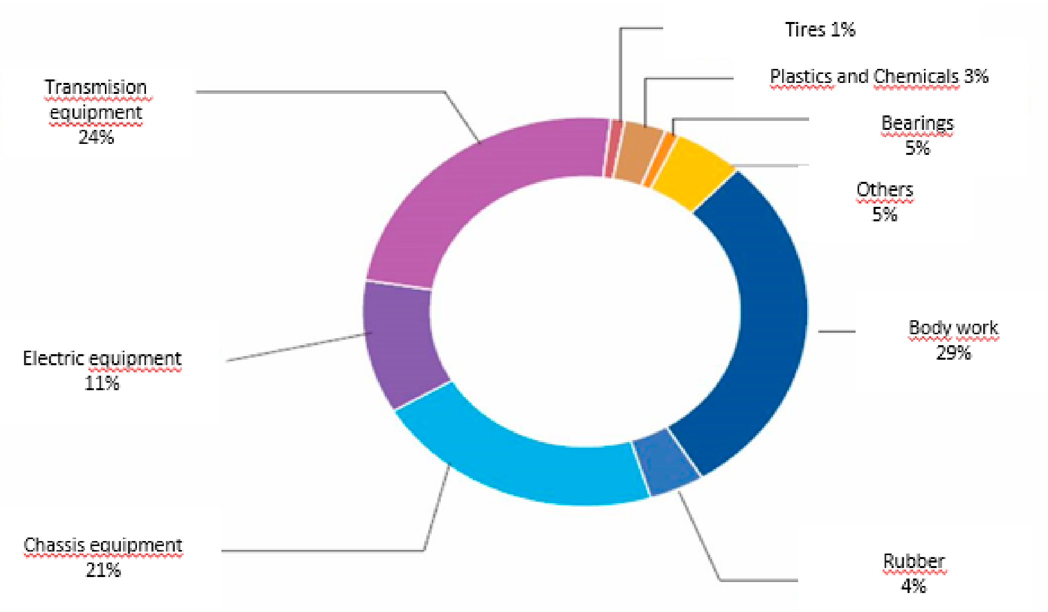
The next level is for operators performing repair or maintenance operations. These agents are the official service, the workshop and the specialist chains.

In the third level are the agents who carry out the retail distribution of spare parts: the spare parts store (associated with either a purchasing group or independent), the official service (which also distributes spare parts to independent workshops) and the auto centers. Also, the Authorized Treatment Centers (CAT) are included.

On a fourth level, there are the agents who carry out the wholesale distribution of automotive spare parts: the distribution groups in the independent spare part and the vehicle manufacturers in the official spare part.

Finally, we meet the manufacturer of equipment and components. Many of these companies are large multinationals with a significant presence in the sector and supply all the agents that carry out the distribution operation (builders, purchasing groups and specialist chains), although each has different policies of action.

Table 9. Specialization of the spare part industry by product group



Source: Sernauto (2020)

On the other hand, the manufacturers of "Motor and Transmission Equipment" and "Chassis Equipment" represent 24% and 21% respectively, while those that manufacture "Electrical and Electronic Equipment" represent 11% of the total of companies.

The large number of companies involved in manufacturing these four product groups also generates a larger share of the overall turnover of the sector. Specifically, they concentrate 84% of the total turnover of the sector.

An analysis by product group shows that the Equipment and Components sector in Spain is mainly made up of "Bodywork" and "Motor Equipment" companies which, together, they account for 52% of turnover and represent 53% of the Spanish business fabric. This concentration in turnover is also reflected in the distribution of turnover in terms of the number of employees, 78% of turnover comes from companies with more than 500 employees and in the position vis-à-vis manufacturers, and the sector of the first team concentrates 72% of the total turnover of the sector.

Through this analysis, the automotive equipment and component manufacturers sector is a very relevant sector within the Spanish industrial landscape and plays a key role in the vehicle manufacturing industry.

3.4. IoT, BIG DATA, AI WITHIN THE AUTOMOTIVE SECTOR

3.4.1. IoT

Internet of Things (IoT) is a novel and revolutionary concept that transcends the scope of the already "traditional" M2M: it tells us about an environment in which "everything" will be connected and in which people will occupy a central position, being able to interact with the physical objects that surround us in a simple and intuitive way. It therefore covers much more than machine-to-machine communications and has the potential to radically transform many sectors of industry and society. The world of the future will be a "hyper-connected" world (Höller *et al.*, 2014).

A connected car is a vehicle with Internet access, which allows devices, both inside and outside the car, to interact with each other. Inside the car, we can find devices, sensors and on-board computers. Out-of-car devices can be part of other cars and infrastructure, among others (Evans, 2011).

Internet of Things (IoT) is the promise of a more connected world, where all devices can talk to each other, exchange information and improve people's lives (Feki, Kawsar, Boussard and Trappeniers, 2013). With the connection of the devices, you gain efficiency and enable a lot of new services and business opportunities. For companies, being able to take advantage of the benefits of IoT could result in operating efficiencies, improved costs and the generation of new businesses (Miraz, Ali, Excell and Picking, 2015).

#1. Safety and security

IoT in the automotive industry provides thousands of hardware and software solutions for vehicles to better understand the environment and be more autonomous. For example, if the vehicle can communicate with the city's infrastructure (V2X), it can obtain real-time information about road conditions, accidents, traffic and the current climate. The data helps the driver to change his route, avoiding traffic jams and possible accidents. With that, the vehicle can collect information about objects on the road, including curbs, bumps, and other vehicles that circulate on the road, which allows the vehicle to know in advance that it can be found later and to prepare for it in advance (Wang, O'Keefe y Petovello, 2013).

#2. Efficiency

The connected vehicle software may make use of the data collected for our benefit. For personal cars, the software can generate the most effective routes to our destinations, avoiding traffic jams, accidents, congested streets or roads under construction, with the time and fuel savings that that brings us. For vehicle fleets, connected car software solutions help to manage all units at the same time. For example, the company can track the location of vehicles using GPS and analyze their status in real time or schedule maintenance, increasing the efficiency of cars (Gora and Rüba, 2016).

#3. Return on investment

The implementation of IoT infrastructure on the roads is not cheap, nor are connected vehicles. However, as we mentioned earlier, we will get a benefit in the amount of time and fuel saved by minimizing traffic and traffic jams. In addition, with a heavily implemented infrastructure it will make it easier for people to share travel (Seuwou, Banissi and Ubakanma, 2020).

#4. The environment

With more people sharing vehicles, there will be fewer cars on the roads, which means less environmental pollution by reducing emissions from vehicles. In addition, the trend is for more and more modern connected cars to run on electricity, a trend that is expanding (European Automobile Manufacturers Association, 2020).

#5. Accessibility to

Smart cars will offer more opportunities for disabled people to have better access to transport options. In many cases, people with mobility problems can only rely on public transport, and even needed additional help. With autonomous cars connected, the disabled will be able to "drive" alone easily, with advanced technologies that will help them and improve their mobility (Monzón, 2015).

#6. Data for

Sensors in connected cars collect a large amount of data, which is useful to the driver when driving or are used by the vehicle to generate an autonomous response to a situation. But, for manufacturers and companies offering some kind of service, this data can be especially useful to further improve the user experience or obtain patterns, statistical studies, etc. (Seuwou *et al.*, 2020).

3.4.2. BIG DATA

Big Data is the set of data, both structured and unstructured, and the combination of the set of these, whose volume, complexity, and speed of growth make it difficult not only its processing, but also its storage and its collection. To do this effectively, it is essential to have specific technology designed for it (De Mauro, Greco and Grimaldi, 2016).

In the case of Big Data and automotive, this can help brands to compare current models with previous similar models, as well as different colors, add-ons, etc. This information can be cross-referenced with dealerships sales by geographical area, at both the national and international levels. To continue, we should include the analysis of the evolution of these sales, to determine which type of vehicles, of which characteristics and with which accessories are sold more in one place or another and thus assign communication and logistics, and the business strategy accordingly. This simple example could only be done through Big Data (Johanson, Stanislay, Jalmiger and Gjertz, 2014).

Among the main applications of use of Big Data and automotive, the following stand out:

#1. In the industrial process

The industrial process in the automotive industry has reached optimal levels of automation, which are the prelude to data storage, not only because of its immense volume, but also because of the ability to integrate knowledge in a reliable and systematic way. Robots in assembly plants have been storing data related to quality control for years and using Big Data to predict the durability of the different parts that make up the car. According to the Fraunhofer IFA Institute, the automotive industry could save up to 20% of its maintenance costs if it used predictive models to anticipate the wear of parts, (Ontheroad, 2019).

#2. In the process of designing new models

The Internet is one of the great generators of data, and social media is the great endless source of unstructured data. Knowing how to collect the information captured by consumers in these media, storing it and knowing how to analyze it, through Big Data systems, the information could be properly arranged in such a way that it is useful to be able to determine, through predictive models using such information. Facts such as which finishes would be sold more, which complements the user demands more, which type of vehicle can be the most sold, depending on the segment, etc., can be known (Janakiraman, 2015).

#3. In the process of customer loyalty

In this phase Big Data and automotive have a lot to do, as managing large amounts of information related to our customers, and crossing it with geographic, social, lifestyle or even emotional information. We can create models that help us to know when the vehicle will change and what type of car is most likely to look for, including what color and features, to anticipate it and launch it (Johanson *et al.*, 2014).

#4. In the after-sales service

In this case, technology applied to the service economy can make a significant leap towards a positive experience, thanks to the precise knowledge of consumer requirements. In addition, thanks to the Big Data it will be possible to foresee the failures of the car, since it will remain connected with the workshop, being able to arrange an appointment, even before such failure occurs, helping to significantly reduce the accident rate (Johanson *et al.*, 2014).

#5. In the creation of new services

Connected cars as well as autonomous cars will lead to an increase in the number of data. It is estimated that connected vehicles could emit about 5 TB in data in a single hour, according to Automotive World (Deloitte, 2015). This amount of information will encourage its use not only by brands, but also by third parties, even saying that a user will end up consuming a service instead of a car (Miller, 2020).

3.4.3. AI (Artificial Intelligence)

Artificial Intelligence (AI) is a technology that car manufacturers can use to adapt to this new paradigm. The AI will create significant opportunities for car manufacturers to reduce production costs and introduce new sources of revenue, including auto-conduction technology, predictive maintenance and route optimization Artificial intelligence is integrated in the whole process of creation of vehicles, obviously in the use of the same, in the recognition of the drivers and their habits, also in the associated services (ACEA, 2020).

Among the main applications of AI and automotive use, the following stand out:

#1 AI helps us in driving

Basically, we can divide them into two levels: assistance to a driver and fully autonomous cars.

- Driving assistance (Eisenberg, 2018):

  Before industry and governments can deploy a fleet of autonomous cars, what remains for us is to rely on technology to help us. Having an intelligent co-pilot who makes his own decisions, at the same time he informs us from the data he receives from many sensors and cameras that surround the vehicles. Here we can find systems such as alerts on lane changes, emergency brakes based on the detection of traffic around us, automatic parking, monitoring of blind spots, even steering assistance. All this always with one person in charge.

- The car drives itself (Webedia Brand Services, 2019):

  Considering all the technology that cars already integrate, the logical step is to be able to drive alone. Many manufacturers are already working on fully autonomous vehicles.

  In the world of technology we could say that Tesla (and its Autopilot) and Google (through Waymo) are the ones with the lead voice, with the greatest number of kilometers covered in real tests, but there are also many small companies developing the technology: Autox,Drive.Ai, Optimus Ride or nuTonomy (Schroer, 2019).

#2 Monitoring the driver

Artificial intelligence is also at the service of what happens inside the vehicle in three scenarios (Webedia Brand Services, 2019):

- Recognition and identification of the user (Eisenberg, 2018). The software is able to know which driver is in charge and keep it in mind, adapting the conditions to your preferences. It can also become a vehicle locking mode, allowing its driving only to recognized people.
- Monitor during driving time. By looking at the driver's eyes, and the movement of his head, the system is able to tell if he is falling asleep or is aware of things other than the road.
- Control of the entertainment system. Whether with voice recognition or with gestures, artificial intelligence means controlling things like changing music, maps or notifications.

#3 The services of clouds

The vehicles of the future have to be connected devices and very powerful in processing capability. They will have a special dependency on the data, which will be hosted in the cloud. Artificial intelligence is going to help that data to be managed efficiently. With the information gathered, it will be predicted, for example, its maintenance. Imagine an intelligent system with information from thousands of cars, it is logical that you can forecast incidents with greater speed. It will also be possible to present solutions with software downloads (Eisenberg, 2018).

In the same way that companies know a lot about us through our mobile devices, they will also get it with a connected car. In it, there are entertainment systems and voice assistants that will make possible to collect the tastes and preferences of all those who manage them (Agrawal *et al.*, 2018).

#4 In the manufacture of vehicles

The fact that there are robots on the assembly lines is not new, the interesting thing is that they are sensitive to the presence of humans and adapt to their rhythm and position, so that nothing happens with them, they call them collaborative robots (cobots). On a second level we have the AVG or Automated Guided Vehicles, capable of moving through a factory with cargo without the intervention of humans (Webedia Brand Services, 2019).

#5 AI insurance

Another area that will evolve in the next few years is insurance and smart processes. Predicting what is going to happen is essential for a company dedicated to securing our belongings, so all the tools that help assess possible risks are welcome.

AI will be able to predict breakages based on our use and car and will help us in the accident parts. For the user there are also applications that will report what it will cost us to fix a car in an accident (Webedia Brand Services, 2019).

3.5. CONCLUSION

The automotive equipment and components industry -currently the third largest Spanish industrial sector by turnover- emerged in Spain at the beginning of the 20th century. Its development was slow, as was that of the country's automobile industry, but before 1936 it had already reached a significant size and was in the process of expansion and modernization. The Civil War and the industrial policy of the immediate postwar period slowed down this process, but in the 1950s the sector progressed rapidly coinciding with the takeoff of the automobile industry.

The great growth of the auxiliary industry between 1950 and 1970 occurred in a protectionist framework, which limited its modernization and generated problems of supply to the main industry.

But, after the liberalization of the seventies, it managed to modernize and internationalize, although largely thanks to the multinationals that arrived in Spain.

For a long time, the lower wage cost has been an element that has given a comparative advantage to the establishment of large multinational groups in Spain. However, at present, this advantage is not so significant (Ortiz, 2010).

Cost containment points to difficulties in meeting another no less significant cost, namely distribution or logistics, where the essential element is the proximity of assembly centers. In these circumstances, it is currently difficult to accept the wage advantage that the sector could have in Spain a few years ago. On the other hand, distribution costs may no longer be favorable, bearing in mind the tendency to locate vehicle factories in eastern and central Europe, close to the main consumer markets.

More interesting are the second- and third-tier companies which are suppliers and complement to the main or first-tier auxiliary sector, and which have demonstrated their ability to adapt to the dynamics of the sector. They will, however, be forced to accept new policy constraints if they are to maintain their relationship with first-tier suppliers (Sernauto, 2020).

These companies, together with the large producer brands installed in the country, are perhaps the main assets that the auxiliary sector has in Spain (Sernauto, 2020). The constant rearrangement of the automotive sector, which seeks a comparative advantage in precise market segments within the idea of globalization, carries an implicit condition in the functioning of the auxiliary activity. Hence, offshoring approaches are always present.

The competitiveness of the Spanish automotive components sector in the global environment will depend on its ability to internationalize and invest in new technologies, developing new products and processes (Sernauto, 2020). Companies need to take advantage of the growth in vehicle sales in emerging market markets and continue investment policies and agreements in those markets (Piccinini, Hanel, Gregory and Kolbe, 2015).

In conclusion, the automotive industry is a dynamic and constantly evolving one, in which the manufacturers of equipment and components play a key role as reference suppliers for vehicle manufacturers. Components play an important role in the development of new products and the implementation of manufacturing, management and quality assurance processes that enable the automotive industry to be more competitive. The development of the automotive equipment and component manufacturing industry is therefore a key to the success of the automotive and fabric industry.

EMPIRICAL PART

CHAPTER 4.
Methodology Investigation: survey and research

In this chapter, a quantitative study will be carried out to empirically contrast the hypotheses of the research. It includes the decisions we have taken on the design of the study, the sample chosen, the data collection procedure and the development of measures as well as the methodological choice.

CHAPTER 4. METHODOLOGY INVESTIGATION: SURVEY AND RESEARCH

4.1. OBJECTIVE

Our aim was to develop a practical approach that would argue the validity and applicability of this thesis. Accordingly, we present below an empirical study within the framework of a business in the automotive sector and components. Based on the theoretical foundations studied, and before proceeding to the analysis of the results, we dedicate this chapter to describing the design of the research, which will allow us to obtain the empirical evidence from the approach used.

We used a questionnaire for data collection and detail the information sources used. We reviewed the literature, analysed the measurement elements, exposed the hypotheses and justified the model used to validate the importance and relevance of the relationships between the proposed variables. The choice of an appropriate research method should be based on the type of problem investigated (Kerlinger, 1986). The research design adopted and the hypotheses raised in this research are explained below; I would like to highlight that the order of the hypotheses does not reflect their importance.

4.2. FOCUS OF THE STUDY

The specific and primary objective of any academic research can be twofold. It may be aimed at developing a new theory, or it can be aimed at the provision of information or relevant facts that reaffirm, validate or refute an existing theory.

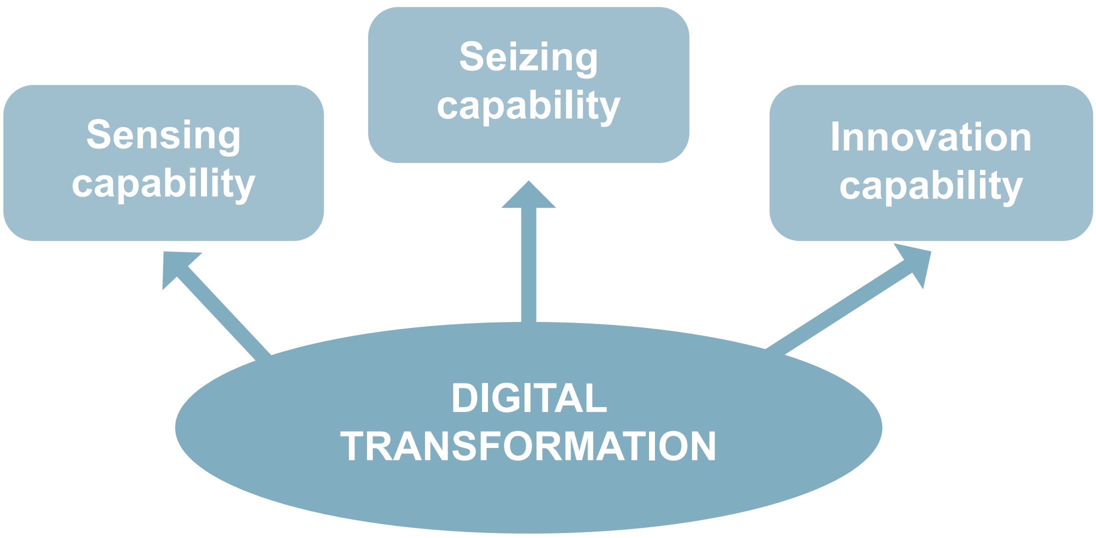
Our work was developed following the empirical research type and, in particular, using statistical sampling. We used a certain sample of the automotive sector to establish the relationships through the different hypotheses. This thesis adopted the structural equation modelling (SEM) analysis technique, which allowed us to analyse multiple relationships between different blocks of variables. Each block was composed of the observed variable numbers and could be represented by a latent variable. This technique can be used in both exploratory and confirmatory analyses (Cepeda and Roldán, 2004).

SEM analysis with latent variables as a statistical technique has been used widely in the marketing and market research sectors (Caballero, 2006), which makes it possible to deal with intangible assets. According to Fernández, Fa and Arteaga (2010), SEM allows the expression of the multiple relationships between variables that appear in the social sciences, so the phenomena under study can be empirically validated.

4.3. INDICATORS´ IDENTIFICATION

As mentioned earlier, the theory of resources and capabilities and dynamic capabilities can explain how organizations achieve competitive advantages in dynamic environments, where changes occur continuously (Teece, Pisano and Shuen, 1997), based on the competitive forces approach. In this paper, we aim to corroborate whether dynamic capabilities arise in automotive companies as a consequence of digital transformation. The following figure shows the chosen dynamic capabilities and how digital transformation influences them.

Figure 1. Influence of digital transformation on dynamic capabilities.



Source: Authors' own (2021)

As the basis for this study, it is assumed that dynamic capabilities can develop sensing, seizing and innovation capabilities in organizations. The measurement of these capabilities was carried out through the specification and estimation of a system of structural equations with latent variables, which were estimated, as detailed below, through measurable indicators; this allowed us to test statistically the existing relationships between them.

As shown in table 10, the criteria for selecting these indicators was primarily their validity, according to the relevant literature, for the measurement of the dynamic capabilities proposed. The complete survey used is available in Annex 1.

We have chosen 23 representative elements, because each statement measures one of them at the time of the questionnaire. The capabilities were selected based on previous work on dynamic capabilities. The estimation of the capabilities has been used, in turn, to determine their influence on the respective indicators through which they are manifested.

The reasons and implications for the system under study are detailed below, as well as the nature of each of the indicators:

INDICATOR: BD_SENS

14. How often do you use BIG DATA for purchasing behavior analysis?

Through Big Data, it is possible to know for example the number of visitors looking at a website, because this variable can indicate significant changes of the audience with respect to a new marketing plan (Tran and Houng, 2016). In this case, the count of visitors can be monitored by a control chart (Montgomery, 2007). The charts can also be employed to analyze customer satisfaction surveys (Kenett, Deldossi, and Zappa, 2011). With data, the understanding of each stage of the consumer decision-making process is expanded (Hofacker, Malthouse, and Sultan, 2016).

26. How often is possible to advance in the PRODUCT DESIGN to acceptance according to real tastes, education, geographical areas, etc. through Big Data?

Collecting data, customers can express their needs, which provides information to business managers to develop customer-centric products, as well as information regarding operations and supply chain management. Big data is low-cost, interactive information resulting from mass communication. Through it, customers have greater understanding of products (Zhan, Tan, Li and Kei Tse, 2018). Companies require knowledge of the external environment for product innovation (Chuang and Lin, 2015; Lichtenthaler, 2016). For such a reason, customers are important sources of information and knowledge; and their involvement can enhance new product development (Cooper and Kleinschmidt, 2011).

INDICATOR: DT_SENS

20. How often has digital technology enabled the sales force to OPTIMIZE ROUTES?

One of the main trends today is the automation of the sales force, in other words, the application of technology to make sales more effective (Sandhusen, 2002). To automate the sales force, electronic tools such as cell phones and tablets are used, which connected to the Internet allow the company to maintain contact with customers, carry out sales operations and keep informed of what is happening in the market. In addition to these tools, specialized software allows salespeople to manage visit routes, manage the agenda, take orders, invoice, among other important activities. With mobile devices, salespeople can also manage their relationships with customers and create profiles and prospects in order to analyze and forecast sales (Kotler, and Armstrong, 2003).

Sales force automation allows for more information for the salesperson, satisfied customers, more dynamic sales, real-time feedback, lower administrative costs and updating of the database for contact management (Thompson, 2006).

23. How often has digital technology developed solutions to PREVENT ACCIDENTS?

Intelligent transportation systems are gaining more and more importance as a solution to make roads safer in smart cities. The growing number of vehicles increases the likelihood of traffic accidents. For this reason, vehicle-integrated sensors enable the detection of dangerous situations and thus avoid incidents. Most of the systems used for this purpose minimize responses, but they are often costly solutions. However, the development of applications on cell phones allows the collection of information on factors that allow estimating the situation, such as speed, gravitational force, pressure, location, and sound, which can be processed to detect incidents on roads and thus, avoid accidents (Bhatti, Shah, Maple and Islam, 2019).

Meanwhile, Pansambal (2020) to overcome the performance limitations of sensors installed in conventional smart vehicles in terms of obstacle detection range and small roads proposes a new autonomous emergency braking system using car-to-car communication technology. The results of their study show that the method can further reduce the risk of collision.

INDICATOR: IoT_SENS

17. How often do YOU USE NETWORKING WITH OTHER PLATFORMS?

Networking main objective is to build and maintain interpersonal relationships that potentially facilitate work, in view of the fact that it allows access to resources, which is advantageous for the people involved (Wolff and Moser, 2006). According to Utz and Breuer (2019), the use of social networks such as Linkedln, brings people professional benefits because it allows them to be in contact with relevant information. In the same vein, companies that use social networks such as Facebook or Twitter quickly share information with people interested in their products and services, thus having the opportunity to know suggestions and comments in real time and thus build a closer relationship with their customers (Sandoval Almazarán, 2011).

INDICATOR: BD_SEIZ

24. How often do you use sensor integration or data management to make COMMERCIAL ALLIANCES with suppliers or/and customers?

Customer experience (CX) is a sustainable source of information for gaining competitive advantage through big data processing (Holmlund, Van Vaerenbergh, Ciuchita, Ravald, Sarantopoulos, Villarroel and Zaki, 2020). The analysis of big data has become a source of innovation and competition, because it provides more and more value to the company, through the use of the dynamics of people, processes and the transformation of data into knowledge to make business decisions and address the problems that arise (Akter and Wamba, 2016). In this sense, LaValle, Lesse, Shocley, Hopkins and Kruschwitz (2011) are of the opinion that business analytics (or the ability to use big data) for decision-making must necessarily be related to the organization's strategy.

27. How often does digital technology allow you to estimate THE DURABILITY of the different parts that make up the product?

The evolution of technology through modern tools such as the internet of things, artificial intelligence or sensing technology, have influenced the maintenance model, establishing a transition between reactive maintenance (RM) and preventive maintenance (PM). The former is executed when equipment fails and causes delays that influence repair cost; while PM is scheduled (Yongyi Ran, Zhou, Lin, Wen and Ruilong, 2019). Thanks to technology, predictive maintenance has become the solution to address smart manufacturing and perform equipment condition estimation, specifically in terms of fault diagnosis and remaining equipment life assessment (Zhang, Yang and Wang, 2019).

INDICATOR: DT_SEIZ

18. How often does technology UNIFY SYSTEMS GLOBALLY across your plants and logistics centers?

Many companies have divided business environments, where there is no effective communication between business and technology information, affecting productivity levels. In this sense, Dvorak, Reddy Depa and Gonzales (2013) outline five steps for business and technology unification: a) establish a common link through the application portfolio, b) determine the investment of resources in technology, c) measure the transformational capability of the company, d) promote the modernization of the technological infrastructure and e) establish a unified digital platform oriented to clarify the meaning of data and priorities of the company. Available technological resources such as technical equipment, data storage devices, software, communication networks, among others, are used to serve consumers (Laudon and Laudon, 2006).

21. How often has digital technology made it possible to CONNECT ALL BUSINESS DIVISIONS under one direction?

The organizational changes brought about by digital transformation are changing life in companies (Yoo, 2010). Consequently, new managerial challenges arise that merit understanding the nature of digital technology (which are described as the combination of information technologies, cloud computing, communication, connectivity, data analytics and mobile technologies) (Bharadwaj, El Sawy, Pavlou and Venkatraman, 2013). Therefore, digital technologies offer new, more flexible environments to create new organizational forms with customers (Lucas, Agarwal, Clemons, El Sawy and Weber, 2013; Yoo, Boland, Lyytinen and Majchrzak, 2012).

According to Hildebrandt, Hanelt, Firk, and Kolbe (2015), vehicle OEMs that have heterogeneous knowledge of digital technologies and can integrate it into their companies and commercialize this knowledge are better prepared to face digital transformation in their businesses.

INDICATOR: IoT_SEIZ:

15. How often do YOU USE ALERTS installed in customers' vehicles?

Voice warnings significantly increase drivers' alertness and give drivers a sense of control because it provides them with information about the vehicle's operational status; therefore, it is essential communication channels to keep the driver informed. In general, drivers prefer a voice-activated alert system, which allows concluding that people feel safer with the driver warning system (Koo, Shin, Steinert and Leifer, 2016).

Some driver warning systems are designed to determine fatigue to monitor the driver and alertness to prevent falling asleep at the wheel to avoid accidents. Abulkair, Alsahli, Taleb, Bahran, Alzahrani, Alzahrani, and Fattouh (2015), presented the proposal of FDS (driver fatigue detection system), through a software running in the smartphone, employing a mobile camera and Android system to record a real-time video and track the driver.

INDICATOR: BD_INNOV

25. How often do insurance companies contact your company to offer a CUSTOMIZED PRODUCT depending on the driving style by the data you collect directly from the vehicle?

With the advancement of technology, insurance products based on the use of information provided by the internet have appeared. These products will depend on the driver's risk identification based on his or her driving style. Binary logistic and ordinary least squares regions are also used to effectively calculate the short-term driving risk score to identify different risk factors such as driving speed, braking times, revolutions per minute and accelerator pedal position. These data also allow an analysis of the safety implications for traffic and insurance companies (Sun, Bi, Guillen and Pérez Marín, 2020).

Usage-based insurance (RBU) classifies the driver according to the data provided by car sensors, which helps insurers to estimate the level of accident risks. In this regard, behavior-based pricing model (BVIP) achieve better accuracy in terms of risk level classification (Bian *et al.*, 2018).

19. How often are PREDICTIVE MODELS used to ANTICIPATE WEAR of parts have had an impact on the vehicle's maintenance cost?

One of the great challenges associated with Industry 4.0 is to use and process the data generated by IoT sensors that are installed in machines, to obtain information to anticipate possible failures and schedule predictive maintenance of equipment. Through this type of maintenance, the state of the equipment is evaluated, which will allow deciding whether to intervene, thus saving on expenses that could be generated by unforeseen breakdowns. This way, adequate prediction models are useful information for the maintenance process (Sittón, Rodríguez and Muñoz 2018).

Intelligent systems of machine learning, artificial intelligence and preventive maintenance, are widely used in the industry to determine the condition of equipment. Digital transformation then allows obtaining a large amount of information to detect failures automatically, which allows reducing equipment downtime and increasing the utilization rate of components (Murat, Abdussal, Zeeshan, Korhan, Asmael and Safaei, 2020).

INDICATOR: DT_INNOV

22. How often has digital technology allowed us to make decisions about ORGANIZATIONAL CHANGES?

Attaran, Attaran and Kirkland (2019) describe that while the digital revolution is evident, many companies do not fully understand what they need to do to benefit from it. Technology-driven organizational change is not only about integrating digital technologies such as social networks or email. A true digital transformation requires a cultural and organizational transformation, where employees are empowered with new skills so that they can develop a disruptive culture through sustainable operations.

Companies that understand the importance of digital transformation show more modern work styles, consider user preferences and the information they can obtain from the context. The proper processing of this information is the key to reach competitive advantage, so employees must have access to the right information to be able to properly execute their tasks and thus increase quality and productivity (Dority, 2016).

28. How often do you use digital technology to know when the customer WILL CHANGE THE PRODUCT, the type of product you are going to look for, color, features in order to anticipate it and thus launch the user a communication that makes you purchasing it?

According to Pantano and Timmermans (2014), emotional engagement, interactive interfaces and devices that allow customers to visualize information dynamically strengthen the relationship between customers and companies. From this perspective, technology becomes smart when the company connects with the customer and both derive benefits from that connection (Ahmadinia *et al.*, 2015).

Consumers will adapt to the rapidly changing digital environment (Anderson and Bolton, 2015), so for the company it is important to timely understand customer behavior and accept changes in their dynamics. In this regard, the key to the success of the organization is to keep track of the changing habits of customers that can affect their business (Foroudi, Gupta, Sivarajah and Broderick, 2017).

29. How often does the digital transformation allow your company to ANTICIPATE FUTURE CAR FAILURES allowing the connection with the workshop, being able to make an appointment, even before such a failure occurs?

Industry 4.0 approaches, intelligent systems, predictive maintenance, and artificial intelligence are applied in industries to manage the condition of equipment by employing information and communication techniques. This helps the company to have large amounts of data on the operating conditions of equipment and thus determine failures even before they occur (Murat Çınar, Abdussalam, Zeeshan, Korhan, Asmael, and Safaei, 2020). The possibilities of manufacturing and placing sensors on equipment will continue to increase as the rise of the internet of things increases. With the increase in sensors, the amount of data will also increase, enabling the development of machine learning algorithms to perform preventive maintenance. The data collected provides useful information and valuable insights to improve system dynamics and already supports decision making in various areas (Borgi, Hidri, Neef and Naceur, 2017).

INDICATOR: IoT_INNOV

16. How often is the DEGREE OF INNOVATION OF COMPETITION IDENTIFIED through networked devices?

The presence of digital technology in products, services and operations significantly influences the way companies achieve and maintain their competitive advantages (Hana, 2013). Digitalization changes the nature of products, the value creation process, and their competitive environment. This allows companies to make unlimited combinations of products and services and to establish new forms of value co-creation where all actors are involved. Companies can thus intervene in their environment to shape it and make strategic decisions for their benefit (Koch and Windsperger, 2017).

INDICATOR: DT_SALES

30. How much has digital transformation allowed us to increase our MARGIN ON SALES?

Value creation at the customer level can occur at all stages in which the consumer makes the decision to buy (Sweeney and Soutar, 2001). Prior to purchase, the consumer recognizes his or her needs, seeks information, and evaluates product alternatives. During purchase he/she chooses, orders, and pays; post-purchase he/she uses the product and requests service (Lemon and Verhoef, 2016). Digital transformation exposes new ways of value creation because it allows satisfying customer needs through automation, individualization, interaction, and transparency. So, customers will prefer to interact with actors that achieve better value creation in such dimensions (Reinartz, Wiegand and Imschloss, 2019), which has a direct influence on their purchase decision and thus on the company's sales margin.

INDICATOR: DT_PROD

31. How much has digital transformation allowed us to increase the production process (PRODUCTIVITY)?

Digital transformation drives business growth in at least three sectors: workforce creation, productivity and cost reduction, in view of the fact that it offers complementary tools for current human capital, which boosts innovation and leveraging technology (Accenture, 2018). In this sense, according to Aly (2020), there is a positive relationship between digital transformation and economic development and labor productivity. In this vein, according to Bertani, Raberto and Teglio (2020) there is a positive correlation between the growth rate of tangible and intangible investments and productivity (which include technological tools for communication and information, software and databases) and the labor and total productivity of companies.

INDICATOR: DT_RENT

32. How much has the digital transformation allowed us to increase FINANCIAL PROFITABILITY (EBIT)?

The digital transformation that has occurred through information systems has been key to the growth of large companies around the world. Such growth is due to the close relationship between information systems and employee productivity when technological systems are integrated to optimize business operations. The consequences are an increase in operations and therefore an increase in economic income. In this sense, new information systems through the web and the cloud allow the creation of new forms of business and customer relationships (Zhu, Dong, Xu, and Kraemer, 2006).

However, at the current level of digital transformation, medium-sized companies are the ones that show the highest growth in revenue and EBIT, which is presumably due to the large number of companies that have been affected by digitization, because as digitization increases, so does the economic pressure as executives are attentive to the competition and to track the return on their digital investments. Under this scenario, some companies earn high returns, while many others, even in the same industries, present below-cost returns (Bughin, LaBerge and Mellbye, 2017).

INDICATOR: DT_SHARE

33. How much market share has digital transformation allowed us to win?

Companies that adopt technologies as a tool to improve their processes and to adapt to market changes are defining their own digital transformation strategies. Any technology taken on is a way to evaluate new markets or to reorient the internal structure to the changing characteristics of the current market (Vacas Aguilar, 2018).

However, innovations in products, processes and business practices must be accepted by consumers for these to be successful, which requires understanding how buyers initiate the product search, evaluate, and make their selection of market offerings. In this sense, marketing innovations are the new actions that produce ideas, products and technologies based on the changing needs and wants of customers (Gillpatrick, 2019).

INDICATOR: DT_SATISF

34. To what extent has digital transformation enabled us to identify the REAL needs of customers?

Marketing and innovation are key factors for company growth. According to Teixeira (2019), it is of vital importance to study consumer buying processes to achieve success. Traditional marketing methods are not sufficient to understand customer needs in a context that has been transformed by the digital market. Consumer buying and selling behavior has rapidly evolved towards the use of mobile technology, online shopping, co-creation of value, among others, which has led to the development of new models for assessing the nature of consumer demand, such as Consumer Decision Journal and the Consumer Value Chain (Gillpatrick, 2019). According to Moeller, Hodson and Sangin (2018), companies able to reduce costs, engage customers and make efficient use of their assets with the use of digital technology will be among the winners of digital disruption.

INDICATOR: DT_CONTA

35. To what extent has it enabled us to CONTACT customers and solve the problems of digital transformation?

Customer knowledge management and innovation are the keys to companies' sustainable competitive strategies (Pil and Holwelg, 2003). In this sense, Nonaka and Takeuchi (1995) believe that knowledge is necessary for innovation and competitiveness. For this reason, it is necessary to operate Customer Knowledge Management to exchange knowledge and thus achieve successful innovation practices (Alegre, Kishor and Lapiedra, 2013). In the same vein, Prahalad and Ramaswamy (2004) state that collaboration with the customer is the modern basis for innovation, as well as being an effective system to enable successful organizations to learn from the needs of their customers to meet their demands and improve performance.

Organizational transformation aligned with digital transformation must focus on transforming customer experience, relationships, and processes, because if a company has satisfied customers, it will be able to meet the challenges it faces. Consequently, the success of digital transformation will depend on creating customer value and understanding the need to improve processes and not just automate them (Davenport and Spanyi, 2019).

INDICATOR: DT_PROA

36. To what extent has it allowed us to be in direct contact with the customer by allowing us to collect data to OFFER PRODUCTS and/or ADDITIONAL SERVICES to the current ones anticipating your digital transformation needs?

Customers are increasingly informed and connected, which allows them multiple alternatives of products and services. This is precisely the field in which the digital world changes companies because the customer, in addition to liking the product, must like the way it is being offered, which requires not only to think about the product, but also to think about the service. The main purpose is to think about the customer. For this reason, not only the marketing and sales departments must be involved in the product offering, but also all processes must be integrated, because the consumer appears in several business areas of the organization (Estevez, 2017). In this sense, digital transformation is based on three pillars: improving customer experience through their knowledge; making processes more efficient and opening new business avenues.

The focus of any transformation action within the company must be connected to the customer to improve their experience, either from the point of view of product quality or by improving communication and contact through digitization (Von Leipziga *et al.,* 2017).

37. To what extent has the digital transformation made it possible to REDUCE VEHICLE ACCIDENTS?

Autonomous and assisted driving of vehicles will be made possible by the integration of advanced technologies including GPS and sensors, cameras, connectivity, and algorithms (Ibanez, Laugier, Yoder and Thrun, 2012). This is expected to reduce car accidents. The goal is to make this type of driving available in less expensive vehicle models to help prevent accidents and save more lives (Newman, 2017). The autonomous or assisted driving vehicle operates for dynamic driving in all travel situations and conditions, which is expected to decongest roads and reduce accidents (World Economic Forum, 2016).

38. To what extent has the installation of sensors, predictive models and algorithm learning achieved MORE EFFICIENT DRIVING?

The vehicle is becoming an efficient machine that functions as a real-time data transfer center. The human being and the vehicle are connected with other vehicles, traffic and municipal services through roads and infrastructure using sensors integrated into the vehicle or in the mobile devices of travelers (Accenture Research Deck, n.d.). An example of driving efficiency through digital transformation is that developed by Jaguar Land Rover, which has introduced self-learning smart cars. These vehicles are designed to limit distractions and offer a personalized driving experience, the system learns preferences and passengers; it integrates with cell phones and offers coaching options, calendars, and navigation guidance.

INDICATOR: DT_VALUE

39. VALUE ADDED SUPPLY THROUGH DIGITAL TRANSFORMATION has:

Significant improvements in the value chain due to digital transformation include increased efficiency, reduced costs, and greater collaboration and innovation. This represents new ways of interacting with customers and suppliers through data. Business strategies for vehicles are focused on delivering value to the customer experience (Hoffman, Zayer and Strempel, 2019). Digitalization also influences the supply chain, which, being connected, enables cost reduction and better management at all stages of the process (Accenture, 2017).

Other effect to consider of digital transformation in the automotive industry is the redefinition of the way customers and vendors interact. Customers expect seamless communication when purchasing products and services; at the same time, connected services enable predictive maintenance thanks to digital diagnostic systems (Llopis, Rubio and Valero, 2021).

INDICATOR: DT_BMODEL

40. Our BUSINESS MODEL through digital transformation has:

The business model has the following components: key partners, key activities, resources, value propositions, customer relationships, customer segments, cost structure and revenues (Osterwalder and Pigneur, 2010), where each area has its specific objectives. Organizations can take a composite view of their business models to understand their morphology and analyze the possible strategic adjustments they need to make, which may include a new component, disruption of some component or further innovation. In this sense, digital technology is presented as a facilitator of changes in the organization's paradigms and in people.

Furthermore, it is important to evaluate the organization's business models to respond to the need for change, because if not, the company's ability to compete in the market or even to survive may be affected. Business models change by the evolution of new concepts, to achieve acceptance of established concepts and by disruptive innovations, in all cases, the evolution is driven by digital transformation (Kotarba, 2018).

INDICATOR: DT_DIFF

41. Digital transformation has allowed us to DIFFERENTIATE ourselves from competition in time

Digital transformation focuses on the strategic importance of information systems for firms to maintain competitive advantage (Yetton, Johnston and Craig, 1994; Raghunathan and Madey 1999). Within the firm, competitive advantage refers to cost savings (Venkatraman 1994; Noble 1995) and operational efficiency, which is achieved through proper management of needs and strategic differentiation from competitors (Noble, 1995; Griffiths, and Whitmore, 1990).

To make market operations more efficient and for the company to achieve competitive advantage, the needs and requirements imposed by Industry 4.0, which is critical for long-term market survival must be identified and recognized (Adamik and Nowicki, 2018).

INDICATOR: IoT_TECNO

9. How often do you use RFID technology to optimise the vehicle production chain, improve logistics and quality mechanisms?

RFID is a means of identifying and tracking items automatically, using tags that provide real-time information about their identity, location, activity or history, which is then processed by software (Gale, Rajamani and Sriskandarajah, 2009). Radio Frequency Identification (RFID) is a more effective automatic identification system than the barcode (Bhattacharya, Petrick, Mullen and Kvasny, 2011). The idea of RFID technology is that it uniquely identifies objects, the numbering is the Electronic Product Code (EPC) (Bhattacharya, Chu and Mullen 2007). Tagging on the item allows extreme visibility (Zhou, 2009). RFID offers a great opportunity to optimize overall performance in the supply chain (Gale *et al.*, 2009).

INDICATOR: IA_TECNO

10. How often do you use ARTIFICIAL INTELLIGENCE?

The goal of artificial intelligence for vehicles (AIV) is to apply both practical and advanced AI techniques so that vehicles can perform human-like or even superhuman behaviors (Faezipour, *et al.,* 2017; Oh and Kang, 2017). Data science and machine learning are key in optimizing the automotive industry of the future. It also improves the industry's approach from process, product to customers and their connection to the product. Artificial intelligence is used in analytical data processing, in fields where quick decisions are required and in monotonous activities that require constant monitoring (Hofmann, Neukart and Bäck, 2017).

INDICATOR: BD_TECNO:

11. How often do you use TECHNOLOGY INFORMATION (sensors, etc.) in decision-making (manufacturing, logistics, human resources, etc.)?

Information technology can be employed to collect data to serve decision makers within organizations, because data provides knowledge for these decisions to be the right ones (Brours, Janssen, and Herder, 2018). In this sense, the internet of things transforms supply chain processes and management (Fosso Wamba *et al.,* 2015; Kumar *et al.,* 2016). According to Llopis, Rubio and Valero (2021), it is necessary for the automotive industry to adapt to the digital transformation, because this will allow manufacturers to obtain greater benefits, productivity, and competitiveness; and consumers will have greater access to more and better services.

12. How often do you create PREDICTIVE MODELS by cross-referencing data collected from devices and sensors?

Through predictive models, equipment conditions can be determined to evaluate when maintenance can be performed, avoiding downtime due to unexpected breakdowns, reducing costs, and extending the useful life of the equipment. Sensors provide the necessary data to make the decision regarding maintenance; to prevent unpredictable losses, and improve the quality of services (Chuang, Sahoo, Lin and Chang, 2019). Authors such as Syafrudin et al. (2018) propose real-time monitoring systems to alert in advance the existence of failures.

INDICATOR: DT_TECNO

14. How often do you use BIG DATA for purchasing behavior analysis?

Through Big Data, it is possible to know for example the number of visitors looking at a website, because this variable can indicate significant changes of the audience with respect to a new marketing plan (Tran and Houng, 2016). In this case, the count of visitors can be monitored by a control chart (Montgomery, 2007). The charts can also be employed to analyze customer satisfaction surveys (Kenett, Deldossi, and Zappa, 2011). With data, the understanding of each stage of the consumer decision-making process is expanded (Hofacker, Malthouse, and Sultan, 2016).

The following table lists the works in the literature that associate the use of Digital Transformation with the indicators considered in each of the capabilities.

Table 10. SUMMARY Literature revision of the indicator use in our model

INDICATORS	QUESTIONS	LITERATURE REVISION
BD_SENS	14. How often do you use BIG DATA for purchasing behavior analysis?	Hofacker, Malthouse and Sultan, (2016). Kennett, Deldossi,. and Zappa, D. (2011). Montgomery, (2007). Tran, and Houng, (2016).
	26. How often is it able to advance in the PRODUCT DESIGN to acceptance according to real tastes, education, geographical areas, etc. through Big Data?	Chuang, and Lin, (2015) Cooper, and Kleinschmidt (2011). Lichtenthaler (2016). Zhan, Tan, Li, and Kei Tse. (2018).
DT_SENS	20. How often has digital technology enabled the sales force to OPTIMIZE ROUTES?	Kotler, and Armstrong, (2003). Sandhusen, R., (2002). Thompson, I., (2006).
	23. How often has digital technology developed solutions to PREVENT ACCIDENTS?	Bhatti, F., Shah, M. Maple, C. and Islam, S. (2019). Pansambal, B., (2020).
IoT_SENS	17. How often do YOU USE NETWORKING WITH OTHER PLATFORMS?	Sandoval Almazán, R. (2011). Utz, S., and Breuer, J. (2019). Wolff, H. G. and Moser, K., (2006).
BD_SEIZ	24. How often do you use sensor integration or data management to make COMMERCIAL ALLIANCES with suppliers or/and customers?	Akter, S., Wamba, S.F.,)2016). Holmlund, M., Van Vaerenbergh, Y., Ciuchita, R., Ravald, A., Sarantopoulos, P., Villarroel, F., Zaki, M., (2020). LaValle, S., Lesser, E., Shockley, R., Hopkins, M. S., and Kruschwitz, N. (2011).
	27. How often does digital technology allow you to estimate THE DURABILITY of the different parts that make up the product?	Ran, Y., Zhou, X., Lin, P., Wen, Y. and Deng, R., (2019). Zhang, W.; Yang, D.; Wang, H., (2019).
DT_SEIZ	18. How often does technology UNIFY SYSTEMS GLOBALLY across your plants and logistics centers?	Dvorak, B., Reddy Depa, E., Gonzales, C., (2013). Laudon, K. C.; Laudon, J. P., (2006).
	21. How often has digital technology made it possible to CONNECT ALL BUSINESS DIVISIONS under one direction?	Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., and Venkatraman, N., (2013). Hildebrandt, B., Hanelt, A., Firk, S. and Kolbe, L., (2015). Lucas, H. C., Agarwal, R., Clemons, E. K., El Sawy, O. A., Weber, B., (2013). Yoo, Y., (2010). Yoo, Y., Boland, R. J., Lyytinen, K., and Majchrzak, A., (2012).
IoT_SEIZ	15. How often do YOU USE ALERTS installed in customers' vehicles?	Abulkair, M., Alsahli, A., Taleb, K., Bahran, A., Alzahrani, F., Alzahrani, H. and Fattouh, L. (2015). Koo, J., Shin, D., Steinert, M. and Leifer, L. (2016).
BD_INNOV	25. How often do insurance companies contact your company to offer a CUSTOMIZED PRODUCT depending on the driving style by the data you collect directly from the vehicle?	Bian, Y., Yang, C., Zhao, J. L., et al. (2018)
	19. How often are PREDICTIVE MODELS used to ANTICIPATE WEAR of parts have had an impact on the vehicle's maintenance cost?	Sittón, I., Rodríguez, S. and Muñoz, L. (2018). Murat, Z., Abdussalam, A., Zeeshan, Q., Korhan, O., Asmael, M. and Safaei, B., (2020).

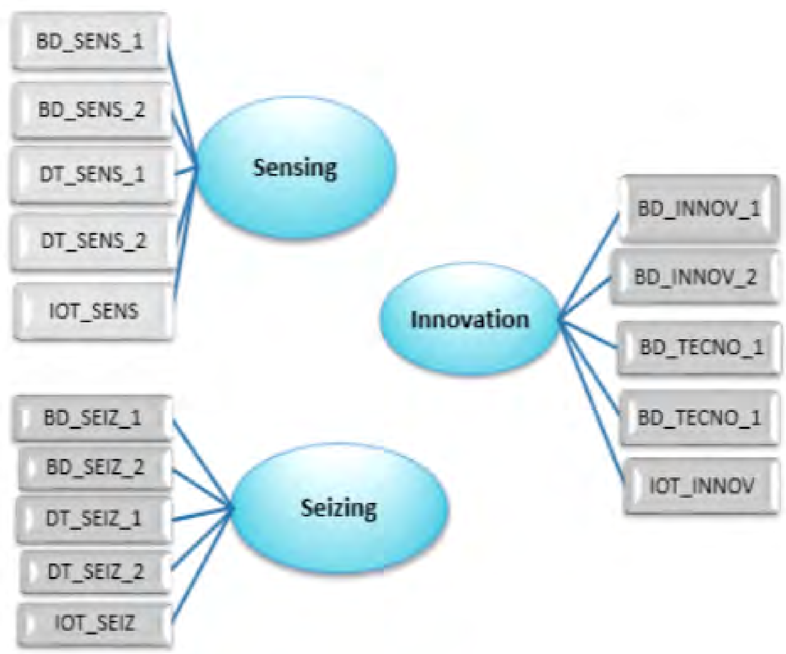
INDICATORS	QUESTIONS	LITERATURE REVISION
DT_INNOV	22. How often has digital technology allowed us to make decisions about ORGANIZATIONAL CHANGES?	Attaran, M., Attaran, S. and Kirkland, D., (2019). Dority, G. K., (2016).
	28. How often do you use digital technology to know when the customer WILL CHANGE THE PRODUCT, the type of product you are going to look for, color, features in order to anticipate it and thus launch the user a communication that makes you purchasing it?	Ahmadinia, H. Karim, M. and Ofori, E. (2015). Anderson, M. and Bolton, J., (2015). Foroudi, P., Gupta, S., Sivarajah, U. and Broderick, A., (2017). Pantano, E. and Timmermans, H., (2014).
	29. How often does the digital transformation allow your company to ANTICIPATE FUTURE CAR FAILURES allowing the connection with the workshop, being able to make an appointment, even before such a failure occurs?	Borgi, T.; Hidri, A.; Neef, B.; Naceur, M. S. (2017). Murat Çınar, Z., Abdussalam, A., Zeeshan, Q., Korhan, O., Asmael, M., and Safaei, B. (2020).
IoT_INNOV	16. How often is the DEGREE OF INNOVATION OF COMPETITION IDENTIFIED through networked devices?	Koch, T. and Windsperger, J. (2017). Hana, U. (2013).
DT_SALES	30. How much has digital transformation allowed us to increase our MARGIN ON SALES?	Lemon, K. N. and Verhoef, P. C. (2016). Reinartz, W., Wiegand, N. and Imschloss, M. (2019). Sweeney, J., and Soutar, G., (2001).
DT_PROD	31. How much has digital transformation allowed us to increase the production process (PRODUCTIVITY)?	Accenture, (2018). Aly, H., (2020). Bertani, F., Raberto, M. and Teglio, A. (2020).
DT_RENT	32. How much has the digital transformation allowed us to increase FINANCIAL PROFITABILITY (EBIT)?	Bughin, J., LaBerge, L. and Mellbye, A. (2017). Zhu, K., Dong, S., Xu, S. X., and Kraemer, K. L. (2006).
DT_SHARE	33. How much market share has digital transformation allowed us to win?	Vacas Aguilar, L., (2018). Gillpatrick, T., (2019).
DT_SATISF	34. To what extent has digital transformation enabled us to identify the REAL needs of customers?	Gillpatrick, T. (2019). Moeller, L., Hodson, N. and Sangin, M. (2018). Teixeira, T., (2019).
DT_CONTA	35. To what extent has it enabled us to CONTACT customers and solve the problems of digital transformation?	Alegre, J., Kishor, S., and Lapiedra, R., (2013). Davenport, T. and Spanyi, A. (2019). Nonaka, I., and Takeuchi, H. (1995). Pil, F. K., and Holwelg, M. (2003). Prahalad, C., and Ramaswamy, V. (2004).

INDICATORS	QUESTIONS	LITERATURE REVISION
DT_PROA	36. To what extent has it allowed us to be in direct contact with the customer by allowing us to collect data in order to OFFER PRODUCTS and/or ADDITIONAL SERVICES to the current ones anticipating your digital transformation needs?	Estevez, J. (2017). Von Leipziga, T., Gampa, M., Manza, D, Schöttlea, K., Ohlhausena, P., Oosthuizenb, G., Palma, D., von Leipzigb, K. (2017).
	37. To what extent has the digital transformation made it possible to REDUCE VEHICLE ACCIDENTS?	Newman, D. (2017). World Economic Forum (2016). Ibanez, J., Laugier, C., Yoder, J. and Thrun, S. (2012). Newman, D. (2017). World Economic Forum, (2016).
	38. To what extent has the installation of sensors, predictive models and algorithm learning achieved MORE EFFICIENT DRIVING?	Accenture Research Deck (s.f.), World Economic Forum (2016).
DT_VALUE	39. VALUE ADDED SUPPLY THROUGH DIGITAL TRANSFORMATION has:	Accenture (2017). Hoffman, M., Zayer, E. and Strempel, K. (2019). Llopis, C., Rubio, F. and Valero, F (2021).
DT_BMODEL	40. Our BUSINESS MODEL through digital transformation has:	Kotarba, M. (2018). Osterwalder, A. and Pigneur, Y. (2010).
DT_DIFF	41. Digital transformation has allowed us to DIFFERENTIATE ourselves from competition in time	Adamik, A. and Nowicki, M. (2018). Noble, F. (1995). Raghunathan, M. and Madey, G. R. (1999). Venkatraman, N. (1994). Ward, J., Griffiths, P. and Whitmore, P. (1990). Yetton, P. W., Johnston, K. D. and Craig, J. F. (1994).
IoT_TECNO	9. How often do you use RFID technology to optimise the vehicle production chain, improve logistics and quality mechanisms?	Bhattacharya, M. B., Chu, C. H., Mullen, T. (2007). Bhattacharya, M. B., Petrick, I., Mullen, T. y Kvasny, L. (2011). Gale, T., Rajamani, D. y Sriskandarajah, C. (2009). Zhou, W. (2009).
IA_TECNO	10. How often do you use ARTIFICIAL INTELLIGENCE?	Hofmann, M., Neukart, F. and Bäck, T. (2017). Li, J., Cheng, H., Guo, H. *et al.* (2018). Faezipour, M., Nourani, M., Saeed, A., et al. (2012). Oh, S. and Kang, H. B. (2017).
BD_TECNO	11. How often do you use TECHNOLOGY INFORMATION (sensors, etc.) in decision-making (manufacturing, logistics, human resources, etc.)?	Brours, P., Janssen, M. y Herder, P. (2018). Fosso Wamba, S., Akter, S., Edwards, A., Chopin, G. and Gnanzou, D. (2015). Kumar, M., Graham, G., Hennelly, P. and Srai, J., (2016). Llopis, C., Rubio, F. and Valero, F. (2021).
	12. How often do you create PREDICTIVE MODELS by cross-referencing data collected from devices and sensors?	Chuang, S., Sahoo, N., Lin, H., Chang, Y. (2019). Syafrduin, M., Alfian, G., Fitriyani, N. L., Rhee, J. (2018).
DT_TECNO	14. How often do you use BIG DATA for purchasing behavior analysis?	Hofacker, C., Malthouse, E. and Sultan, F. (2016). Kennett, R. S., Deldossi, L. and Zappa, D. (2011). Montgomery, D. (2007). Tran, P. y Houng, P. (2016).

Source: Author´s own (2020/2021)

Using the indicators already presented, it has been possible to establish the relationship model as well as assigned 15 observed variables to the dynamic capabilities´ dimensions of sensing, seizing and innovation (Figure 2). In the reflective model, from a quantitative methodology of exploratory analysis, the correct assignment of the indicator to the dynamic capabilities (DynCap) was strongly associated with the indicators sensing, seizing and innovation.

Figure 2. Indicators assigned to each latent variable



Source: Author's own (2020).

4.4. HYPOTHESES APPROACH

Major megatrends such as autonomous cars, connectivity and car sharing are creating new business models (Li, Cheng, Guo and Qui, 2018) and bringing new opportunities as well as threats to current car manufacturers. These are simultaneously opening to new competitors in the market, which are starting to transform the industry as well as impacting into the financial results (Llopis, Rubio and Valero, 2021).

Customers are active entities, who know their needs and know that they have alternative products and services to satisfy them (Lemon and Verhoef, 2016). Although the success of a company depends on different factors, one of the most important to achieve and increase is the financial performance (Reinartz, Wiegand and Imschloss, 2019).

Financial performance refers to how strategies and decisions are implemented as well as how to increase profitability and attain the desired goals (Na-nan and Sanamthong, 2020). The current volatile business environment also forces the organization to sense the market, seize efficiency in its internal resources to increase the capacity to introduce innovation products and services (Wolff and Pett, 2006). Strength is measured by cash flow, success is measured by sales growth and net profit, while progress is made by increasing investments in other businesses (Hervás-Oliver, Sempere-Ripoll, Boronat-Moll, 2014).

The hypotheses contain these factors, and based on them, the statements that we are going to accept or refute through the model. The relationship of the hypotheses formulated with respect to the capabilities is shown below. The variation in the number of questions is related to the variables considered most important to measure.

Table 11. Proposed hypotheses

Hypothesis 1	The sensing capability influences the seizing capability.
Hypothesis 2	The seizing capability influences the innovation capability.
Hypothesis 3	The sensing capability influences the innovation capability.
Hypothesis 4	The process sequence of adapting dynamic capabilities is sensing, seizing and innovation.
Hypothesis 5	Dynamic Capabilities positively influences on customer satisfaction
Hypothesis 6	Dynamic Capabilities influences on financial results
Hypothesis 7	Dynamic Capabilities influences creating a competitive advantage
Hypothesis 8	Competitive Advantages influences on financial results

Source: Author´s own (2020)

Hypothesis 1 Sensing capability influences seizing capability

As expressed by Teece, Pisano and Shuen (1997), dynamic capabilities refer to the ability of an organization to configure and create internal and external competencies based on the changes occurring in the environment. In this sense, Teece (2007) describes how dynamic capabilities are built by seizing capabilities (potential investments and evaluation of existing and new capabilities), *sensing* (ability to identify opportunities and follow up on them) and *reconfiguring/innovation* (which is the ability to expand, create and modify resources as the company grows and changes occur in the market).

In the opinion of Feijoo Pardo and González Illescas (2019) the fact that the pace of the internal environment conditions the development of the dynamic capabilities of companies that are interested in information from the external environment, does not necessarily imply that, in environments with little turbulence, such as stable markets, companies develop few capabilities. In other words, this is not a condition for their development, because analyzing the external environment means acquiring new knowledge to take advantage of its conditions and make the necessary adaptations, which means continuous learning.

In this regard, Lapuente, Kretschmer, Vasconcellos and Reis Gonçalo (2019) express that the nature of the sensing dimension capability implies investing in efforts for research, information search and resource allocation that do not yield immediate returns, i.e., sensing involves activities that require investments. That is why, according to these authors, the sensing dimension is a prerequisite for the other dimensions, i.e., seizing and threat management and reconfiguration. According to Lee and Yoo (2019), sensing capability acts positively on seizing capability. Consequently, sensing capability influences seizing capability because it allows knowing the identified opportunities and resources to take advantage of them and transform ideas into new products, services, and processes that, strategically employed through a well-organized business plan, will influence the organization's performance. Organizations that frequently participate in market detection are prepared to take advantage of the opportunities presented to develop competitive skills (Teece, 2007).

Hypothesis 2. The seizing capability influences the capability for innovation

Dynamic capabilities are also constituted by the capability for seizing, i.e. the capability to develop possible investments and evaluate existing and emerging capabilities (Teece, 2007). Seizing has a direct influence on innovation capability because the new opportunities identified are exploited to create new products and services (Lapuente *et al.*, 2009). With the adoption of new technologies and the development of appropriate business models, competitive advantages are achieved, since the company produces combinations and arrangements of assets in a particular way that would be difficult for other organizations to imitate (Teece, 2007).

Seizing capability or seizing refers to taking advantage of the opportunities detected, adopting a business model to develop a new product, allocating the necessary resources and commercializing it. The choice of a business model and a value creation mechanism for new product development are essential for innovation (Chesbrough, 2003). Elements to leverage capability should include market-driven product development strategies, vertical integration strategies in the supply chain, strategic objectives, leadership, and timely decision-making (Eisenhard and Marti, 2000).

For innovation, the transformation of externally acquired knowledge is essential, which requires merging the newly acquired knowledge with the existing one and improving the adaptation to the changing environment, using for this purpose the existing resources within the organization as new tools to face the changes in the environment (Pavlou and Sawy, 2011).

Consequently, the most appropriate opportunities are used at the right time to create innovative outcomes (Lee and Yoo, 2019).

Hypothesis 3. The sensing capability influences the dynamic capability for innovation

Innovation is considered by many authors as one of the sources of competitiveness, economic development, and growth of the company; because it allows the company to accumulate the necessary knowledge and technological capabilities to improve the quality of its products, reduce costs and create new products or services (Dressler, 2013, Lau and Lob, 2015). In other words, innovation refers to the development and marketing of products and services to meet customer demands and needs. In this sense, innovation brings differentiated competitiveness under the service and quality approaches, thus giving customers the opportunity to choose. Companies that win this competition position themselves in the market, are leaders and perform in such a way as to attract new customers (Eng and Okten, 2011). Consequently, innovation constitutes the key to sustainable business profit in a constantly changing environment (Mariz, Tejeiro and García, 2012; Martínez, Céspedes and Pérez, 2013).

Innovation activities are carried out with the purpose of maintaining the survival and growth of the company, because a company that offers superior value to the competition, intervenes in the purchase intention and behavior of customers, resulting in competitive advantage (Morgan, Kaleka and Katsikeas, 2004).

Opportunities for product innovation depend on the knowledge of the external environment, i.e., sensing capability, which means that firms should pursue product innovation strategies that enable them to grow in the short, medium and long term (Lee and Yoo, 2019). A firm's awareness of its external environment is going to depend on the purpose; that is, whether exploration activities are developed for the development of new products, or whether exploitation activities are carried out to improve existing ones (Hwang and Lee, 2010).

However, innovation is much more than developing new products, it also refers to the ability to renew a business, expand it and create new markets, hence the importance of timely detecting the opportunities and threats posed by the environment, such ability, which is represented by sensing, must be fully developed to carry out innovation (Teece, 2007). This sensing involves the formulation of hypotheses about the future implications that new products, services, or business models would have, as well as the organization of new scenarios that allow the company to prepare for change (Teece, Peteraf and Leih, 2016).

In general, internal experts are likely to have the knowledge needed for the improvement of existing products, but the knowledge needed for the development of new products or services is also likely to come from outside, i.e., from users or communities external to the firm (Yoo, Lee and Choi, 2013).

Hypothesis 4. The process sequence of adapting dynamic capabilities is sensing, seizing and innovation

The objective of dynamic capabilities is to explain how to achieve competitive advantages for the organization, which includes a sequence consisting of three aspects: a) the ability to perceive and understand the opportunities and threats offered by the environment (sensing), b) seizing opportunities (seizing) and c) keeping the company in the competitive market, through improvements, reconfigurations and combinations when necessary (Day and Schoemaker, 2016; Teece and Leih, 2016; Teece, Peteraf, and Leih, 2016; Teece, 2007). As dynamic capabilities comprise all capabilities that are needed to cope with customer changes and technological opportunities (Teece, 2007), innovation capabilities are also included. In this sense, strong dynamic capabilities are organized in a way that enables the firm to rapidly create and test its innovations (Teece and Leih, 2016).

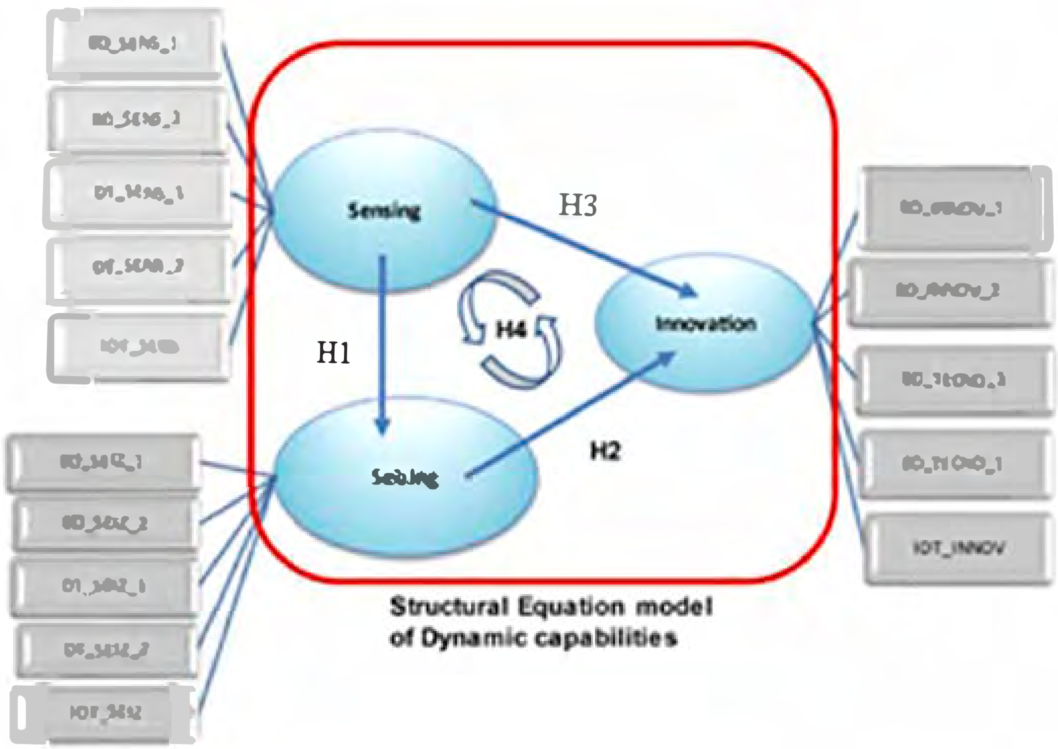
The ability to search for and form opportunities (sensing) allow managers to know the current challenges in dynamic competitive environments (Jiao, Aon, and Gui, 2011); this implies developing the dynamic capabilities to implement the strategies and actions that allow them to take the best advantage of opportunities and face the challenges and threats in a changing environment (Miranda, 2015). Once the opportunities have been identified, managers take advantage of their potential (seizing) to transform and exploit knowledge in the creation, innovation, process improvement and definition of strategies to combine new knowledge with existing knowledge.

Seizing is related to strategic processes to raise organizational performance and competitive advantage (Foss, Lyngsie and Zhra, 2013). The seizing capability is applied to the configuration of the business model (Teece, 2007), so organizations use dynamic competencies to create, reconfigure or modify the competencies and resources they have according to the changes occurring in the context (Mezguer, 2014).

For such a reason, innovations require changes in the skills and competencies of human resources, new knowledge to place new impactful applications in the market, which create value for shareholders and customers and adapt to changes in the environment (Acikdilli and Yasar, 2013). "A firm with strong dynamic capabilities will be able to build and renew ordinary resources, assets, and capabilities cost-effectively, reconfigure them as needed to respond to (or cause changes in the marketplace" (Teece, 2018, p. 43). In this way, opportunities can be seized, threats eliminated, and competitive advantage brought to the firm (Schilke, 2014).

The relationship between the hypotheses 1-4 are shown in Figure 3 according to the indicators assigned.

Figure 3. Hypotheses formulated 1-4 as well as indicators assigned to each latent variable



Source: Author's own (2021).

Hypothesis 5. Dynamic capabilities (DynCap) positively influence on customer satisfaction (CustSatis)

In the commercial sphere, it is not only necessary to offer added value, but also to place it on the market so that customers can enjoy it, and although most companies may claim that they offer their customers what they want, it is necessary to take into account that the customer is not a passive character who merely accepts what companies offer. Customers know what they want and know that they have options to choose from among the offers presented to them (Ulwick, 2002). In this order of ideas, sensing refers to a company's ability to review the context, evaluate markets, assess competition, generate ideas and understand how the structure, markets and demand evolve. In addition, sensing involves selecting, monitoring, creating, interpreting and measuring opportunities and threats in the environment (Enkel, Roseno and Mezger, 2012; Kuuluvainen, 2012).

In this sense, companies must not only have information regarding the market, but also know the trends of customer behaviors through the information they provide. This allows defining strategies to increase competitiveness through the creation of new products and services to meet the demands, requirements or needs of customers and consumers (Rodríguez, Ruíz and Armario, 2012; Wu, 2007). In this regard, Teece (2007) expresses that, detecting opportunities and threats refers to adequately perceiving emerging trends, to interpret them and from there create and learn. Sensing allows to obtain specific information and to know both the internal and external environment of the organization. This allows the company to be informed about any imbalance and take advantage of it, to accommodate the offer according to what the customer needs or potential demands. For this, the constant search and exploration of technologies and markets is carried out, through the development of individual capabilities to identify the needs of users and the solutions offered by the markets.

According to Teece (2007), through management and development, the right technologies are chosen, the supplier's innovation is exploited and the market that can offer the best acceptance is identified. In this way, the measurement of opportunities is based on the existing gaps or spaces unattended by other companies; to lead the development of products, processes or services according to the assets of the organization.

The new opportunity detected should be materialized. For this, managers develop skills to take advantage of the potential of the opportunities detected and thus use them in the creation of new products, processes, businesses, or services. This is what is known as seizing capability. At the beginning, the company's technological competencies and complementary resources must be maintained and improved, but once the opportunity takes shape, it is necessary to invest in new technologies and designs to increase the possibility of market acceptance. The company then needs to define strategies for investing and managing resources appropriately, including time (Carattoli, D'Annunzio and Dupleix, 2013).

The development of this skill requires the participation of competent, expert personnel and the acquisition of knowledge (Jiao, Wei and Cui, 2010). The task of identifying unmet customer needs, selecting the technology and in what ways these will be addressed, as well as the value of the activities, are functions that must be taken into account for the development of a business model that pursues profit. Therefore, there must be a balance between creation, delivery and capture in a model dedicated to serving customers and through which money is earned (Teece, 2018).

The company must not only decide what, how and when to invest in, but also define an effective marketing strategy. These important decisions are made in reference to technology, market segments to be served and financial decisions. In this sense, the development of an effective business model, apart from being creative, must make a good use of the information provided by customers, suppliers and competitors. For this business model, it is also necessary to integrate the "how to do" of other organizations with the "how to do" within the company itself, this helps to structure new opportunities and to see them as new opportunities to create competitive advantage (Teece, 2007).

Companies choose their business models depending on the strength of their dynamic capabilities. Firms with weak dynamic capabilities, even if they have recognized new opportunities, will prefer to adopt business models based on past investments and known organizational processes. Firms with strong or solid dynamic capabilities will not hesitate to take on business models that involve radical changes in both activities and resources (Teece *et al.*, 2016).

Innovation is defined as the operations carried out by companies for the creation of new products, processes, marketing methods, new organizational methods or improvement of existing ones (OECD, 2005). Customer satisfaction refers to the evaluation of the customer's satisfaction with the product or service provided by the company (Nemati, Khan and Iftikhar, 2010).

It is very important for companies to adapt to the global market in order to provide solutions to the demands of customers, who, because they have increasing access to information, are more and more demanding, sophisticated and demand personalized attention, quality and novelty in terms of products and services. Consequently, in order for companies to adapt to the needs of their customers, they must offer innovative, quality and environmentally friendly products (Stark, 2011).

Under this approach, innovation in order to achieve customer satisfaction must follow quality and environmental standards that allow them to compete in the markets (Simon and Petnji, 2012). Consequently, in order to satisfy customer demands or needs, companies must find ways to do so by creating an environment and culture intended for that purpose; in this regard, many companies create management system standards (Zeng, Shi and Lou, 2007) that focus on customer satisfaction.

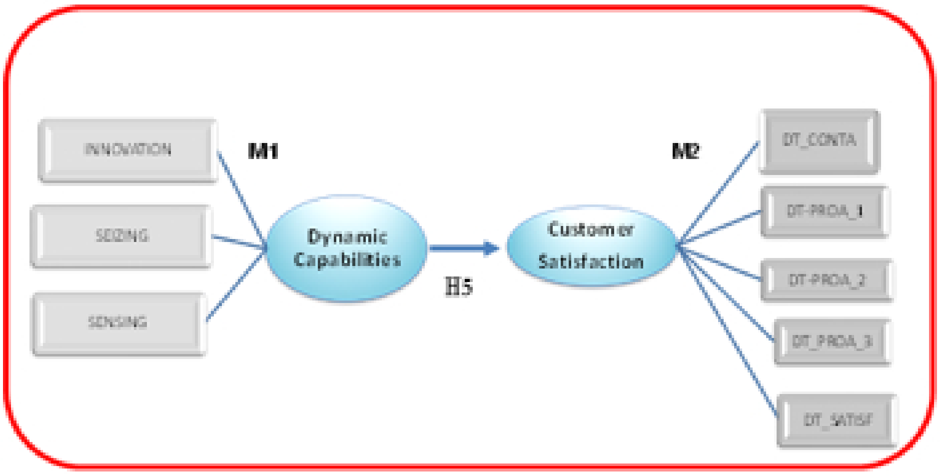
Innovation and customer satisfaction are some of the most important issues addressed by companies that want to increase their competitiveness in the market (Nemati *et al.*, 2010). Consumers know that any company can satisfy their tastes and preferences, and this is something that every company that wants to have a competitive advantage must understand (Gil Lafuente and Bassa, 2011).

The market is increasingly evolving into a market of services, in which long-term relationships between the customer and the company are evident, in which an exchange of value is evidenced between the customer's needs and what the company offers to satisfy them. Companies that listen to and understand the needs of their customers hold the key to the development of new products and services and can continuously adjust or improve their practices and processes in line with customer expectations, resulting in many cases in profitable improvements in techniques, services and products (Nordberg, Campbell and Verbeke, 2003).

From the framework shown in Figure 2, in which the assignment of the observed variables to the dimensions of sensing, seizing and innovation is done, the following research questions were presented: Could the dimensions of sensing, seizing and innovation be grouped into a construct called "Dynamic Capabilities"? Did dynamic capabilities positively show influence on customer satisfaction? Therefore, two measurement models and a structural equation model were proposed (Figure 4).

The proposed hypotheses were represented by means of a system of structural equations models in two stages. In the first stage, two reflective models (M1 and M2) were constructed. In a second stage, in hypothesis 5, a structural equation model was built in which the relationships between dynamic capabilities (DynCap) and customer satisfaction (CustSatis) were evaluated.

Figure 4. Hypothesis 5 as well as indicators assigned



Source: Author's own (2021).

Hypothesis 6. Dynamic capabilities (DynCap) positively influence on financial results (FinRes).

In view of the constant changes occurring in the environment, companies face significant challenges, where to be successful, they must offer quick and consistent responses to the demands of consumers and customers. So, from the identification of the conditions of the environment, they will be able to make strategic changes, create or reconfigure products and processes to achieve their objectives (Feijoo and Gonzalez, 2019).

Dynamic capabilities play therefore an important role in managing the organization´s strategy to be suitable for competitive and highly lively situations (Matysiak *et al.*, 2018). Organizations must develop the ability to learn and define new resources bases to overcome the traps set by existing capabilities and create a new source of competitive advantages (Prajogo, 2016). Dynamic capabilities are basically high-level activities that help organizations set goals for the production of existing and new products as well as services that have high market demand (Pukkeeree, Na-Nan, Wongsuwa, 2020).

Besides, studies by Li and Liu (2014) and Wu and Wang (2007) show that dynamic capabilities positively influence a firm's competitive advantage. In this sense, companies tend to leave behind traditional solutions to adopt new ideas that arise as a product of new technologies (Urbancova, 2013), among which is the correct interpretation of the signals provided by the changes, so as to respond appropriately and create according to the pace of demand (McGrath, 2013).

Consequently, new products, processes or transactional actions seen as novelties are expected to surpass the technical and economic solutions that already exist in the market and, therefore, can generate huge profits to the company (Cherubini, Barbieux, Reichert, Tello, and Zawislak, 2017).

Dynamic capability is a concept for managing change under this dynamic environment (Helfat and Peteraf, 2015). Past research supports a direct positive relationship between dynamic capability and firm performance results, but it did not focus on the proposed mediator variable Competitive Advantage (ComAdv).

If a company wants to compete in the market it must select to develop the cost leadership strategy or differentiate its products and services from those of competitors (González, Fernández, Fuentes, and Clavel, 2016). Consumers consider a product or service to be unique based on its design, quality or service delivery among other attributes (Gómez Ortiz, 2018). Based on the literature review aforementioned, the second research hypothesis was postulated as below.

Hypothesis 7: Dynamic capabilities (DynCap) positively influence on competitive advantages (ComAdv).

Competitive advantage is a term generally used to describe the relative performance of the firm compared to the competition in a specific market environment (Peteraf and Barney, 2003). For this situation to occur, what is usually necessary is to generate greater value in their customers than their rivals do (Morgan, Kaleka and Katsikeas 2004). Competitive advantages are the consequence of business strategy, and results from the use of the organization's resources and capabilities. This situation enables the reduction of costs, the exploitation of market opportunities and the neutralization of competitive threats (Newbert, 2008). All of these situations are especially necessary in dynamic and changing markets (Pezeshkan, Fainshmidt, Nair, Frazier, and Markowski, 2016).

The company develops its own unique strengths that will help it increase its efficiency, quality and innovation to respond to its customers, all of which can create superior value and competitive advantage (Maltis and Jackson, 2014). The speed and degree to which a company aligns its resources with customer needs depends on its dynamic capabilities. For this, apart from detecting opportunities, the company must be able to continuously seize them in order to achieve a proactive position that allows it to address threats and new opportunities as they arise (Teece, 2018).

This is why innovation is a prerequisite for the development of small and medium-sized enterprises, which are able to survive and compete thanks to it. To remain in the competitive market, the organization's innovation must be constant and in all fields. This innovative capability can arise from market sensing competencies, which helps companies to know their customers and also the competition (Sulaeman and Kusnandar 2020).

Consequently, the idea of dynamic capabilities emerges as an attempt to explain competitive advantages in ephemeral environments (Felin and Powell, 2016) through three elements: a) the dynamic capabilities of the organization, b) the proactivity of managers, and c) the influence of the environment in shaping dynamic capabilities (Cyfert and Krzakiewicz, 2016). On the other hand, the theory of dynamic capabilities also aims to explain how some firms manage to gain competitive advantage in changing environments (Garzón, 2015).

Navarro-García and Moreno (2018) studied the relationship between dynamic capability and organizational performance with competitive advantage as a transmission factor in the car sales business. The results of the research showed that dynamic capability influenced the organization's performance through a variable of competitive advantage.

Therefore, if Dynamic Capabilities are important to maintain competitive advantages, then organizations need to make decisions based on their competitive advantages and those have an impact into the results (Arranz and Arroyabe, 2020). These arguments lead to the proposal of the following hypothesis:

Hypothesis 8: Competitive Advantages (ComAdv) positively influence on financial results (FinRes).

The changes that have occurred in the market require companies to develop better processes, creativity and capabilities to adapt to the environment. In this sense, the organization must execute strategies to place its products and services in the market and thus achieve its objectives (David, 2013). According to Kaplinsky and Morris (2010), strategies must consider the value chain that is followed so that this product or service acquires the added value that will make it different from those of the competition. Therefore, the good financial performance of the company will show its current status and its growth perspective (Wijayanto, Dzulkirom and Nuzula, 2019).

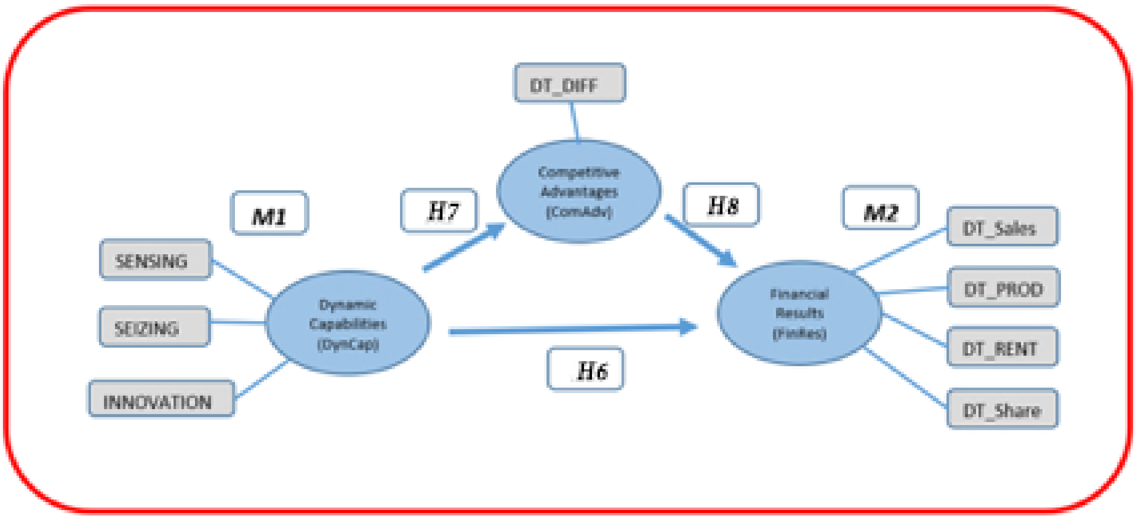
Sustainable competitive advantages are developed from the strategic cost management that reflects the relationships that exist between the activities that form the value chain. Therefore, if the company wants to compete in the market it must select to develop the cost leadership strategy or differentiate its products from those of competitors. Consumers consider a product or service to be unique based on its design, quality or service delivery among other attributes (Gómez Ortiz, 2018).

In the opinion of Arrartre (2006), sometimes companies are attractive because of the offer they make of their products, which reflects the efficient use of resources in advertising and marketing them; however, profitability, costs, market share and productivity are also indicators of competitiveness. Consequently, the company that wishes to compete must carry out global and continuous activities such as research, development, design, production, marketing, distribution, and after-sales service, because in this way it will develop the competitive strategy that will allow it to maintain and increase the number of customers and thus its profits.

The activities that create value are those that, when properly executed, generate financial benefits, which should be the company's goal. Therefore, all activities that are executed efficiently, but are not value-creating, should be reviewed to evaluate their transformation for value creation (Gómez Ortiz, 2018).

The proposed hypotheses were represented by means of a system of structural equations models in two stages. In the first stage, the reflective models were constructed. In a second stage, in hypothesis 6, a structural equation model was built in which the relationships between dynamic capabilities (DynCap) and financial results (FinRes). Then, hypothesis 7 and 8, a structural equation model was built to measure the effect of Competitive Advantages as a mediator that transmits the effects of Dynamic Capabilities to Financial Results. All of them were evaluated according to Figure 5

Figure 5. Models and hypotheses in theoretical model



Source: Author's own (2021).

Besides all the hypotheses evaluated we must consider that **technological adoption is a prerequisite for Dynamic Capabilities** assuming the following:

Case a: the higher the technological adaptation level, the higher the generation of dynamic Sensing capability.

Companies decide to make investments to improve and optimize their resources to increase their performance in the market. The new challenge for organizations is to produce and apply knowledge in highly industrialized environments, and in this scenario, technology management is one of the capabilities they can count on. Recognizing that it needs to acquire elements that differentiate it, companies can assume new risks that translate into technological advances of viable application to generate competitive advantages (Perozo and Nava, 2005).

The adoption of technologies is manifested through innovative procedures carried out by the company, which are then transferred to the internal and external context. Technological management is based on the application of the scientific method to obtain an operational result, which may be a product, higher quality, greater effectiveness, adding more value or increasing competitiveness.

Likewise, technological management corresponds to the appropriate and necessary use of technology for the achievement of organizational objectives. Considering these aspects, technological management is the instrumental knowledge necessary to discover new opportunities and, consequently, must be acquired to meet the organization's objectives (Thompson and King, 1997).

Companies recognize that knowledge is a very important non-economic resource within the organization, that is why they strive to acquire it. In this sense, through technological management the company can know about products, market opportunities, customers and most importantly, know how to combine all these factors to increase its competitiveness. To conceive that technology allows the company to involve data and knowledge is to assume that information can be put to good use through manufacturing support processes, artificial intelligence, diagnosis systems, among others (Perozo and Nava, 2005).

Case b: the higher the technological adaptation level, the greater the generation of dynamic Seizing capability.

The procedural execution of knowledge (i.e., information regarding context and experience) involves the application of technology through its management (Thompson and King, 1997). The company can choose and use technology for strategic purposes thanks to its technological development capability (Gomel and Sbragia, 2006), this will allow it to create new processes, techniques and products (Zhou and Wu, 2010).

Business and technology have a very strong link today because technology is present in almost all business activities of organizations. However, when technologies are underutilized or undervalued, companies lose opportunities to obtain the benefits derived from their use. In this sense, entrepreneurs must have a basic knowledge of the technologies that are at their service, as well as the use of internet, social networks and media to give digital identity to their organization. Such knowledge helps in the design of business strategies and online marketing, necessary for business development in the current environment, where technologies are of massive use (Ventura, Salinas, Mendoza, and Herrera, 2017).

Case c: the higher the technological adaptation level, the higher the Innovation dynamic capability generation.

Technological development is the result of learning through which companies obtain new knowledge that leads them to generate technological changes and, therefore, new products. This learning capability can be manifested by the acquisition, imitation, adaptation, development or modification of knowledge or techniques for internal use, resulting in new goods and services based on this technological innovation. Through the capability for technological development, the company is driven to a technical change that produces a successful innovation (Zawislak, Alves, Tello-Gamarra, Barbieux, and Reichert, 2012).

According to Lall (1992), technological capability enables firms to absorb, create, change, and generate viable technical applications, represented by new processes, new products, or new routines.

> However, the fact that a company has developed technological capability does not mean that it also has innovation capability, because the possible technological solution must be translated into an operational adjustment that, managed correctly and efficiently, achieves the expected results. The process requires routines of searching, creating and recreating operations to absorb new knowledge and visualize what it is desired to create (Zawislak *et al.*, 2012).

Knowledge of consumer needs is essential to, from technology management, establish new discoveries and new markets. Consequently, applying technology through the company's own management leads to competitive advantages due to a) the market's increasing demand for innovation, b) companies are focusing on creating greater value for their customers and c) there is a growing need to manage business complexity (Perozo and Nava, 2005).

4.5. RESEARCH METHODOLOGY

To statistically test the relationships between the indicators and the latent constructs, as well as the structural relationships between the latent hypothetical constructs, a structural equation model (SEM) has been built. The model was estimated using the partial least squares (PLS) procedure applying SmartPLS3 software (Ringle *et al.*, 2015).

Regarding the practical part of this study, to carry it out, quantitative data collection techniques have been used, such as the use of a questionnaire.

The analysis technique applied to the empirical study is based on the use of structural equations with latent variables and measurement errors. Structural equation analysis is a multivariate analysis technique whose use is increasing considerably in social science research in general.

Structural equations attempt to simultaneously integrate a series of different but interdependent multiple regression equations, since variables that are dependent in one relationship may be independent in another relationship within the same model.

The incorporation of variables that are not directly observable, called latent variables, allows their measurement through other directly observable variables. In this way, interdependent relationships are established between latent and manifest variables, giving rise to this type of model.

Since it is not possible to evaluate the indicators directly, they are considered as latent variables and measured through their manifestations in a series of measurable variables as detailed in the following pages.

The general structural equation model is made up of a system of equations whose variables can be both directly observed variables and non-measurable (latent) variables that represent concepts that cannot be measured directly but through other variables through which they manifest themselves.

Structural equation models are composed of two sub-models: the structural model, which relates only the latent variables, and the measurement model, which relates each latent variable to its corresponding variables, called indicators, through which it is measured. It is assumed that there is a causal structure between the latent variables.

The reason for choosing to apply this type of model is due to the fact that they have certain characteristics that make them particularly suitable for the problem under study, namely:

a) They allow the explicit inclusion of measurement error terms for each variable.

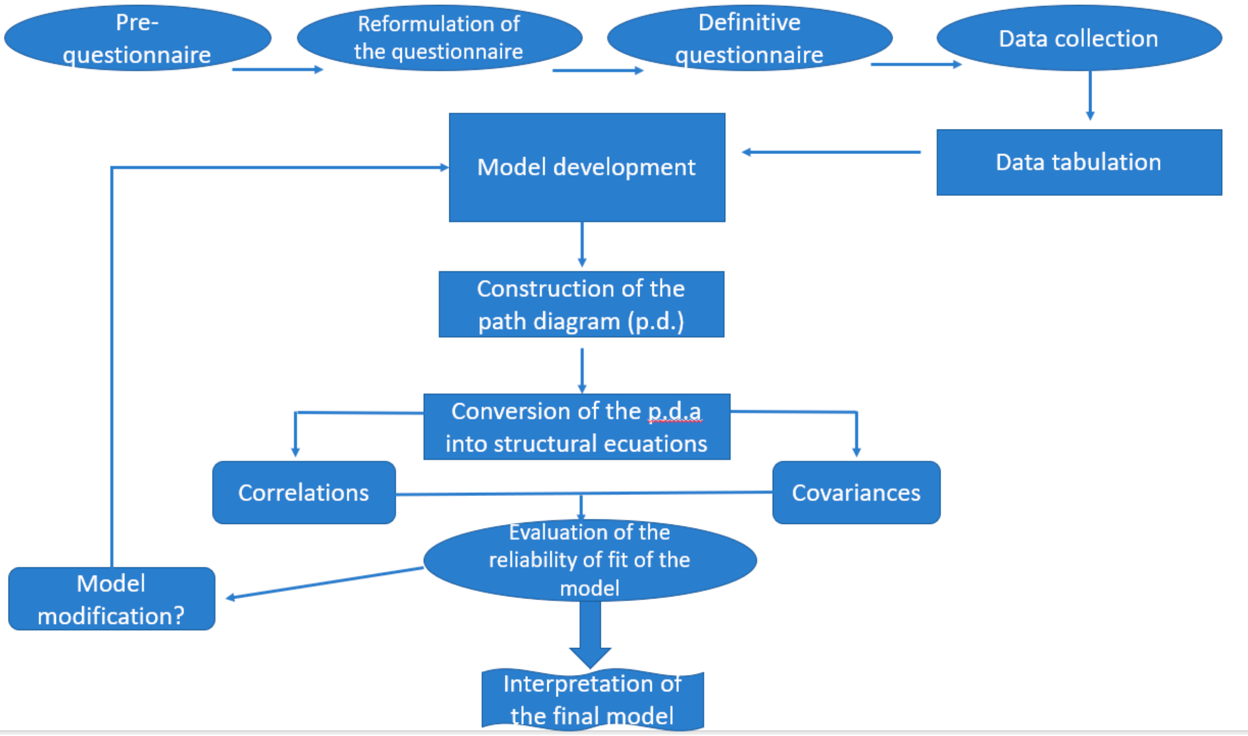
b) Simultaneous estimation of the parameters of the dependence relationships established between the variables, in which a variable can act as dependent in some equations and as independent in others.

c) They allow expressing reciprocal relationships and solving recursive and non-recursive models.

d) They can be applied in an exploratory or confirmatory way.

The following table shows more clearly the flow of the analysis process (adapted from Hair et al, 1995).

Table 12. Stages for the development of a structural equation model



Source: Adapted from Hair et al. (1995)

4.5.1 Sources of Information

We have resorted to the use of deferred information to obtain specialized bibliography. Depending on the medium, printed books, articles and reports in electronic form were consulted. Above all, the specialized articles collected in periodical publications of recognized prestige have been key to carry out the study. According to Carrizo (1999), it should be noted that they are a fast and effective vehicle of communication that also conveys recent information. For this reason, publications have been selected as an optimal source for consultation.

The information sources used to find specialized bibliography on the subject are databases. They allow the location of high-quality references by means of keywords. In the present work, specialized databases such as ABI, the Web of Science and SCOPUS have been used, as well as Google Scholar, since it allows access to documents available on the Internet.

Scientific articles were the most consulted bibliographic resources due to the quality of the information they contain and their level of topicality. However, books and reports published by companies or public entities were also used. Doctoral theses related to this subject have also been consulted.

The literature consulted, according to criteria such as language and typology, is described in more detail below:

Table 13. Document typology

LANGUAGE	
English	108
Spanish	38
Portuguese	7
French	2

TIPOLOGY	
Articles	113
Books	32
Reports	7
Thesis	3

Source: Authors´own (2021)

4.5.2 The sample

In the classification of CNAE 29: Manufacture of motor vehicles, trailers and semi-trailers, 1,800 motor vehicle companies and 9,060 automotive component companies appear in the annual detailed Enterprise statistics for industry (Eurostat, Annual detailed enterprise statistics for industry. 2021). The study population was composed by 106 automobile manufacturers and component manufacturers (Anfac, 2021).

A total of 127 requests to answer the survey were sent. This number corresponds to a very high number of identified companies that met the requirements of belonging to the automotive and components sector. Of these, a total of 42 responses were obtained, which constitute the sample with which the model was estimated.

The target public are profiles of executives and managers who work in these companies as general manager, managers, or staff. We have considered that, due to their distance from the world of research and their occupation profile, their time to complete surveys is very limited. For this reason, the survey was designed in such a way as to avoid the risk of the survey taking a long time to complete and the high propensity of abandonment (in our case, there was no case of abandonment).

All the people surveyed have higher education and more than 5 years of experience in the automotive and components sector. In the choice, it was not the organization, but the contact and knowledge about the digital transformation that took precedence.

The type of companies that participated in the process is shown below. Of the total of 42 companies, 4 of them have less than 50 employees, 5 have between 50-100 employees, 11 have between 101-250 and 22 have more than 250 employees. Hence, we can say that through the questionnaire we will have a good diversity of company typology.

Table 14. Number of employees within the companies participated

Number of employees		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	below 50	4	9.5	9.5	9.5
	between 50-100	5	11.9	11.9	21.4
	between 101-250	11	26.2	26.2	47.6
	more than 250	22	52.4	52.4	100.0
	Total	**42**	**100.0**	**100.0**	

Furthermore, if we continue analyzing the sample of the companies that participated in the questionnaire, we observe that 4 are less than 25 years old, 15 are between 25 and 50 years old, 23 are over 50 years old, so we can also assume that we have a good representation of the type of companies according to their age of operation.

Table 15. Company age within the companies participated

	Company age	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	below 25	4	9.5	9.5	9.5
	between 25-50	15	35.7	35.7	45.2
	more than 50	23	54.8	54.8	100.0
	Total	**42**	100.0	100.0	

Besides, it seems relevant to us to observe the typology of companies according to their territory activity; 3 of them only operate in Spain, 2 in the European Union and the remaining, 37 are recognized as multinationals operating in a global environment.

Table 16. Territory operations within the companies participated

	Company operations	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Spain (only)	3	7.1	7.1	7.1
	Europe (only)	2	4.8	4.8	11.9
	Global	37	88.1	88.1	100.0
	Total	**42**	100.0	100.0	

Finally, as our sample comes from the automotive sector as well as the automotive components, we have considered important to highlight the split among the different companies selected. 30 out of 42 are purely automotive companies meanwhile the remaining 12 are focusing on the spare parts sector such as batteries, tires, etc.

Table 17. Sector typology within the companies participated

Sector		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Automotive	30	71.4	71.4	71.4
	Automotive components, accesories and spare parts	12	28.6	28.6	100.0
	Total	**42**	100.0	100.0	

In conclusion, the survey included 8 socioeconomic (age, gender, company size, professional profile, among others). We can summarize in the following table nº18 where it shows the typology of the companies and the socio-demographic profile of the respondents. A 78.6% of the companies have more than 100 employees and 90% of the companies are consolidated with an age of more than 25 years, belonging to the automotive sector (71.4%) and with local and international activity (88%). The respondents were evenly distributed among staff, managers, and directors. The majority were men (97.6%) between 25 and 50 years of age (95.2%).

Table 18. Descriptive Data

Variable	Relative frequency (%)
Number of employees	
Below 50	9.5
Between 50-100	11.9
Between 101-250	26.2
More than 250	52.4
Company age (y)	
below 25	9.5
between 25-50	35.7
more than 50	54.8
Company position	
Staff	31.0
Middle manager /Manager	38.1
Executive /Director	31.0
Gender	
Male	97.6
Female	2.4
Age (y)	
between 25-50	95.2
more than 50	4.8
Sector	
Automotive	71.4
Automotive components	28.6
Company operations	
Spain (only)	7.1
Europe (only)	4.8
Global	88.1

To contextualize the characteristics of the sample, the following table shows relevant aspects to be considered, such as the procedure, the geographical scope, the methodology used in the study and other important information that constitutes the technical data sheet.

Table 19. Technical data

Population	Managers/Directors of the Automotive + Components Sector with more than 5 years of experience
Geographical scope	Europe
Methodology	Structural survey
Questionnaire tool	Survey by Google link via email
Sample size	127
Response rate	33%
Sampling error	+/- 10%
Procedure	Simple random sample
Realization dates	05.2020-11.2020

Source: Author´s own (2021)

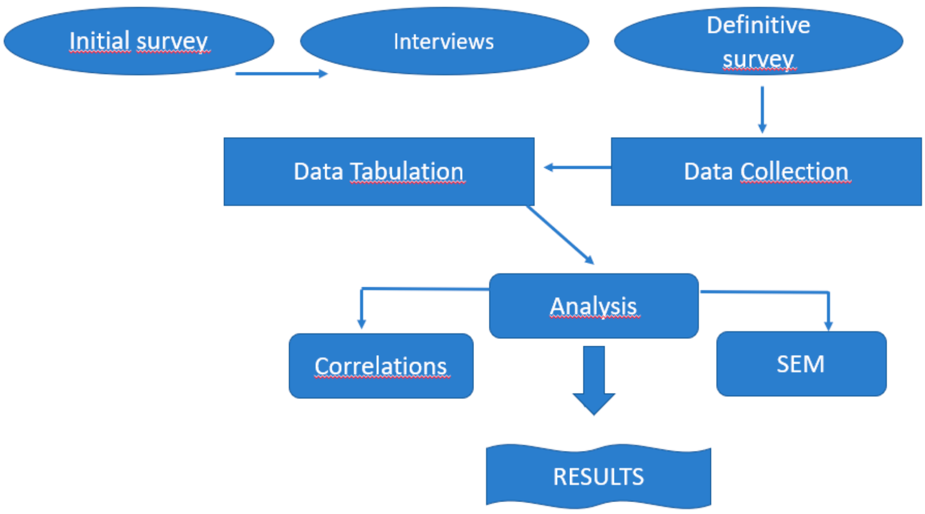
4.5.3 The survey and collection data

To collect first-hand information, and directed at a specific population, the survey was used as a quantitative technique. The final questionnaire and its tabulation, as well as the data, contain information on the sections that we propose to validate through the hypotheses, which are grouped as follows.

In Annex 1, it is possible to observe the type of survey sent; where the first 8 questions correspond to sociodemographic variables about the person and the company that responds to it. Subsequently, there are 31 questions in Likert scale in which the different items consisted of closed questions with five alternatives (from 1 to 5). Finally, there are 2 closed questions with only two options.

Cronbach's alpha was used to verify the reliability of the questionnaire. The measurement of reliability using Cronbach's alpha assumes that the items (measured on a Likert-type scale) measure the same construct and that they are highly correlated. The closer the alpha value is to 1, the higher the internal consistency of the items analyzed. The reliability of the scale should always be obtained with data from each sample to ensure reliable measurement of the construct in the research sample. As a general criterion, values higher than 0.7 are recommended.

Table 20. Data collection process



Source: Author´s own (2021)

Between March and May 2020, an initial questionnaire is carried out after the study of the most relevant literature. Subsequently, in the month of June, we conducted a verification of this questionnaire through 6 telephone interviews to see in depth the understanding of each question with 6 directors (Director of Goodyear, Nissan, KIA, Dunlop, Toyota, Bergé Group) that will be part of the final questionnaire.

In July 2020, and based on the results of the interviews, we modified the questionnaire to validate it and thus have the definitive questionnaire. During that month, the email questionnaire was sent to a total of 127 companies in the automotive and components sector. The email sent is attached in Annex 2.

During the month of September, a gentle reminder was sent to the entire audience to reinforce the need of having more answers to the survey launched in July.

During November and December 2020, we proceeded to finalize the reception of data by tabulating them to facilitate the statistical treatment. In this tabulation, tabulated responses were made, giving values from 1 to 5, as well as specific treatment of the sociodemographic questions.

In January 2021, we proceeded to the exploratory analysis, as well as to the search for correlations between the different variables. In February, we began drafting the corresponding report to identify and formulate the hypotheses.

During the months of February and April, we proceeded to analyze the data according to structural equations to validate or not the hypotheses formulated. From this analysis, 3 articles are produced for the interpretation of the results.

- **Article 1:** Validation of dynamic capability generation through digital transformation in the automotive sector.
- **Article 2:** Validate the generation of dynamic capabilities through digital transformation in the automotive sector into the customer satisfaction
- **Article 3:** Validate the generation of dynamic capabilities through digital transformation in the automotive sector as a competitive advantage and financial results

In the following table, we outline the development of the methodological process of the research design.

Table 21. Research design process

Analysis and study of the literature	September 2018, 2019 and 2020
Development of initial questionnaire	March-April 2020
Interviews with experts	April-May 2020
Development and submission of final questionnaire	June-October 2020
Formulation and formulation of hypotheses	October- April 2021
Tabulation and regrouping of responses	October- January 2021
Statistical treatment of data	February-April 2021
Analysis and interpretation of first results	April 2021
Structural equation análisis	March-May 2021
Interpretation of the results of the 3 articles	May-December 2021
Publishing the articles	July- 2020-July 2022
Writing of the final text of the doctoral thesis	May-July, 2022

Source: Author´s own (2021)

All the above process corresponds to the objectives previously set for the development of the study, which were the following:

- **General objective:** search and empirical validation of the model.
- **Sub-objective 1:** analysis of the most relevant literature.
- **Sub-objective 2**: hypothesis formulation.
- **Sub-objective 3:** elaboration of the questionnaire and statistical treatment.

The following table shows the objectives pursued and the corresponding expected results.

Table 22. Objectives vs. specified outcomes of the study

General objective: Search and empirical validation of a global model.	Results specified in each sub-objective
Sub-objective 1: Analysis of the most relevant literature.	Update of the bibliographic review to the publications that appeared during the period when the empirical analysis was initiated.
Sub-objective 2: hypotheses formulation	Analysis and restatement of the hypotheses indicated so far.
Sub-objective 3: elaboration of the questionnaire and statistical treatment.	Debugging of the questionnaire Sample definition Interviewing experts Sending the questionnaire Receipt of the questionnaire Statistical treatment of the data obtained Analysis of results Interpretation of results Elaboration of conclusions Preparation of the report prior to publication.

Source: Author´s own (2021)

CHAPTER 5.

RESULTS: EMPIRICAL FINDINGS AND ANALYSIS

This chapter presents the development of the field study based on the research proposal using an instrument and the respective statistical techniques to evaluate the model in terms of its measurements and structure so that the results generated can be used to verify the hypotheses proposed.

CHAPTER 5. RESULTS AND ANALYSIS

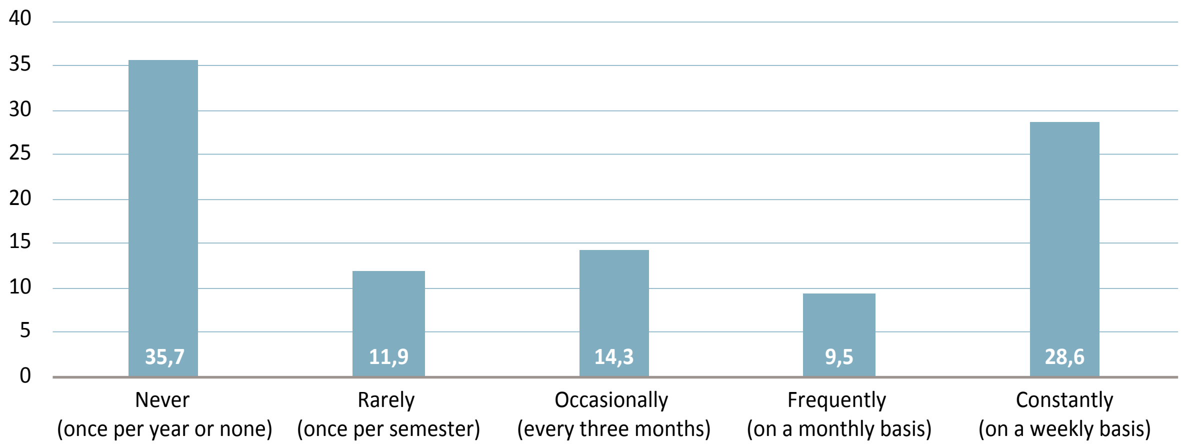
5.1. QUESTIONAIRE RESULTS

The results for each of the questions containing a Likert scale of the questionnaire are presented individually below. In addition, the results obtained are analyzed.

Table 23. How often do you use RFID technology to optimize the vehicle production chain, improve logistics and quality mechanisms?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	15	35.7	35.7	35.7
	Rarely (once per semester)	5	11.9	11.9	47.6
	Occasionally (every three months)	6	14.3	14.3	61.9
	Frequently (on a monthly basis)	4	9.5	9.5	71.4
	Constantly (on a weekly basis)	12	28.6	28.6	100.0
	Total	**42**	100.0	100.0	

Mean	2.83
Median	3.00
Variance	2.825
Std. Deviation	1.681



From the analysis of the information obtained on "How often do you use RFID technology to optimize the vehicle production chain, improve logistics and quality mechanisms.", we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 38.1% while the standard deviation with respect to the mean is 1.681, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

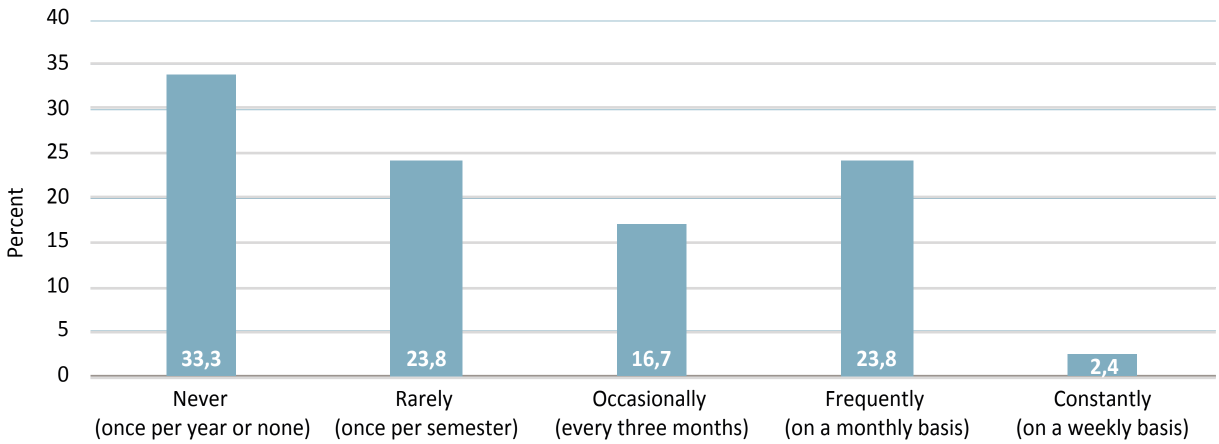
All the experts consulted answered this question. The overall average affinity for the question was 2.83 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 3: that is, between 3 and 5 there is the same number of responses as between 1 and 2.

Table 24. How often do you use ARTIFICIAL INTELLIGENCE?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	14	33.3	33.3	33.3
	Rarely (once per semester)	10	23.8	23.8	57.1
	Occasionally (every three months)	7	16.7	16.7	73.8
	Frequently (on a monthly basis)	10	23.8	23.8	97.6
	Constantly (on a weekly basis)	1	2.4	2.4	100.0
	Total	**42**	100.0	100.0	

Mean	2.38
Median	2.00
Variance	1.559
Std. Deviation	1.248



From the analysis of the information obtained on " How often do you use ARTIFICIAL INTELLIGENCE ", we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 26.2% while the standard deviation with respect to the mean is 1.248, a value that is considered medium given that the affinity of the respondents has been dispersed among the values.

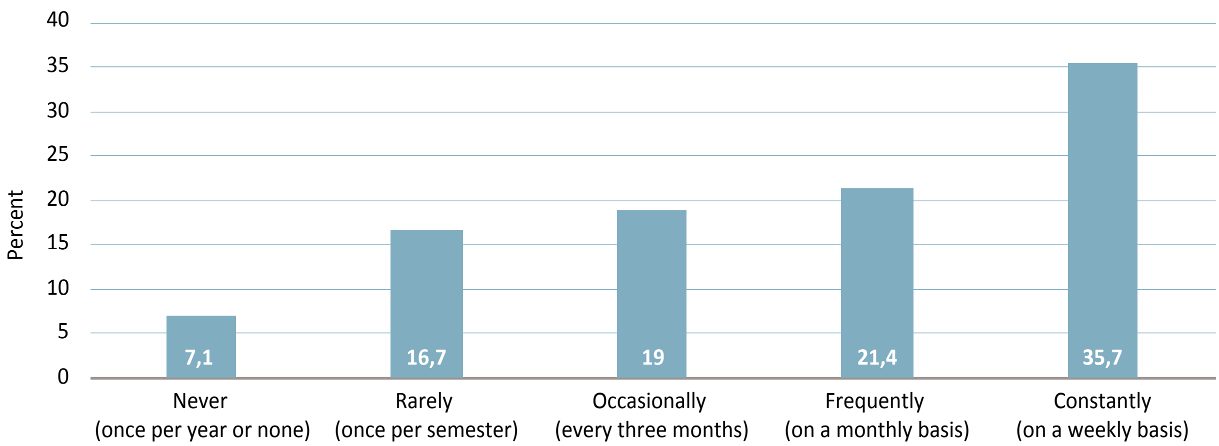
All the experts consulted answered this question. The overall average affinity for the question was 2.38 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 2: that is, between 2 and 5 there is the same number of responses as 1.

Table 25. How often do you use TECHNOLOGY INFORMATION (sensors, etc.) in decision-making (manufacturing, logistics, human resources, etc.)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	3	7.1	7.1	7.1
	Rarely (once per semester)	7	16.7	16.7	23.8
	Occasionally (every three months)	8	19.0	19.0	42.9
	Frequently (on a monthly basis)	9	21.4	21.4	64.3
	Constantly (on a weekly basis)	15	35.7	35.7	100.0
	Total	**42**	100.0	100.0	

Mean	3.62
Median	4.00
Variance	1.754
Std. Deviation	1.324



From the analysis of the information obtained on " How often do you use TECHNOLOGY INFORMATION (sensors, etc.) in decision-making (manufacturing, logistics, human resources, etc.)", we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 57.1% while the standard deviation with respect to the mean is 1.324, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

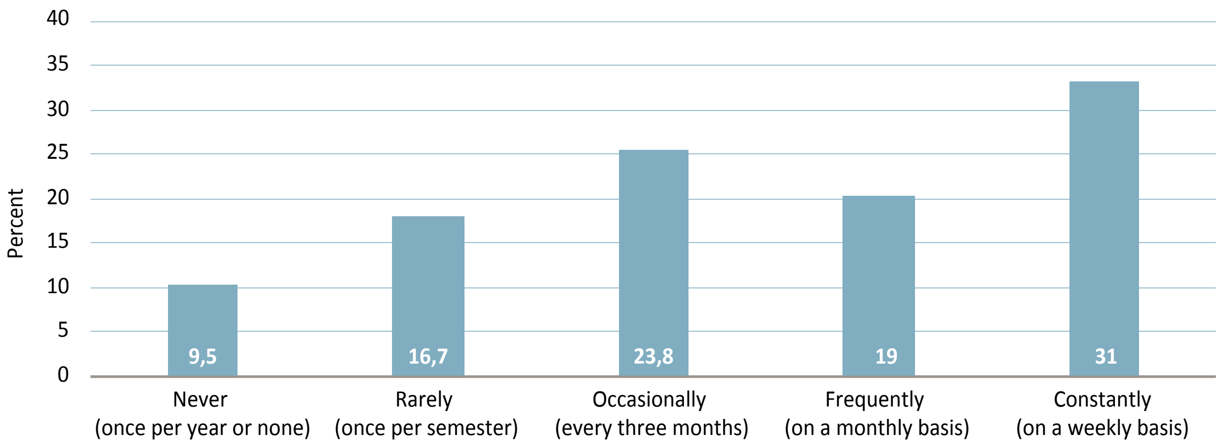
All the experts consulted answered this question. The overall average affinity for the question was 3.62 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 4: that is, between 4 and 5 there is the same number of responses as between 1 and 3.

Table 26. How often do you create PREDICTIVE MODELS by cross-referencing data collected from devices and sensors?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	4	9.5	9.5	9.5
	Rarely (once per semester)	7	16.7	16.7	26.2
	Occasionally (every three months)	10	23.8	23.8	50.0
	Frequently (on a monthly basis)	8	19.0	19.0	69.0
	Constantly (on a weekly basis)	13	31.0	31.0	100.0
	Total	**42**	100.0	100.0	

Mean	3.45
Median	3.50
Variance	1.815
Std. Deviation	1.347



From the analysis of the information obtained on “How often do you create PREDICTIVE MODELS by cross-referencing data collected from devices and sensors”, we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 50% while the standard deviation with respect to the mean is 1.347, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

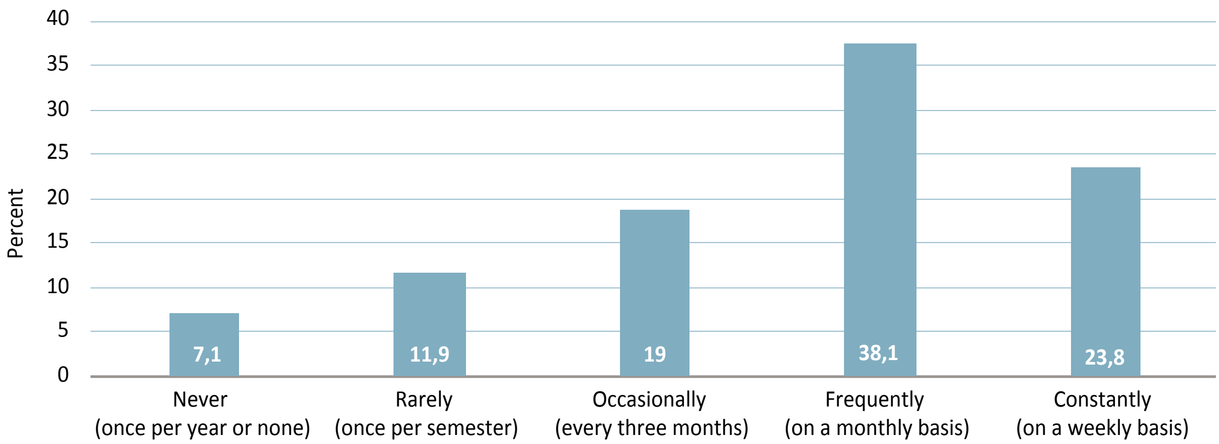
All the experts consulted answered this question. The overall average affinity for the question was 3.45 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 3.5: that is, between 3.5 and 5 there is the same number of responses as between 1 and 3.5

Table 27. How often do you use DIGITAL TECHNOLOGY (IoT, IA, Big Data) to get to know the customer?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	3	7.1	7.1	7.1
	Rarely (once per semester)	5	11.9	11.9	19.0
	Occasionally (every three months)	8	19.0	19.0	38.1
	Frequently (on a monthly basis)	16	38.1	38.1	76.2
	Constantly (on a weekly basis)	10	23.8	23.8	100.0
	Total	**42**	**100**.0	**100**.0	

Mean	3.60
Median	4.00
Variance	1.418
Std. Deviation	1.191



From the analysis of the information obtained on "How often do you use DIGITAL TECHNOLOGY (IoT, IA, Big Data) to get to know the customer", we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 61.9% while the standard deviation with respect to the mean is 1.191, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

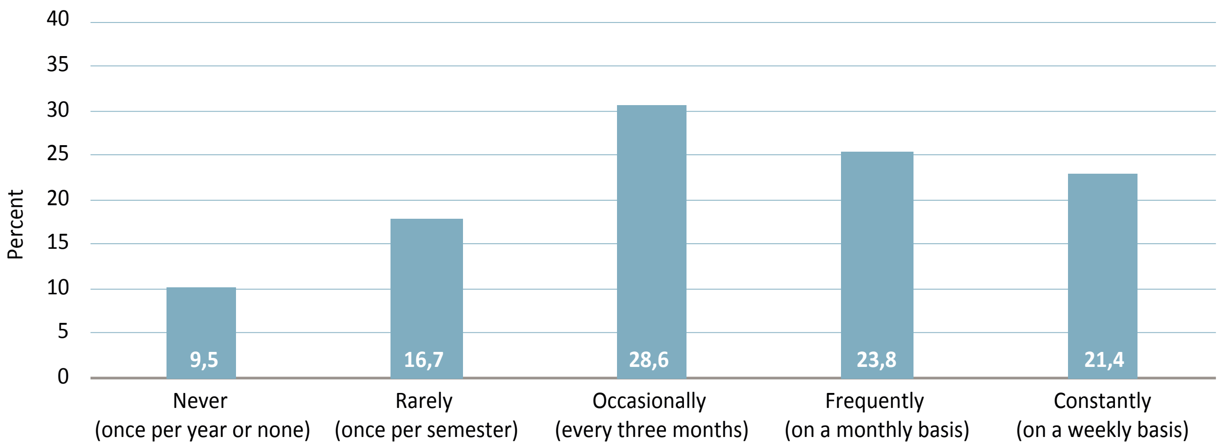
All the experts consulted answered this question. The overall average affinity for the question was 3.6 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 4: that is, between 4 and 5 there is the same number of responses as between 1 and 4.

Table 28. How often do you use BIG DATA for purchasing behavior analysis?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	4	9.5	9.5	9.5
	Rarely (once per semester)	7	16.7	16.7	26.2
	Occasionally (every three months)	12	28.6	28.6	54.8
	Frequently (on a monthly basis)	10	23.8	23.8	78.6
	Constantly (on a weekly basis)	9	21.4	21.4	100.0
	Total	**42**	100.0	100.0	

Mean	3.31
Median	3.00
Variance	1.585
Std. Deviation	1.259



From the analysis of the information obtained on “How often do you use BIG DATA for purchasing behavior analysis”, we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 45.2% while the standard deviation with respect to the mean is 1.259, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

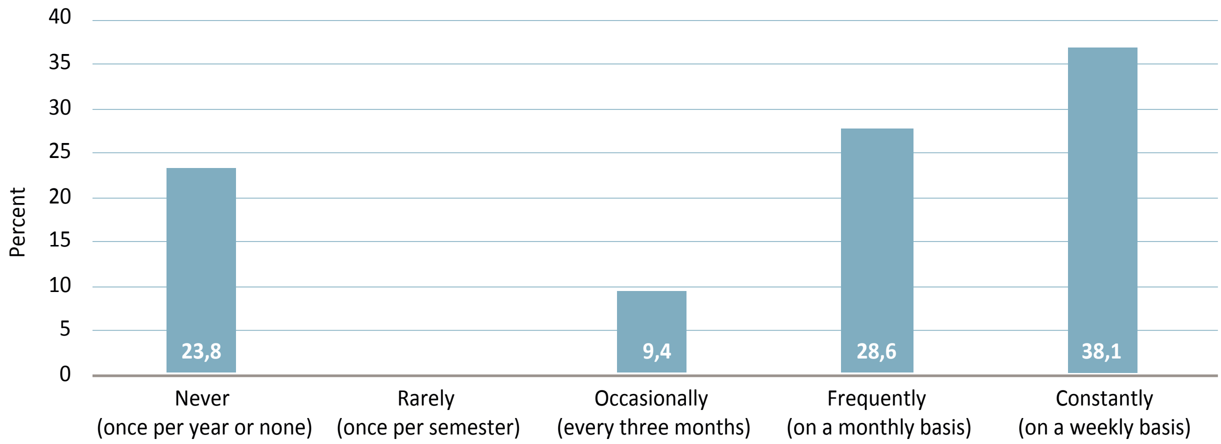
All the experts consulted answered this question. The overall average affinity for the question was 3.31 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 3: that is, between 3 and 5 there is the same number of responses as between 1 and 2.

Table 29. How often do YOU USE ALERTS installed in customers' vehicles?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	10	23.8	23.8	23.8
	Occasionally (every three months)	4	9.5	9.5	33.3
	Frequently (on a monthly basis)	12	28.6	28.6	61.9
	Constantly (on a weekly basis)	16	38.1	38.1	100.0
	Total	**42**	**100.0**	**100.0**	

Mean	3.57
Median	4.00
Variance	2.495
Std. Deviation	1.579



From the analysis of the information obtained on "How often do YOU USE ALERTS installed in customers' vehicles", we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 66.7% while the standard deviation with respect to the mean is 1.579, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

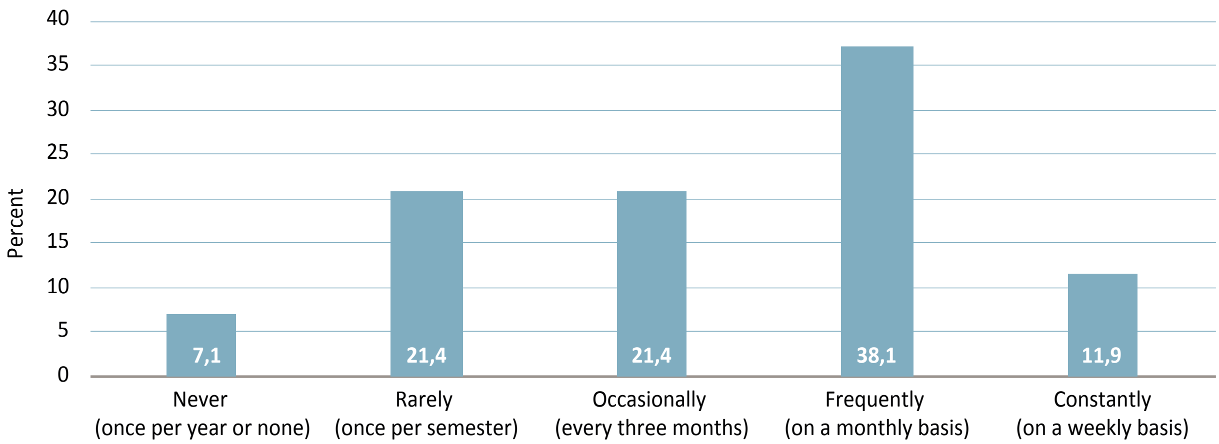
All the experts consulted answered this question. The overall average affinity for the question was 3.57 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 4: that is, between 4 and 5 there is the same number of responses as between 1 and 3.

Table 30. How often is the DEGREE OF INNOVATION OF COMPETITION IDENTIFIED through networked devices?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	3	7.1	7.1	7.1
	Rarely (once per semester)	9	21.4	21.4	28.6
	Occasionally (every three months)	9	21.4	21.4	50.0
	Frequently (on a monthly basis)	16	38.1	38.1	88.1
	Constantly (on a weekly basis)	5	11.9	11.9	100.0
	Total	**42**	**100.0**	**100.0**	

Mean	3.26
Median	3.50
Variance	1.320
Std. Deviation	1.149



From the analysis of the information obtained on "How often is the DEGREE OF INNOVATION OF COMPETITION IDENTIFIED through networked devices", we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 50% while the standard deviation with respect to the mean is 1.149, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

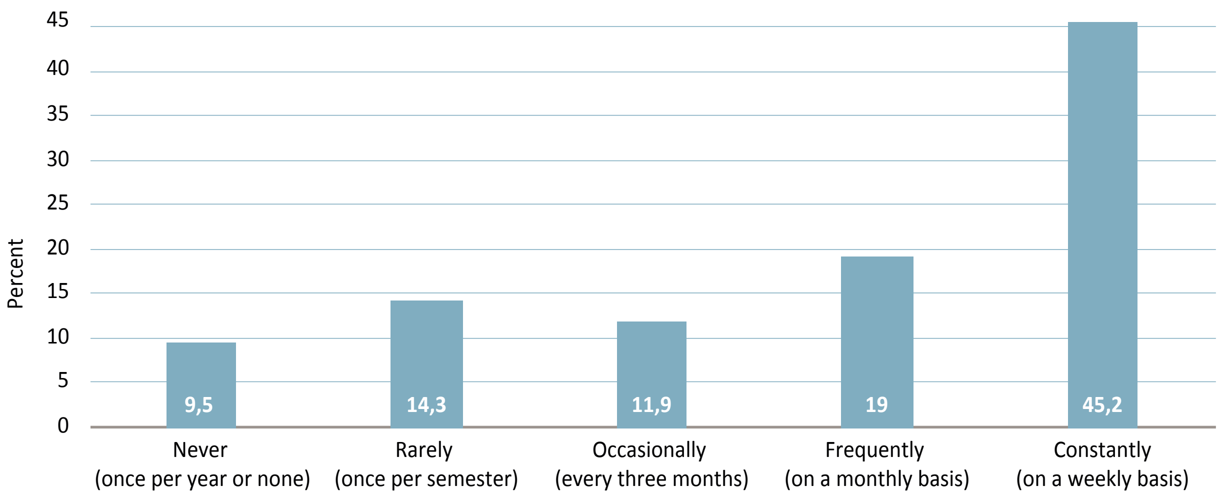
All the experts consulted answered this question. The overall average affinity for the question was 3.26 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 3.5: that is, between 3.5 and 5 there is the same number of responses as between 1 and 3.5

Table 31. How often do YOU USE NETWORKING WITH OTHER PLATFORMS?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	4	9.5	9.5	9.5
	Rarely (once per semester)	6	14.3	14.3	23.8
	Occasionally (every three months)	5	11.9	11.9	35.7
	Frequently (on a monthly basis)	8	19.0	19.0	54.8
	Constantly (on a weekly basis)	19	45.2	45.2	100.0
	Total	**42**	**100.0**	**100.0**	

Mean	3.76
Median	4.00
Variance	1.991
Std. Deviation	1.411



From the analysis of the information obtained on “How often do YOU USE NETWORKING WITH OTHER PLATFORMS”, we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 64.2% while the standard deviation with respect to the mean is 1.411, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

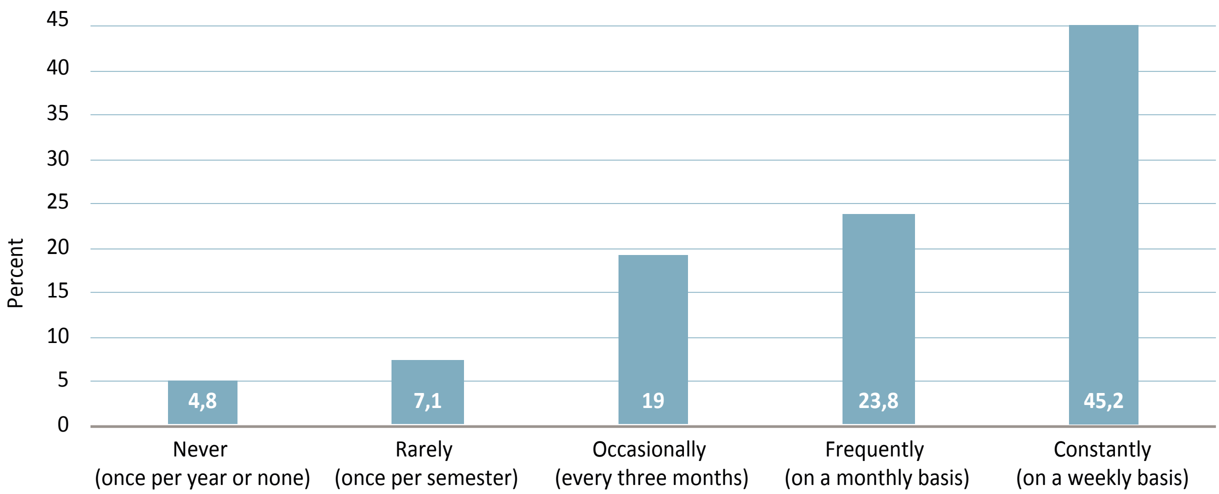
All the experts consulted answered this question. The overall average affinity for the question was 3.76 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 4: that is, between 4 and 5 there is the same number of responses as between 1 and 3

Table 32. How often does technology UNIFY SYSTEMS GLOBALLY across your plants and logistics centers?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	2	4.8	4.8	4.8
	Rarely (once per semester)	3	7.1	7.1	11.9
	Occasionally (every three months)	8	19.0	19.0	31.0
	Frequently (on a monthly basis)	10	23.8	23.8	54.8
	Constantly (on a weekly basis)	19	45.2	45.2	100.0
	Total	**42**	100.0	100.0	

Mean	3.98
Median	4.00
Variance	1.390
Std. Deviation	1.179



From the analysis of the information obtained on "How often does technology UNIFY SYSTEMS GLOBALLY across your plants and logistics centers", we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 69% while the standard deviation with respect to the mean is 1.179, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

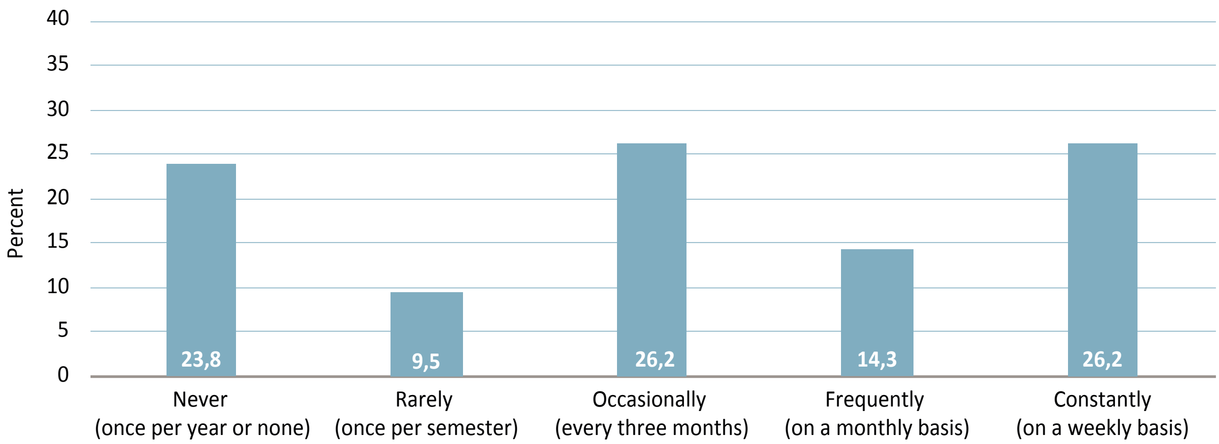
All the experts consulted answered this question. The overall average affinity for the question was 3.98 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 4: that is, between 4 and 5 there is the same number of responses as between 1 and 3

Table 33. How often are PREDICTIVE MODELS used to ANTICIPATE WEAR of parts have had an impact on the vehicle's maintenance cost?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	10	23.8	23.8	23.8
	Rarely (once per semester)	4	9.5	9.5	33.3
	Occasionally (every three months)	11	26.2	26.2	59.5
	Frequently (on a monthly basis)	6	14.3	14.3	73.8
	Constantly (on a weekly basis)	11	26.2	26.2	100.0
	Total	**42**	100.0	100.0	

Mean	3.10
Median	3.00
Variance	2.283
Std. Deviation	1.511



From the analysis of the information obtained on “How often are PREDICTIVE MODELS used to ANTICIPATE WEAR of parts have had an impact on the vehicle’s maintenance cost”, we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 40.5% while the standard deviation with respect to the mean is 1.511, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

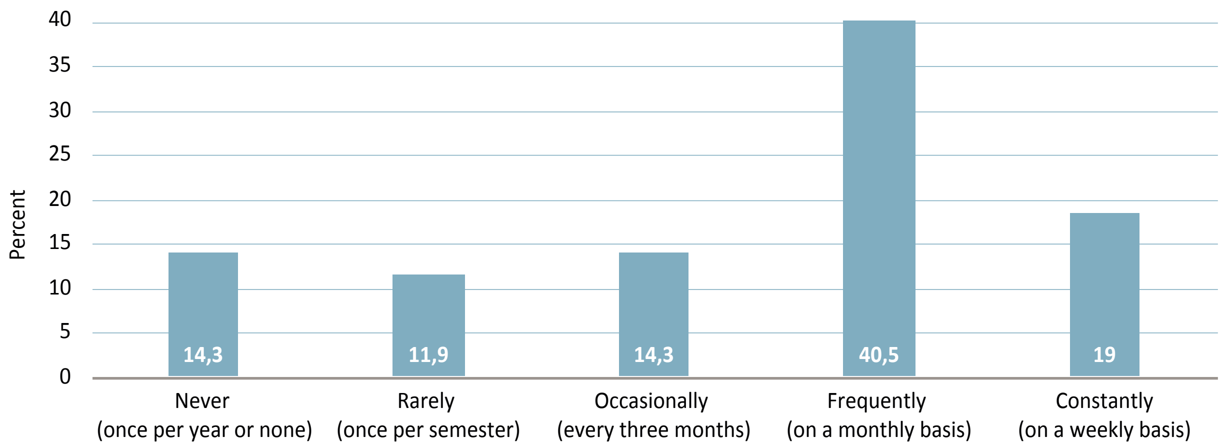
All the experts consulted answered this question. The overall average affinity for the question was 3.10 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 3: that is, between 3 and 5 there is the same number of responses as between 1 and 3

Table 34. How often has digital technology enabled the sales force to OPTIMIZE ROUTES?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	6	14.3	14.3	14.3
	Rarely (once per semester)	5	11.9	11.9	26.2
	Occasionally (every three months)	6	14.3	14.3	40.5
	Frequently (on a monthly basis)	17	40.5	40.5	81.0
	Constantly (on a weekly basis)	8	19.0	19.0	100.0
	Total	**42**	100.0	100.0	

Mean	3.38
Median	4.00
Variance	1.754
Std. Deviation	1.324



From the analysis of the information obtained on "How often has digital technology enabled the sales force to OPTIMIZE ROUTES", we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 59.5% while the standard deviation with respect to the mean is 1.324, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

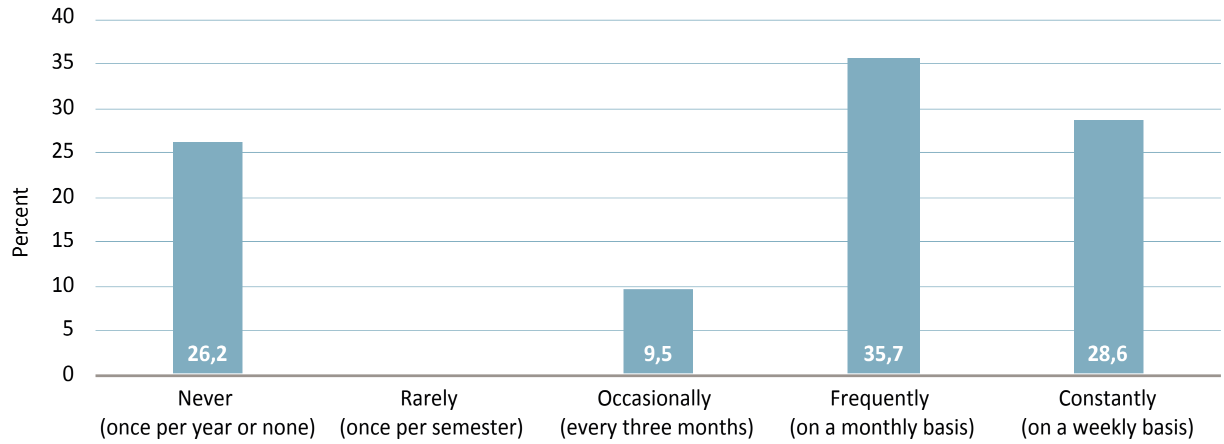
All the experts consulted answered this question. The overall average affinity for the question was 3.38 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 4: that is, between 4 and 5 there is the same number of responses as between 1 and 4.

Table 35. How often has digital technology made it possible to CONNECT ALL BUSINESS DIVISIONS under one direction?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Rarely (once per semester)	11	26.2	26.2	26.2
	Occasionally (every three months)	4	9.5	9.5	35.7
	Frequently (on a monthly basis)	15	35.7	35.7	71.4
	Constantly (on a weekly basis)	12	28.6	28.6	100.0
	Total	**42**	100.0	100.0	

Mean	3.67
Median	4.00
Variance	1.350
Std. Deviation	1.162



From the analysis of the information obtained on "How often has digital technology made it possible to CONNECT ALL BUSINESS DIVISIONS under one direction", we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 64,3% while the standard deviation with respect to the mean is 1.162, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

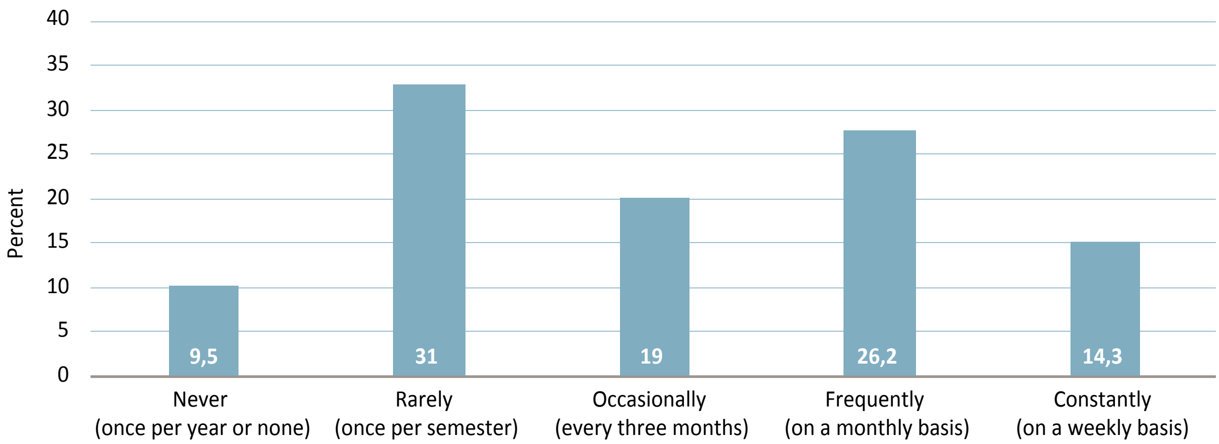
All the experts consulted answered this question. The overall average affinity for the question was 3.67 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 4: that is, between 4 and 5 there is the same number of responses as between 1 and 4.

Table 36. How often has digital technology allowed us to make decisions about ORGANISATIONAL CHANGES?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	4	9.5	9.5	9.5
	Rarely (once per semester)	13	31.0	31.0	40.5
	Occasionally (every three months)	8	19.0	19.0	59.5
	Frequently (on a monthly basis)	11	26.2	26.2	85.7
	Constantly (on a weekly basis)	6	14.3	14.3	100.0
	Total	**42**	**100.0**	**100.0**	

Mean	3.05
Median	3.00
Variance	1.559
Std. Deviation	1.248



From the analysis of the information obtained on “How often has digital technology allowed us to make decisions about ORGANISATIONAL CHANGES”, we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 40,5% while the standard deviation with respect to the mean is 1.248, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

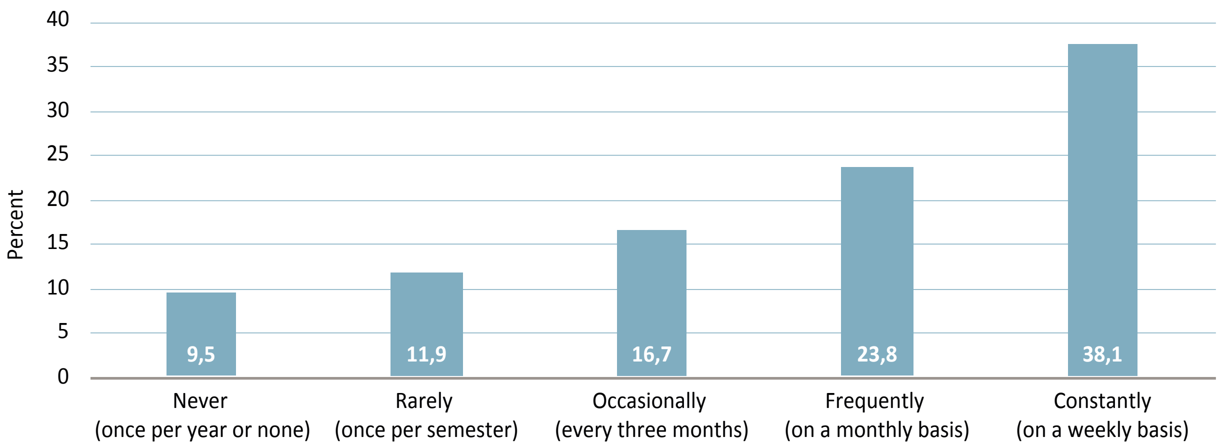
All the experts consulted answered this question. The overall average affinity for the question was 3.05 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 3: that is, between 3 and 5 there is the same number of responses as between 1 and 3.

Table 37. How often has digital technology developed solutions to PREVENT ACCIDENTS?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	4	9.5	9.5	9.5
	Rarely (once per semester)	5	11.9	11.9	21.4
	Occasionally (every three months)	7	16.7	16.7	38.1
	Frequently (on a monthly basis)	10	23.8	23.8	61.9
	Constantly (on a weekly basis)	16	38.1	38.1	100.0
	Total	**42**	100.0	100.0	

Mean	3.69
Median	4.00
Variance	1.829
Std. Deviation	1.352



From the analysis of the information obtained on "How often has digital technology developed solutions to PREVENT ACCIDENTS", we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 61,9% while the standard deviation with respect to the mean is 1.352, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

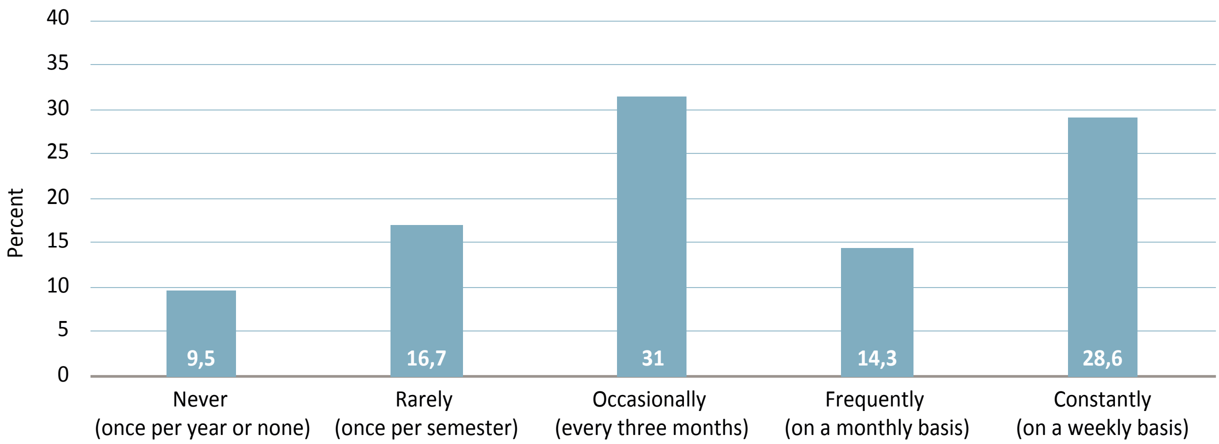
All the experts consulted answered this question. The overall average affinity for the question was 3.69 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 4: that is, between 4 and 5 there is the same number of responses as between 1 and 4.

Table 38. How often do you use sensor integration or data management to make COMMERCIAL ALLIANCES with suppliers or/and customers?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	4	9.5	9.5	9.5
	Rarely (once per semester)	7	16.7	16.7	26.2
	Occasionally (every three months)	13	31.0	31.0	57.1
	Frequently (on a monthly basis)	6	14.3	14.3	71.4
	Constantly (on a weekly basis)	12	28.6	28.6	100.0
	Total	**42**	100.0	100.0	

Mean	3.36
Median	3.00
Variance	1.747
Std. Deviation	1.322



From the analysis of the information obtained on “How often do you use sensor integration or data management to make COMMERCIAL ALLIANCES with suppliers or/and customers”, we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 42.9% while the standard deviation with respect to the mean is 1.322, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

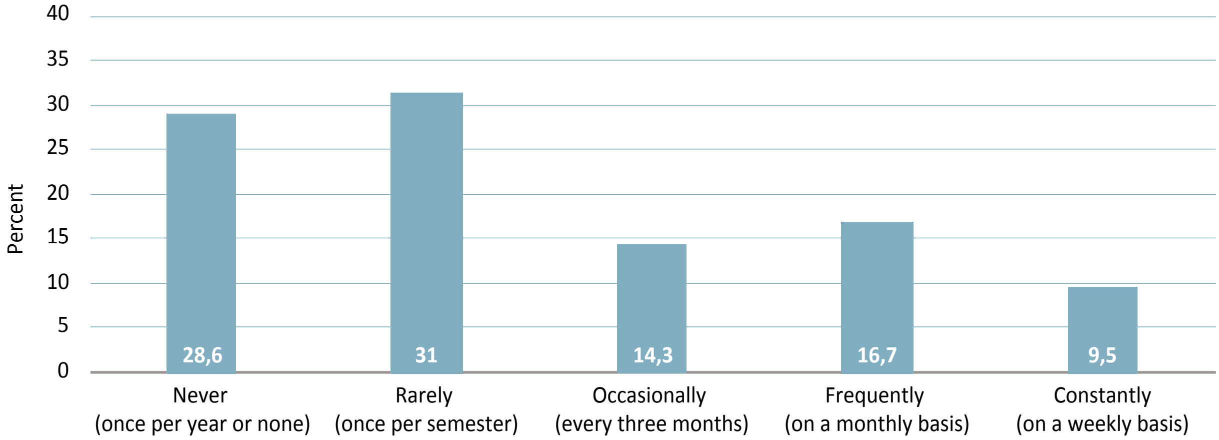
All the experts consulted answered this question. The overall average affinity for the question was 3.36 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 3: that is, between 3 and 5 there is the same number of responses as between 1 and 3.

Table 39. How often do insurance companies contact your company to offer a CUSTOMIZED PRODUCT depending on the driving style by the data you collect directly from the vehicle?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	12	28.6	28.6	28.6
	Rarely (once per semester)	13	31.0	31.0	59.5
	Occasionally (every three months)	6	14.3	14.3	73.8
	Frequently (on a monthly basis)	7	16.7	16.7	90.5
	Constantly (on a weekly basis)	4	9.5	9.5	100.0
	Total	**42**	**100.0**	**100.0**	

Mean	2.48
Median	2.00
Variance	1.768
Std. Deviation	1.330



From the analysis of the information obtained on "How often do insurance companies contact your company to offer a CUSTOMIZED PRODUCT depending on the driving style by the data you collect directly from the vehicle", we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 26.2% while the standard deviation with respect to the mean is 1.330, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

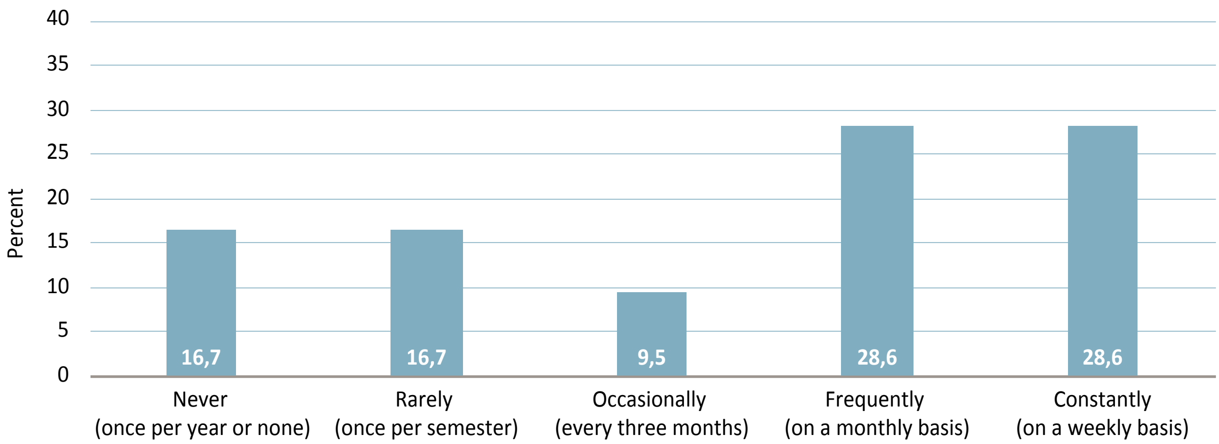
All the experts consulted answered this question. The overall average affinity for the question was 2.48 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 2: that is, between 2 and 5 there is the same number of responses as between 1 and 2.

Table 40. How often is it able to advance in the PRODUCT DESIGN to acceptance according to real tastes, education, geographical areas, etc. through Big Data?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	7	16.7	16.7	16.7
	Rarely (once per semester)	7	16.7	16.7	33.3
	Occasionally (every three months)	4	9.5	9.5	42.9
	Frequently (on a monthly basis)	12	28.6	28.6	71.4
	Constantly (on a weekly basis)	12	28.6	28.6	100.0
	Total	**42**	**100.0**	**100.0**	

Mean	3.36
Median	4.00
Variance	2.186
Std. Deviation	1.479



From the analysis of the information obtained on “How often is it able to advance in the PRODUCT DESIGN to acceptance according to real tastes, education, geographical areas, etc. through Big Data”, we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 57.2% while the standard deviation with respect to the mean is 1.479, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

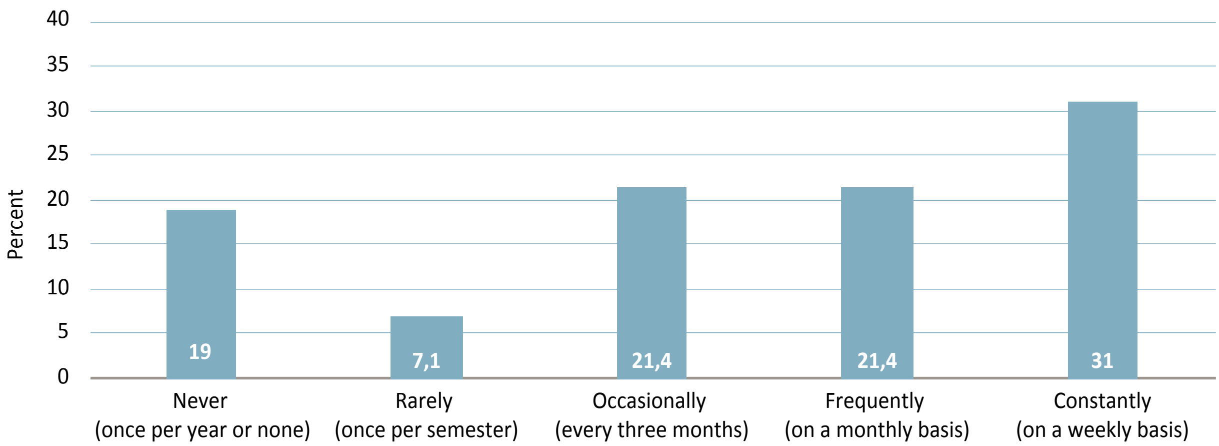
All the experts consulted answered this question. The overall average affinity for the question was 3.36 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 4: that is, between 4 and 5 there is the same number of responses as between 1 and 4.

Table 41. How often does digital technology allow you to estimate THE DURABILITY of the different parts that make up the product?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	8	19.0	19.0	19.0
	Rarely (once per semester)	3	7.1	7.1	26.2
	Occasionally (every three months)	9	21.4	21.4	47.6
	Frequently (on a monthly basis)	9	21.4	21.4	69.0
	Constantly (on a weekly basis)	13	31.0	31.0	100.0
	Total	**42**	100.0	100.0	

Mean	3.38
Median	4.00
Variance	2.193
Std. Deviation	1.481



From the analysis of the information obtained on "How often does digital technology allow you to estimate THE DURABILITY of the different parts that make up the product", we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 52.4% while the standard deviation with respect to the mean is 1.481, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

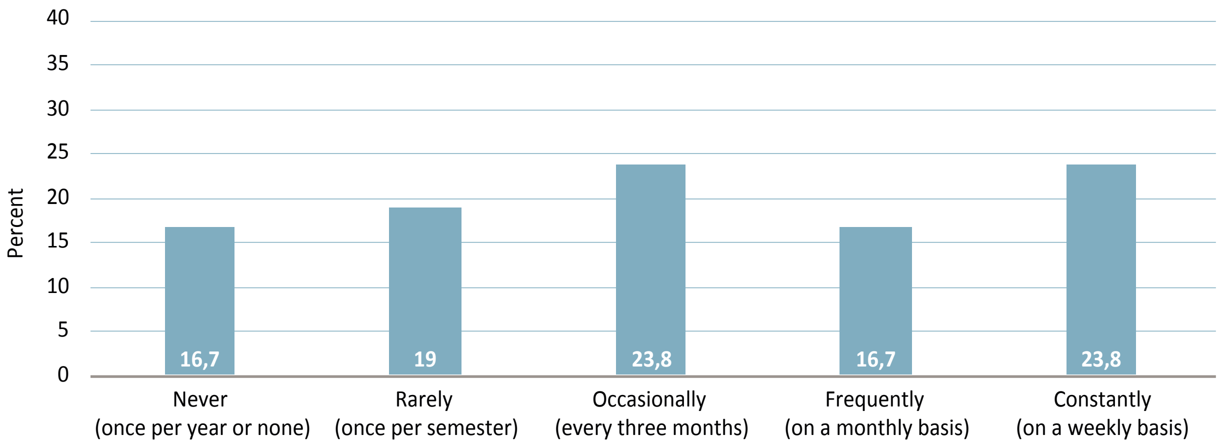
All the experts consulted answered this question. The overall average affinity for the question was 3.38 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 4: that is, between 4 and 5 there is the same number of responses as between 1 and 4.

Table 42. How often do you use digital technology to know when the customer WILL CHANGE THE PRODUCT, the type of product you are going to look for, color, ¿features in order to anticipate it and thus launch the user a communication that makes you purchase it?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	7	16.7	16.7	16.7
	Rarely (once per semester)	8	19.0	19.0	35.7
	Occasionally (every three months)	10	23.8	23.8	59.5
	Frequently (on a monthly basis)	7	16.7	16.7	76.2
	Constantly (on a weekly basis)	10	23.8	23.8	100.0
	Total	**42**	**100.0**	**100.0**	

Mean	3.38
Median	4.00
Variance	2.144
Std. Deviation	1.464



From the analysis of the information obtained on "How often do you use digital technology to know when the customer WILL CHANGE THE PRODUCT, the type of product you are going to look for, color, ¿features in order to anticipate it and thus launch the user a communication that makes you purchasing it", we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 40.5% while the standard deviation with respect to the mean is 1.464, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

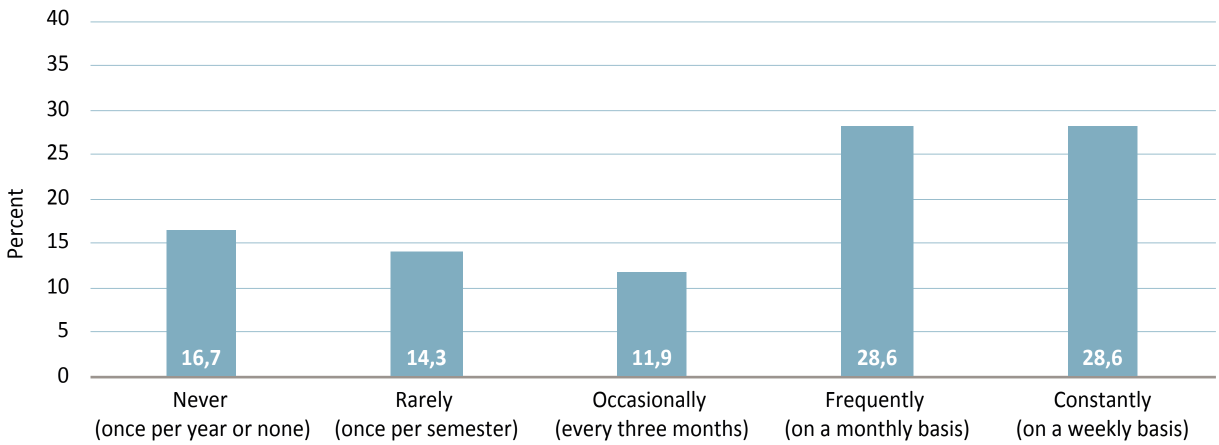
All the experts consulted answered this question. The overall average affinity for the question was 3.38 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 4: that is, between 4 and 5 there is the same number of responses as between 1 and 4.

Table 43. How often does the digital transformation allow your company to ANTICIPATE FUTURE CAR FAILURES allowing the connection with the workshop, being able to make an appointment, even before such a failure occurs?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never (once per year or none)	7	16.7	16.7	16.7
	Rarely (once per semester)	6	14.3	14.3	31.0
	Occasionally (every three months)	5	11.9	11.9	42.9
	Frequently (on a monthly basis)	12	28.6	28.6	71.4
	Constantly (on a weekly basis)	12	28.6	28.6	100.0
	Total	**42**	**100.0**	**100.0**	

Mean	3.38
Median	4.00
Variance	2.144
Std. Deviation	1.464



From the analysis of the information obtained on "How often does the digital transformation allow your company to ANTICIPATE FUTURE CAR FAILURES allowing the connection with the workshop, being able to make an appointment, even before such a failure occurs", we can affirm that there is no consensus among the experts that this statement is valid, given that none of the requirements demanded to consider that consensus is produced is met. With respect to the degree of affinity, the values Frequently and Constantly add up to an affinity of 57.2% while the standard deviation with respect to the mean is 1.464, a value that is considered high given that the affinity of the respondents has been dispersed among the values.

All the experts consulted answered this question. The overall average affinity for the question was 3.38 out of 5.

The median, which represents the value that leaves the same number of responses on both sides, is 4: that is, between 4 and 5 there is the same number of responses as between 1 and 4.

5.2. HYPOTHESES RESULTS

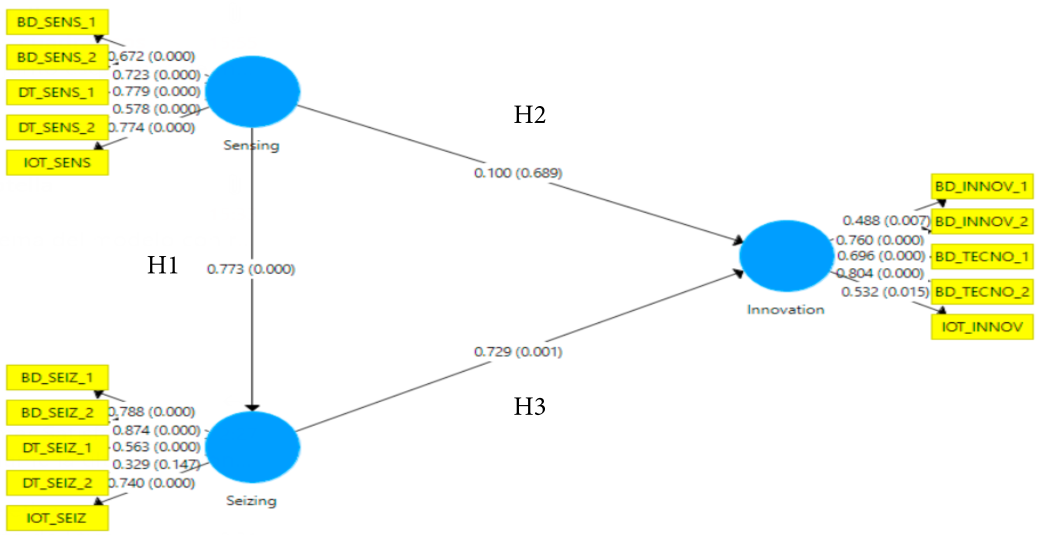
To contrast the relationships between the indicators and the latent variables, as well as the relationships established between the hypotheses and the constructs, which represent the capabilities, a structural equation model (SEM) was specified and estimated.

5.2.1 H1, H2, H3 and H4

Hypothesis 1	The sensing capability influences seizing capability
Hypothesis 2	The seizing capability influences the capability for innovation
Hypothesis 3	The sensing capability influences the capability for innovation
Hypothesis 4	The process sequence of adapting dynamic capabilities is sensing, seizing and innovation.

To test the relationships between the indicators and the latent variables, as well as the relationships established between the hypotheses and the constructs representing the capabilities, a structural equation model (SEM) was specified and estimated. All of the capabilities present in the model - sensing, seizing and innovation - are reflected in Figure 6. The coefficients, on the arrows of the model schematic, are shown on a standardized scale from -1 to 1.

Figure 6: Structural equation model among the capabilities identified.



Source: Author´s own (2021).

Table 44. Summary of the Constructs Reliability and Validity

	Cronbach´s Alpha	Rho_a	Composite Reliability	Average Variance Extracted (AVE)
Innovation	0.679	0.719	0.795	0.446
Seizing	0.687	0.756	0.804	0.472
Sensing	0.755	0.783	0.833	0.503

Source: Author´s own (2021).

Convergent validity was determined by the average variance extracted (AVE). The resulting values (Table 44) are just (0.446) above the admitted threshold value of 0.500 (Ringle, 2004).

As for reliability, internal consistency reliability was assessed by Cronbach's alpha coefficient and composite reliability (Table 44). Both measures exceeded the threshold of 0.679 (Cronbach 1951; Nunally and Berstein 1994; Werts et at., 1974).

Considering the external model (measurement) (see Table 45), the one-dimensionality of the factors was verified by means of an exploratory factor analysis. The loadings of the observed factors vary from 0.488 to 0.874. All of them except one (0.329) are above the 0.5 threshold accepted as high (Chin, 1998).

Table 45. Outer loadings

	Innovation	Seizing	Sensing
BD_INNOV_1	0.488		
BD_INNOV_2	0.760		
BD_SEIZ_1		0.788	
BD_SEIZ_2		0.874	
BD_SENS_1			0.672
BD_SENS_2			0.723
BD_TECNO_1	0.696		
BD_TECNO_2	0.804		
DT_SEIZ_1		0.563	
DT_SEIZ_2		0.329	
DT_SENS_1			0.779
DT_SENS_2			0.578
IOT_INNOV	0.532		
IOT_SEIZ		0.740	
IOT_SENS			0.774

Source: Author´s own (2021).

As for the discriminant validity criteria, the cross-loadings matrix (Table 46) obtained by correlating the values of each latent variable with all the other indicators was considered. The loadings of each indicator are higher for its own construct than for any other (Chin 1998).

Table 46. Cross loadings Matrix

	Innovation	Seizing	Sensing
BD_INNOV_1	0.488	0.352	0.518
BD_INNOV_2	0.760	0.707	0.477
BD_SEIZ_1	0.608	0.788	0.602
BD_SEIZ_2	0.655	0.874	0.723
BD_SENS_1	0.336	0.374	0.672
BD_SENS_2	0.447	0.437	0.723
BD_TECNO_1	0.696	0.489	0.356
BD_TECNO_2	0.804	0.631	0.463
DT_SEIZ_1	0.436	0.563	0.367
DT_SEIZ_2	0.319	0.329	0.368
DT_SENS_1	0.433	0.517	0.779
DT_SENS_2	0.457	0.452	0.578
IOT_INNOV	0.532	0.421	0.449
IOT_SEIZ	0.666	0.740	0.505
IOT_SENS	0.600	0.802	0.774

Source: Author´s own (2021).

As a final step in the validation process of the external model, we confirmed the evaluation of its discriminant validity following the Fornell-Larcker criterion (Fornell and Larcker, 1981), see Table 47. This criterion requires that a latent variable share more variance with its assigned indicators than with any other latent variable.

Table 47. Discriminant Validity. Fornell-Larcker Criterion

	Innovation	Seizing	Sensing
Innovation	0.668		
Seizing	0.807	0.687	
Sensing	0.664	0.773	0.709

Source: Author´s own (2021).

All coefficients of the relationships between the latent variables are significant ($p < 0.05$). The following table presents the values of the estimated effects between the latent variables. There are no multicollinearity problems, as all variance inflation factors (VIFs) are below the threshold limit of 6 (Table 48).

Table 48. Variance Inflation Factors (VIF)

	VIF
BD_INNOV_1	1.379
BD_INNOV_2	1.393
BD_SEIZ_1	1.774
BD_SEIZ_2	2.502
BD_SENS_1	1.981
BD_SENS_2	1.582
BD_TECNO_1	2.595
BD_TECNO_2	2.956
DT_SEIZ_1	1.252
DT_SEIZ_2	1.146
DT_SENS_1	2.029
DT_SENS_2	1.297
IOT_INNOV	1.399
IOT_SEIZ	1.917
IOT_SENS	1.367

Source: Author´s own (2021).

Statistical significance was evaluated by resampling (Bootstrap) with 5000 samples (Table 49). Each sample size in resampling was set as recommended in the literature (Efron and Tibshiran 1993), equal to the sample size ($n = 42$).

Table 49. MV descriptives

	Mean	Median	Standard Deviation	Excess Kurtosis	Skewness	Number of Observations Used
BD_INNOV_1	2.476	2.000	1.314	-0.900	0.544	42.000
BD_INNOV_2	3.095	3.000	1.493	-1.352	-0.125	42.000
BD_SEIZ_1	3.357	3.000	1.306	-1.051	-0.174	42.000
BD_SEIZ_2	3.381	4.000	1.463	-1.125	-0.466	42.000
BD_SENS_1	3.310	3.000	1.244	-0.869	-0.239	42.000
BD_SENS_2	3.357	4.000	1.461	-1.287	-0.420	42.000
BD_TECNO_1	3.619	4.000	1.308	-0.982	-0.502	42.000
BD_TECNO_2	3.452	4.000	1.331	-1.076	-0.334	42.000
DT_SEIZ_1	3.976	4.000	1.165	0.142	-0.984	42.000
DT_SEIZ_2	3.667	4.000	1.148	-1.314	-0.378	42.000
DT_SENS_1	3.381	4.000	1.308	-0.767	-0.623	42.000
DT_SENS_2	3.690	4.000	1.336	-0.707	-0.706	42.000
IOT_INNOV	3.262	4.000	1.135	-0.773	-0.342	42.000
IOT_SEIZ	3.571	4.000	1.561	-0.943	-0.801	42.000
IOT_SENS	3.762	4.000	1.394	-0.832	-0.758	42.000

Therefore, based on the results and summarized in Table 50, looking at the structural model presented in Figure 1, we can state that:

Table 50 Hypotesis results

	Parameter Value	P-Value	Acceptance/ Rejection of the hypothesis
H1 Function	0.773	0.000	Accepted
H2 Function	0.729	0.000	Accepted
H3 Function	0.100	0.689	No accepted
H4 Function	0.564	0.000	Accepted

Source: Author´s own (2021).

- **Hypothesis 1 (H1):** the sensing capability measured through the indicators (BD_SENS_1; BD_SENS_2; DT_SENS_1; DT_SENS_2; IOT_SENS) positively influences the seizing capability is accepted since this relationship is considered proven (0.733; p=0.000).
- **Hypothesis 2 (H2):** seizing capability measured through the indicators (BD_SEIZ_1; BD_SEIZ_2; DT_SEIZ_1; IOT_SEIZ) positively influences innovation capability is accepted since this relationship is considered proven (0.729; p=0.000).
- **Hypothesis 3 (H3):** sensing capability measured through the indicators (BD_SENS_1; BD_SENS_2; DT_SENS_1; DT_SENS_2; IOT_SENS) does not positively influence innovation capability and therefore is not accepted as this relationship is not considered accepted (0.100; p=0.689).
- **Hypothesis (H4):** The sequence of dynamic capabilities adaptation process, uptake and innovation is accepted as this relationship is considered proven. Although H3 does not have a direct influence on innovation, it does have an indirect influence on innovation, the influence is twofold, direct and indirect.

5.2.2 H5

Hypothesis 5	Dynamic capabilities (DynCap) positively influence customer satisfaction (CustSatis)

The customer satisfaction variables were evaluated by the Likert scale in this research. A Likert scale metric was used, from 1 (not important) to 5 (very important). In this case, the intervals between the points on the scale corresponded to empirical observations in the metric sense. A visual analog scale was displayed on each survey question presented to the interviewee.

In Table 51 presents the statistical values for customer satisfaction according to each of the dynamic capabilities considered.

Table 51. Customer satisfaction values for each variable.

Variable observed	Scores (Mean)	SD1 (CV2 %)
DT_CONTA	4.048	1.058 (26.14)
DT_PROA_1	3.857	1.117 (28.95)
DT_PROA_2	3.405	1.432 (42.07)
DT_PROA_3	3.786	1.423 (37.60)
DT_SATISF	3.786	1.048 (27.66)

1Standard deviation, points, 2Coefficient of variation.

According to the results shown in Table 51, the five satisfaction variables showed high mean values and coefficients of variation greater than 25%. Cronbach's Alpha was greater than 0.7, and the questionnaire was validated for each of the indicators.

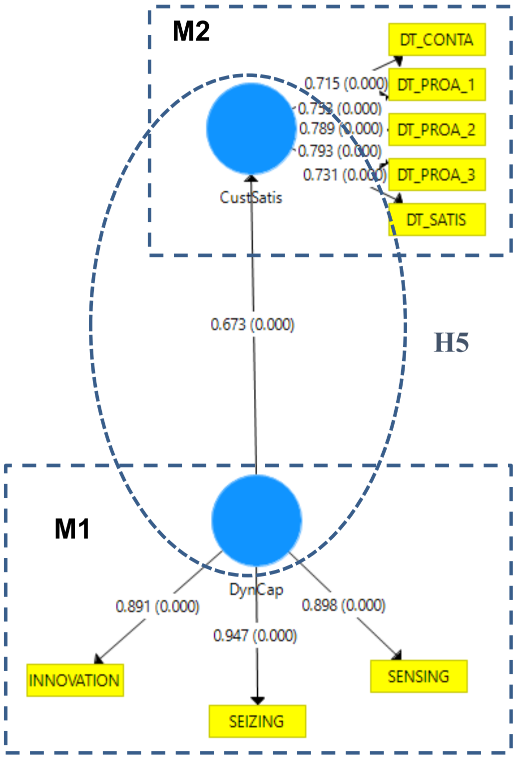
The analyses were carried out in two stages. In the first phase, two reflective measurement models (M1 and M2) were used (Figure 4), which assessed the relationships between the constructs Dynamic capabilities (DynCap) and Customer Satisfaction (CustSatis) and the indicators used. For this purpose, the internal consistency of each construct was measured (Cronbach's alpha and composite reliability), secondly, its convergent validity through the reliability of the indicator and the variance extracted, and finally the discriminant validity between indicators and latent variables (Fornell Larcker criterion) and cross-loadings (Martínez Ávila, Fierro Moreno, 2018).

The causal relationships between dynamic capabilities (DynCap) and customer satisfaction (CustSatis) were measured in a second stage. To validate Hypothesis 5, a structural equation model (SEM) was developed (Figure 4). Both models were estimated using the Partial Least Squares (PLS) procedure applying SmartPLS3 software (Ringle, Wende, Becker, 2015) to test the relationships between indicators and latent constructs, as well as the hypothesized structural relationships between the latent constructs (Jöreskog and Wold, 1982). The criteria for choosing the algorithm were: the novelty of the phenomenon, its modeling is at an emerging stage, minimum PLS recommendations on sample size, prediction accuracy, and comparatively low demands on the multinormality requirements of the data were met (Henseler, Ringle and Sinkovics, 2009).

Finally, Bootstrapping was used to test the statistical significance of various PLS-SEM results such as path coefficients, Cronbach's alpha, HTMT, and R^2 values. In this research bootstrapping procedure was repeated until 5,000 random samples have been created (Anderson and Gerbing, D, 1988).

The model was estimated in two phases, firstly the constructs used and secondly the relationship between dynamic capabilities on customer satisfaction (Figure 7). All the capabilities presented in the model - sensing, seizing, and innovation - are shown in the figure 3 of the previous hypotheses.

Figure 7. Models and hypothesis of Dynamic Capabilities model on Customer Satisfaction.



In Figure 7, and Tables 52, 53 and 54 present the reflective and structural models, testing the hypotheses presented above. On the arrows of the model scheme, the coefficients are shown on a standardized scale from -1 to 1. Each construct was validated for its reliability and validity. Statistically significant relationships have p-values lower than 0.05. Dynamic capabilities showed a high impact on customer satisfaction (P = 0.000).

The step-by-step results showed the following statistical indicators:

From the parameters in Table 52, the reliability and validity of the two proposed constructs are accepted. Convergent validity was determined by the average variance extracted (AVE), defined as the mean value of the construct´s indicators squared loadings. According to Fornell and Larcker, [86] the shared covariance is higher than the AVE for each of the two constructs. The resulting values (Table 52) show that the AVE values for Customer Satisfaction and Dynamic Capabilities were high (0.573 and 0.832 respectively) above the admitted value of 0.500 (Ringle, Wende and Will, 2005). In terms of reliability, internal consistency reliability was assessed using Cronbach's alpha coefficient and composite reliability. Almost all measures exceeded the 0.700 threshold.

Table 52. Construct Reliability and Validity.

	Cronbach's Alpha	Rho_A	Composite Reliability	AVE[1]
CustSatis	0.814	0.822	0.870	0.573
DynCap	0.899	0.906	0.937	0.832

[1]Average Variance Extracted.

Discriminant validity by Fornell and Larcker has been chosen as criteria for evaluating measurement scales that define latent constructs in our model (Table 53). All the correlation showed in table 53 were greater than those obtained between the observed variables. Therefore, the indicators of both variables meet the required discriminant validity criteria (Martínez García and Martínez Caro, 2008).

Table 53. Fornell Larcker Criterion

	CustSatis	DynCap
CustSatis	0.757	
DynCap	0.673	0.912

In table 54 the cross loadings of each indicator on latent variable are shown. It compares the cross-factor loadings of the indicators of a latent variable with the loadings of the other latent variables. As required, the factor loadings show higher values on its own than on than the others construct.

Table 54. Cross Loadings

	CustSatis	DynCap
DT_CONTA	0.715	0.379
DT_PROA_1	0.753	0.527
DT_PROA_2	0.789	0.492
DT_PROA_3	0.793	0.590
DT_SATIS	0.731	0.520
INNOVATION	0.549	0.891
SEIZING	0.650	0.947
SENSING	0.637	0.898

In summary, the DC models' goodness-of-fit was adequate. Bootstrapping results are shown in Table 55. Confidence intervals assist in as certain the significance of the relationships examined (Sánchez, 2013). At a 95% confidence level, dynamic capabilities did impact customer satisfaction in automobile industry, given the available data.

Table 55. Bootstrapping final results

	Sample[1]	SD[2]	T [3]	P-value	Confidence Intervals 2.5%	97.5%
DT_CONTA <- CustSatis	0.695	0.128	5.588	0.000	0.376	0.869
DT_PROA_1 <- CustSatis	0.748	0.096	7.847	0.000	0.501	0.886
DT_PROA_2 <- CustSatis	0.776	0.088	8.997	0.000	0.553	0.897
DT_PROA_3 <- CustSatis	0.792	0.077	10.295	0.000	0.537	0.888
DT_SATIS <- CustSatis	0.731	0.103	7.078	0.000	0.436	0.872
INNOVATION <- DynCap	0.890	0.034	25.940	0.000	0.793	0.937
SEIZING <- DynCap	0.946	0.019	50.598	0.000	0.897	0.973
SENSING <- DynCap	0.897	0.040	22.250	0.000	0.789	0.954

[1]Mean; [2]Standard desviation; [3]T Statistics.

Finally, the impact that Dynamic Capabilities had on the Customer satisfaction was significant: 0.673 (path coefficient) and 0.0000 p-value. The structural equation model goodness-of-fit with a coefficient of determination R2 of 0.453, and size effect (f2) of 0.829. According to Cohen, an f2 greater than 0.35 is considered high. Therefore, we can consider the Hypothesis 5 as validated.

5.2.3 H6, H7 and H8

Hypothesis 6	Dynamic capabilities (DynCap) positively influence on financial results (FinRes)
Hypothesis 7	Dynamic capabilities (DynCap) positively influence on competitive advantages (ComAdv)
Hypothesis 8	Competitive Advantages (ComAdv) positively influence on financial results (FinRes)

In the table 56, the financial results variables were evaluated by the Likert scale in this research. A Likert scale metric was used, from 1 (not important) to 5 (very important). In this case, the intervals between the points on the scale corresponded to empirical observations in the metric sense. A visual analog scale was displayed on each survey question presented to the interviewee.

According to results shown in Table 56, the five financial variables showed high mean values and good coefficients of variation.

Table 56. Financial results values for each variable

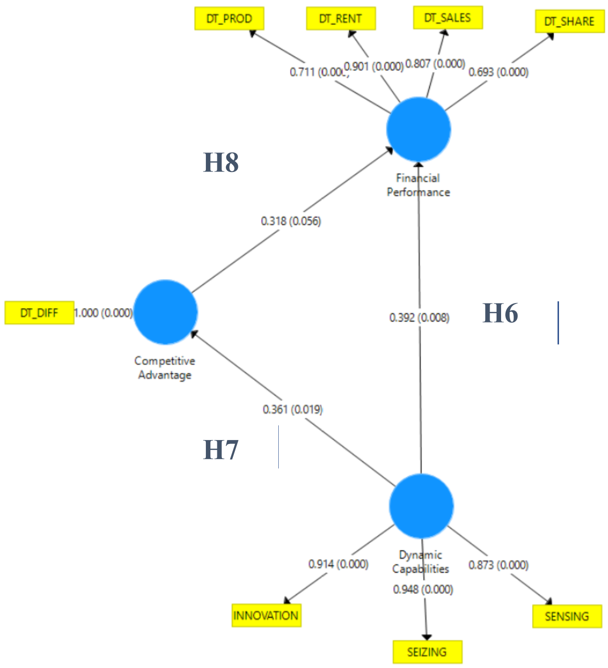
Variable observed	Scores (Mean)	SD1	Minimum	Maximum
DT_PROD	3.67	1.04	1	5
DT_RENT	3.10	0.95	1	5
DT_SALES	3.14	1.06	1	5
DT_SHARE	2.74	0.93	1	5

[1]Standard deviation.

The causal relationships between a) Dynamic Capabilities (DynCap) and Financial Results (FinRes); b) Dynamic Capabilities (DynCap) to Competitive Advantages (ComAdv) as well as Competitive Advantages (ComAdv) to Financial Results (FinRes), as a consequence of both hypotheses, ComAdv acts as a mediator that transmits the effects of DynCap to FinRes was measured in a second stage. To validate the different hypotheses, a structural equation model (SEM) was developed. The models were estimated using the Partial Least Squares (PLS) procedure applying SmartPLS3 software, to test the relationships between indicators and latent constructs, as well as the hypothesized structural relationships between the latent constructs. The criteria for choosing the algorithm were: the novelty of the phenomenon, its modeling is at an emerging stage, minimum PLS recommendations on sample size, prediction accuracy, and comparatively low demands on the multi normality requirements of the data were met.

Finally, Bootstrapping was used to test the statistical significance of various PLS-SEM results such as path coefficients, Cronbach's alpha, HTMT, and R^2 values. In this research bootstrapping procedure was repeated until 5,000 random samples have been created.

Figure 8. Models and hypotheses of Dynamic Capabilities model on Financial Results



Source: Author's own (2021).

The process is shown in Figure 8, and Table 57, 58 y 59 presents the reflective and structural models, testing the hypotheses presented above. Statistically significant relationships have p-values lower than 0.05. Dynamic capabilities showed a high impact on financial performances (P = 0.000). The DC models' goodness-of-fit was enough. Hypotheses results are shown in Table 60. Original path coefficients are compared with the results after bootstrapping. Confidence intervals assist in as certain the significance of the relationships examined. At a 95% confidence level, dynamic capabilities did impact customer satisfaction in automobile industry, given the available data.

From the parameters in Table 57, the reliability and validity of the three proposed constructs are accepted. Convergent validity was determined by the average variance extracted (AVE). The resulting values (Table 57) show that the AVE values for Financial Results and Dynamic Capabilities were high (0.612, 0.832) above the admitted value of 0.500. In terms of reliability, internal consistency reliability was assessed using Cronbach's alpha coefficient and composite reliability. All measures exceeded the 0.700 threshold.

Table 57. Construct Reliability and Validity

	Cronbach's Alpha	Rho_A	Composite Reliability	AVE[1]
FinRes	0.784	0.784	0.862	0.612
DynCap	0.900	0.915	0.937	0.832

[1]Average Variance Extracted

Discriminant validity by Fornell and Larcker as criteria for evaluating measurement scales that define latent constructs in our model. Validity represents a robust condition against certain covariance statistical based analysis. All the correlation showed in table 58 were and greater than those obtained between the observed variables. Therefore, the indicators of both variables meet the required discriminant validity criteria.

Table 58. Fornell Larcker Criterion

	FinRes	DynCap	ComAdv
FinRes	0.782	0.506	0.459
DynCap	-	0.912	0.360

In table 59 the cross loadings of each indicator on latent variable were shown. It compared the cross-factor loadings of the indicators of a latent variable with the loadings of the other latent variables. The factor loadings showed higher values than the others that were evaluated in the models. Besides, indicators concentrated high values in their indicator and low values with the other indicator.

Table 59. Cross Loadings

	FinRes	DynCap	ComAdv
DT_PROD	0.711	0.511	0.319
DT_RENT	0.901	0.433	0.290
DT_SALES	0.807	0.318	0.376
DT_SHARE	0.693	0.278	0.450
DT_DIFF	0.459	0.360	1.00
INNOVATION	0.459	0.914	0.416
SEIZING	0.497	0.947	0.329
SENSING	0.426	0.872	0.217

The impact that Dynamic Capabilities had on the Financial Results was 0.392 (figure 8) (measuring the level of effect´s influence) ($p<0.05$). The structural equation model goodness-of-fit with a coefficient of determination R2 of 0.312, and size effect of determination f2 of 0.204. According to Cohen an f2 greater than 0.15 is considered a medium.

Table 60. Hypotheses results

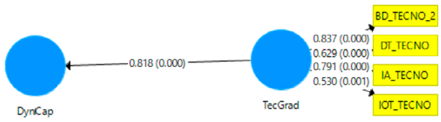
	Sample[1]	SD[2]	t [3]	P-value	Acceptance/ Rejection of the hypotheses
Competitive Advantage -> Financial Performance	0.318	0.166	1.915	0.056	**Accepted**
Dynamic Capabilities -> Competitive Advantage	0.361	0.154	2.342	0.019	**Accepted**
Dynamic Capabilities -> Financial Performance	0.392	0.148	2.649	0.008	**Accepted**

[1]Mean; [2]Standard deviation; [3]t Statistics.

5.2.4. Considering that technological adoption is a prerequisite for Dynamic Capabilities

Cases	Higher the technological adaptation level, the higher the generation of dynamic capabilities

Figure 9. Structural equation model among the capabilities identified.



Source: Author´s own (2021).

Table 61. Summary of the Constructs Reliability and Validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
TecGrad	0.654	0.685	0.796	0.501

Source: Author´s own (2021).

Tabla 62. Outer loadings

	TecGrad
BD_TECNO_2	0.837
DT_TECNO	0.629
IA_TECNO	0.791
IOT_TECNO	0.530

Source: Author´s own (2021).

As for the discriminant validity criterion, the cross-loadings matrix (Table 3) obtained by correlating the values of each latent variable with all the other indicators (Chin 1998) was considered. The loadings of each indicator are variable with respect to the other constructs with which they have been correlated. The loadings of each indicator, in general, are, as expected, higher on its own construct than on the others.

Table 63. Cross-Loadings Matrix

	TecGrad
BD_TECNO_2	0.837
DT_CONTA	0.403
DT_DIFF	0.275
DT_PROA_1	0.325
DT_PROA_2	0.496
DT_PROA_3	0.687
DT_PROD	0.561
DT_RENT	0.312
DT_SALES	0.183
DT_SATIS	0.511
DT_SHARE	0.084
DT_TECNO	0.629
IA_TECNO	0.791
INNOVATION	0.784
IOT_TECNO	0.530
SEIZING	0.725
SENSING	0.730

Source: Author´s own (2021).

As a final step in the validation process of the external model, we confirmed the assessment of its discriminant validity following the Fornell-Larcker criterion (Fornell and Larcker, 1981), see Table 64. This criterion requires that a latent variable share more variance with its assigned indicators than with any other latent variable. Consequently, the square root of the AVE of each latent variable must be greater than its correlation with any other latent variable.

Tabla 64. Discriminant Validity. Fornell-Larecker Criteria

	CompAdv	CustSatis	DynCap	FinRes	TecGrad
TecGrad	0.275	0.641	0.818	0.405	0.708

Source: Author´s own (2021).

Table 65. Total Indirect Effects

	CompAdv	CustSatis	DynCap	FinRes	TecGrad
TecGrad	0.289	0.541		0.423	

Source: Author´s own (2021).

Table 66. Cases

	Parameter Value	P-Value	Acceptance/ Rejection of the hypothesis
TecGrad	0.818	0.000	Accepted

Source: Author´s own (2021).

Therefore, based on the aforementioned results between Tables 61 and 66 and observing the structural model presented in Figure 9, we can affirm that:

Cases: the higher the level of technological adaptation (measured through the indicators BD_TECNO_2, DT_TECNO, IA_TECNO and IOT_TECNO), the higher the generation of dynamic capabilities; this relationship was effectively proven (0.818; p=0.000). It is then understood that, with the adoption of technologies, the company has tools that will facilitate the transformation of its ordinary capabilities into dynamic capabilities and thus the ability to adapt to the changes occurring in the environment.

- **Case A:** the higher the level of technological adoption, the higher the generation of dynamic sensing capability. This relationship is fulfilled, because it has been effectively proven. This allowed us to assume that companies with technological tools will be able to take advantage of those tools to detect the opportunities and threats offered by the environment.

- **Case B:** the higher the level of technological adaptation, the greater the generation of dynamic seizing capability. This relationship is fulfilled, because it has been effectively proven. Companies that are capable of managing technology can use that technology to make strategic changes that add value to their production system and bring greater benefits.

- **Case C:** the higher the level of technological adaptation, the higher the generation of dynamic innovation capability. This relationship is fulfilled, because it has been effectively proven. It is understood that companies that adopt technology can use it to generate new products and services.

CHAPTER 6.

DISCUSSION, CONCLUSIONS, AND FUTURE LINES OF RESEARCH

This sixth chapter sets out the different discussions that have led to the results obtained, as well as the main conclusions of the study. In addition, the limitations encountered in carrying out the work and the resulting lines of research are discussed.

CHAPTER 6. DISCUSSION, CONCLUSIONS, AND FUTURE LINES OF RESEARCH

6.1. DISCUSSION

6.1.1. Measurement of Dynamic Capabilities: Proposed Indicators

From the study developed, it was possible to verify the fulfilment of hypothesis 1 (H1) – that is, the sensing capability measured through the indicators BD_SENS_1, BD_SENS_2, DT_SENS_1, DT_SENS_2 and IOT_SENS positively influences the capability of seizing; this is accepted because this relationship is considered proven based on the theoretical review, which highlights the importance of the information that companies obtain from the context. A proof of this is Big Data, which is used to determine the opportunities and threats presented by the environment; from Big Data, the company can learn about customer needs (Zhan *et al.,* 2018). Big Data also provides information about the number of customers visiting a website (Tran and Houng, 2016). Graphs can also be used to analyse customer satisfaction surveys (Kennett *et al.,* 2011) and understand consumers' decision-making processes (Hofacker *et al.,* 2016).

The automation of processes carried out within the organization, such as the sales force, managed through technological resources such as mobile phones and tablets, allows the company to maintain contact with customers, perform sales operations and keep informed of what is happening in the market (Kotler and Armstrong, 2003). The use of social networks also helps companies to share information with people interested in their products in real time and build a closer relationship with their customers (Utz and Breuer, 2019). In the case of the automotive industry, digital technology has also enabled the introduction of sensors in vehicles that allow contact with customers, detection of dangerous situations and accident prevention; mobile phones applications have even been developed to estimate dangerous road situations and assist the driver to avoid collisions (Bhatti *et al.,* 2019). The capability of sensing thus positively influences the capability of seizing, as expressed by Lee and Yoo (2019), because the company, by developing the capability, can be aware of the opportunities and needs of the environment and take advantage of this information to create new products and processes that will create competitive advantages (Teece, 2007).

Regarding hypothesis 2 (H2), the seizing capability measured through the indicators BD_SEIZ_1, BD_SEIZ_2, DT_SEIZ_1 and IOT_SEIZ positively influences the capability for innovation is accepted, because this relationship is considered proven. This statement is made based on the fact that Big Data analysis has become a source of innovation and competition, because it brings greater value thanks to the information obtained from customers (Holmlund *et al.,* 2020). These data are transformed into knowledge to make business decisions and address customer problems (Akter and Wamba, 2016). In the automotive industry, the evolution of digital technology through tools such as the internet, artificial intelligence and sensing technology have influenced the maintenance model. Predictive maintenance has become a solution to address smart manufacturing and estimate the condition of equipment, diagnosing failures and assessing the remaining lifetime (Zhang *et al.,* 2019). The possibility of manufacturing and placing sensors in vehicles will increase along with the rise of the internet of things, because with the increase of sensors, the amount of data that will be a source for the development of machine learning algorithms for preventive maintenance will also increase (Borgi *et al.,* 2017).

In companies aligned with digital transformation, the available technological resources – such as technical equipment, data storage devices, software and communication networks, among others – are used to provide customer service (Laudon and Laudon, 2006). Authors such as Lucas *et al.* (2013), and Yoo *et al.* (2012) believe that digital technologies offer more flexible environments to create new organizational forms with customers, and as expressed by Hildebrandt *et al.* (2015), vehicle OEMs that have heterogeneous knowledge of digital technologies and that can integrate them into their companies and commercialize this knowledge are better prepared to face the digital transformation.

As for hypothesis 3 (H3), the sensing capability measured through the indicators BD_SENS_1, BD_SENS_2, DT_SENS_1, DT_SENS_2 and IOT_SENS does not positively influence the capability for innovation, so H3 is not accepted. It should be noted, however, that according to Teece (2007), with the information about the opportunities and threats obtained from the environment, an organization can make decisions to modify or create new products and processes, so seizing does influence the capability for innovation, but in this study, this relationship was not proven through the indicators used.

Finally, for hypothesis 4 (H4), it is accepted that the sequence of the adaptation process of dynamic capabilities is sensing, seizing and innovation. Although H3 did not exert a direct influence on innovation, it did have an indirect influence, so the influence is twofold, direct and indirect. This supports the view of Teece (2007), who states that the development of dynamic capabilities is primarily about detecting, seizing new opportunities and transforming or reconfiguring resources to increase performance, rather than analysing and optimizing the current resource base. Dynamic capabilities do not necessarily have a direct effect on performance, but rather an indirect effect through their influence on a firm's resource base (Battisti and Deakins, 2017). Consequently, these dynamic capabilities are essential to promote creativity, and when strong, they make a firm able to cope with the uncertainty of innovation and competition (Rotjanakorn *et al.,* 2020). It should be noted that the automotive industry is continuously affected by the introduction of new technologies, which makes it necessary for organizations to adapt to the fast pace of growth. It is thus necessary to take into account the dynamic capabilities that these companies have, which also exceed the core competencies, to be in continuous observation of the changes in the environment and thus ensure the permanence of the industry in the market.

6.1.2. Impact of Dynamic Capabilities on Customer Satisfaction

We have evaluated how digital transformation has impacted customer satisfaction in the automotive industry through the deployment of dynamic capabilities – concretely sensing, seizing and innovating (Marcoulides and Sanders, 2006). The relationships among dynamic capabilities and customer satisfaction are clearly visible actions from the marketing perspective, as dynamic capabilities mainly appear inside the company and customer satisfaction is external, in the marketplace. Subsequently, both were related through SEM. Our primary focus was to investigate whether the dynamic capabilities of sensing, seizing and innovation could be grouped to build a reliable indicator. Dynamic capabilities were also examined to determine how their deployment might increase customer satisfaction (Breidbach and Brodie, 2017). The main interest of this work lies in the theoretical contribution to the development of the dynamic capabilities construct, such as the integration of innovation capabilities, sensing and seizing, and the quantitative link of dynamic capabilities through digital transformation to customer satisfaction in the automotive sector.

6.1.2.1 Dynamic Capabilities Construct

Dynamic capabilities enable enterprises to develop intangible assets to maintain processes for sustainable performance (Teece, 2007). Several studies have focused on a double aspect, on the one hand identifying the dimensions of dynamic capabilities, which can be disaggregated into the dimensions of sensing, seizing and innovation reported by several authors (Bendig *et al.,* 2018; Dixon *et al.,* 2014; Kevill *et al.,* 2017; Martinez de Miguel *et al.,* 2022; Roy and Khokle, 2016). On the other hand, dynamic capabilities in the automotive sector have also been widely described (Alves, 2011; Camuffo and Volpato, 1996; Christensen, 2011; Leite *et al.,* 2017; Makkonen *et al.,* 2014; Mamun, Muhammad and Ismail, 2017; Mesquita *et al.,* 2013. Nakano, Akikawa and Shimazu, 2013; Rotjanakorn, Sadangharn and Na-Nan, 2020). The present work is novel because the dimensions of sensing, seizing and innovation in the automotive sector were grouped for the first time into a construct that we have called dynamic capabilities; similar models have been constructed by Mutmainah *et al.* (2015) in higher education. Subsequently, the dimensions of the dynamic capabilities considered independently of each other were linked to the results – technological development or innovation (Rotjanakorn *et al.,* 2020).

Sensing capability acts positively on seizing capability. Seizing directly influences the capability for innovation, because the new opportunities identified are used to create new products and services (Garrido *et al.,* 2020) Consequently, the capability of sensing positively influences the capability of seizing, as expressed by Lee and Yoo (2019), because the company can be aware of the opportunities and needs of the environment and take advantage of this information to create new products and processes that will allow innovation. Innovation activities are carried out with the purpose of favouring the survival and growth of the company, because a company that offers superior value to the competition intervenes in the purchase intention and behaviour of customers, thus yielding the best results (Zhan, Tan and Li, 2018). As reflected in the theory, companies obtain valuable information from the context, and, in this way, they learn about the needs of their customers and act accordingly

6.1.2.2 Customer Satisfaction Construct

The customer satisfaction construct showed a strong relationship with the five indicators of satisfaction considered. These results showed how the market is changing bidirectionally, to the extent that digital transformation has enabled companies to identify the real needs of customers, contact them and solve their problems (Piccinini *et al.,* 2015). On the one hand, customers are increasingly demanding more information and are looking for products adapted to their demands (Canfield and Basso, 2016). On the other hand, the market has increased its diversity and offers multiple options from which they can choose (Koch and Windsperger, 2017).

In view of the fact that the market offers customers multiple options from which they can choose, they demand personalized attention, quality and novelty in terms of products and services (Schwertener, 2017). As expressed by Stark (2011), companies manage to adapt to the needs of their customers by offering innovative, quality and environmentally friendly products. Consumers know that any company can satisfy their tastes and preferences, and this is something that every company desiring differentiation must understand (Gil-Lafuente and Luis-Bassa, 2011). Companies that listen to their customers' needs and understand those needs hold the key to the development of new products and services (Nordberg, Campbell and Verbeke, 2003).

In this sense, customer satisfaction – through digital transformation – is oriented (connected to customer, improve their experience, influence on their purchase decision mainly) to give the customer information regarding whether the chosen company is doing the right thing to respond to their demands (Lemon and Verhoef, 2016).The focus of digital transformation within an automotive company must be to be connected to the customer to improve their experience, either from the point of view of product quality or by improving connectivity (Von Leipziga *et al.,* 2017).

This research, with its models and hypotheses, has focused on increasing customer knowledge and making processes more efficient, for which quantitative models are provided. Digitalization transforms the nature of products and the value creation process, so companies can make unlimited combinations of products and services and thus integrate customer preferences into the joint creation of value (Davenport *et al.,* 2019). In companies aligned with digital transformation, the available technological resources, such as technical equipment, data storage devices, software and communication networks, among others, are used to provide customer service (Laudon, 2020). Authors such as Lucas *et al.* (2013) and Yoo (2010) have reported that digital technologies offer more flexible environments to create new organizational forms with customers, and as expressed by Hildebrant *et al.* (2015), vehicle OEMs with heterogeneous knowledge of digital technologies, can be integrated into companies to commercialize this knowledge, making them better prepared to face the digital transformation.

Companies know that it is important to take the initiative to find out what customers' needs are and what opportunities they have to satisfy them (Ulwick, 2002). Once the organization has detected the customer's need and the opportunities available, managers focus on developing skills to exploit the potential of the opportunities detected and use them in the development of new products, processes, business and services (Carattoli, D'annunzio and Dupleix, 2014). This measurement will help to develop active process improvement strategies to raise customer satisfaction and thus improve managerial performance for seeking better results in the sector.

6.1.2.3. Effect of Dynamic Capabilities on Customer Satisfaction

There is a lack of research examining customer satisfaction in the context of digital transformation, and we found an insufficient number of papers investigating the link between customer satisfaction and dynamic capabilities in the automotive sector (Sionji-Elias *et al.*, 2020), although massive investments have been made in digital transformation and technology acceleration by both global and domestic IT companies (Nguyen *et al*, 2021). In this paper, hypothesis 5 (H5) was accepted, according to which dynamic capabilities contribute positively to customer satisfaction in the automotive industry. Knowing this quantitative relationship through SEM is of great value, as an improvement in dynamic capabilities contributes to an increase in customer satisfaction (Borch and Madsen, 2007).

The dynamic capabilities selected are essential to promote creativity, and when strong, they make any firm able to cope with the uncertainty of innovation and competition (Rotjanakorn *et al.*, 2020). Consequently, it is necessary to take into account the dynamic capabilities that these companies have, which exceed the core competencies, to be in continuous observation of the changes in the environment and thus ensure the viability of the firm. Digital transformation brings benefits to the automotive industry, among which the following can be highlighted: a) improvements in the products adapted to customers demand; b) development of new offers with multiple options from which customers can choose; c) change in commercial strategies for selling a product, focusing on the customer experience; and d) personalized attention and quality in terms of products and services. One of the greatest benefits that digital transformation brings to companies is the number of channels of interaction with customers, which allows them to obtain the necessary information about customer requirements, preferences and experiences (Berman, 2011).

Customers can gain information from any device with internet access, and in any language, which allows them to compare quality attributes, prices and recommendations from other users or customers (Canfiel and Basso, 2016). Customer satisfaction through digital transformation is thus oriented to give customers information regarding whether the chosen company is doing the right thing to respond to their demands (Christensen, Hall Dillon and Duncan, 2016).

6.1.3. Impact of Dynamic Capabilities on Financial Results

In this research, we evaluated the roles that dynamic capabilities through sensing, seizing and innovation play through digital transformation on financial results in the automotive sector. The construct was related to financial results through SEM. Our primary focus was investigating if dynamic capabilities might increase financial performance, and we have also investigated the effect of competitive advantages as a mediator that transmits the effects of dynamic capabilities to financial results. Therefore, the main interest of this work was the quantitative link of dynamic capabilities through digital transformation on financial performance in the automotive sector.

First, the results showed that the generation of dynamic capabilities through digital transformation enable the automotive organization to improve the financial performance. Digital transformation allows organizations to make unlimited combinations of products and services, establishing new forms of value creation to shape and make strategy decisions that benefit them in terms of financial results. The present research provides evidence that is essential for implementing a digital transformation process that adapts the volatility of the automotive industry to the generation of dynamic capabilities associated with an increase share of market, developing new revenues satisfying the customer needs which are constantly emerging, improving the productivity of the organization and leveraging profitability. These reasons explain the confirmation of H6.

Second, this paper explains that the use of dynamic environments must not be centred just on financial results, but also on the generation of dynamic capabilities and the achievement of competitive advantages. Through H2, the results showed that the generation of dynamic capabilities through digital transformation enables the automotive industry to compete in turbulent environments, adapting itself to constant changes. Clearly, not all organizations within the sector have dynamic capabilities that enable the firm to react in time in the face of threats and existing opportunities, correcting weaknesses and reinforcing strength. Those that do possess these capabilities have a differentiated positioning in the market, which is an essential source for the generating of sustainable competitive advantages (Kozlenkova, Shamaha and Palmatier, 2014). The development of specific skills to compete in the market is essential to generate customer value, either through products and services which have a high quality–price relationship or with a level of differentiation enabling premium positioning in the market (Vivas López, 2005). This fact explains the direct positive effect of dynamic capabilities on the generation of competitive advantages, confirming H7.

Third, in changing environments, the generation of competitive advantages must be the epicentre of organizations' strategic orientation (Newbert, 2008). The company that wishes to compete must carry out global and continuous activities to develop competitive strategies that will allow it to maintain and increase the number of customers and thus its profits. For example, all activities that are executed efficiently, but are not creating value, should be reviewed to evaluate the potential of digital transformation (Gómez Ortiz, 2018). The most successful ones must offer a quick and consistent response to customer demands, because those strategic changes can lead to value creation which can be promoted to generate incremental financial results. These advantages of costs, differentiation or efficiency will be essential for the organization to continue growing, improving the customer loyalty and increasing organizations' profitability, and will positively influence financial performance, thus confirming H8.

In conclusion, the growth of sustainability and electrification is affecting the automotive industry via continuous digital transformation. Organizations need to adjust quickly and pay attention to dynamic capabilities that are superior to basic abilities and monitor the changing environment. Organizations need to be able to manage change under a volatile environment if they want to survive. Just developing basic abilities may not be enough for the changing environment. Organizations should focus on developing dynamic capabilities as innovation, along with creating competitive advantages in cost leadership and/or differentiating in products and services, is the strategy for attaining the desired results.

The objective was to resolve this controversy by proposing and testing a mediating mechanism between dynamic capacity and firm results within the automotive industry. The results indicate that competitive advantage acts as a mediating mechanism between dynamic capabilities and firm performance, while there also appears to be a direct effect of dynamic capabilities on financial results. Companies can use these research results as a foundation to first understand and then to plan and determine ways to develop and deploy dynamic abilities. Continuous adaptation to the changing environmental and technological conditions will ensure competitive advantage and successful financial results.

6.2. CONCLUSION

The automotive industry is an important driver of growth and prosperity worldwide, due to its social contribution, by facilitating people's mobility in an efficient, safe and affordable way, and due to its economic contribution, as a driver of innovation, a generator of quality employment and a pillar of international trade. There is also a need for automotive companies at critical and unexpected moments, such as the one we are currently experiencing because of the COVID-19 pandemic, to develop processes that allow operating in the virtual context, and this is one of the contributions of this paper.

In this research, we have contributed to identifying the relations between digital transformation and the micro-foundations of dynamic capabilities within the automotive sector. Although there is a consensus in the academic literature on the importance of the development of dynamic capabilities to achieve sustainable competitive advantages over time, this review on the measurement of dynamic capabilities revealed the diversity of studies in this field and defined indicators to measure these capabilities in practice.

This research opens new paths for knowledge in the automotive sector. Sensing, seizing and innovation dimensions were grouped in a reliable indicator called dynamic capabilities. The relationship between the dynamic capabilities construct and customer satisfaction via SEM was the main finding of this research.

In compliance with each specific objective of this research, the indicators used to determine each of the dynamic capabilities were suitable. The indicators used to determine the influence of sensing, seizing and innovation capability were adequate for this purpose. The five indicators proposed to determine customer satisfaction through digital transformation were also suitable. Finally, the relationship between dynamic capabilities and customer satisfaction has been quantified.

Of all the dynamic capabilities evaluated, the one with the greatest influence on customer satisfaction is the capability of sensing, at least in this study, which could be explained because the company, having implemented the technological tools allowed closer contact with the customer, determining their needs and detecting their priorities, which is the first step in making decisions that will give rise to business objectives and make the customer feel cared for, and these were taken into account for the decisions carried out by the organization. The main conclusions of this research on the digital transformation indicators from the tested hypotheses are:

- The sensing capability influences seizing capability.
- The seizing capability influences the capability for innovation.
- The process sequence of adapting dynamic capabilities is sensing, seizing and innovation.
- Dynamic capabilities influence customer satisfaction.
- Dynamic capabilities influence financial results.
- Dynamic capabilities influence the creation of a competitive advantage.
- Competitive advantages influence financial results.
- The higher the technological adaptation level, the higher the generation of dynamic capabilities.

This research has shown that the automotive industry is continuously affected by the introduction of new technologies, which makes it necessary for organizations to adapt to the fast pace of growth. Companies that understand the importance of digital transformation show more modern work styles, consider user preferences and the information they can obtain from context. The results also show that by generating dynamic capabilities, firms can achieve better customer satisfaction, higher financial results and the creation of competitive advantage.

6.3. LIMITATIONS

From a practical perspective, the results are significant, and the model used is recommended. However, the research presents some limitations that should be considered when contextualizing the work done. First, the most representative limitation is the difficulty of obtaining a larger sample, as, out of 142 surveys, only 42 responses were obtained, due to the limited time respondents had to give to the researcher. The study should also be extended to other group of stakeholders at automotive sector. Second, another important limitation is that we do not know the internal organization of the companies where the interviewed people work, so answers may not be fact based; The responses are based on the beliefs of individuals, although majority were executive. Third, this study has been conducted within a narrow geographic context (Europe), and it should be extended to samples from a wider area such as Asia or North America. Fourth the model validated allowed us to measure the impact of digital transformation on dynamic capabilities. Other models should be applied to measure the influence among the different indicators. Although the terms digital transformation and dynamic capabilities are used extensively in the review of literature, the difficulty has been to find papers and investigations within the automotive sector. Finally, the sample and questionnaire were applied before and during the COVID-19 pandemic, so we assume that after this period many companies are likely to have significantly accelerated and transformed digitalization within the organization.

6.4. FURTHER RESEARCH AREAS

We consider that this research offers, in a very innovative way, a large number of indicators for measuring the generation of dynamic capabilities through digital transformation in organizations within the automotive sector. The results of this thesis suggest the following future avenues for research: the first would be to extend this study to other types of companies from different sectors to allow the measurement of the success of organizations based on their dynamic capabilities. The second would be to extend this study to other types of dynamic capabilities, to allow the measurement of the relation and the influence with the indicators selected. The third would be to extend this study to other types of indicators within the digital transformation to measure the impact within the dynamic capabilities selected. It would also be useful to broaden the sample of experts consulted to try to reach a better consensus on the different indicators selected. Future researchers could also delve into the relationship between the construct of dynamic capabilities with company results and the acquisition of competitive advantages through digital transformation within the automotive sector. Finally, it could also be fruitful to extend this study to other type of companies within the automotive sector such as producers of axles, brakes systems, or telematic companies. The present research provides valuable information on the degree of digital transformation and the generation of dynamic capabilities in the automotive sector, with a high confirmation of the contrasted and accepted hypotheses.

CHAPTER 7.

REFERENCES

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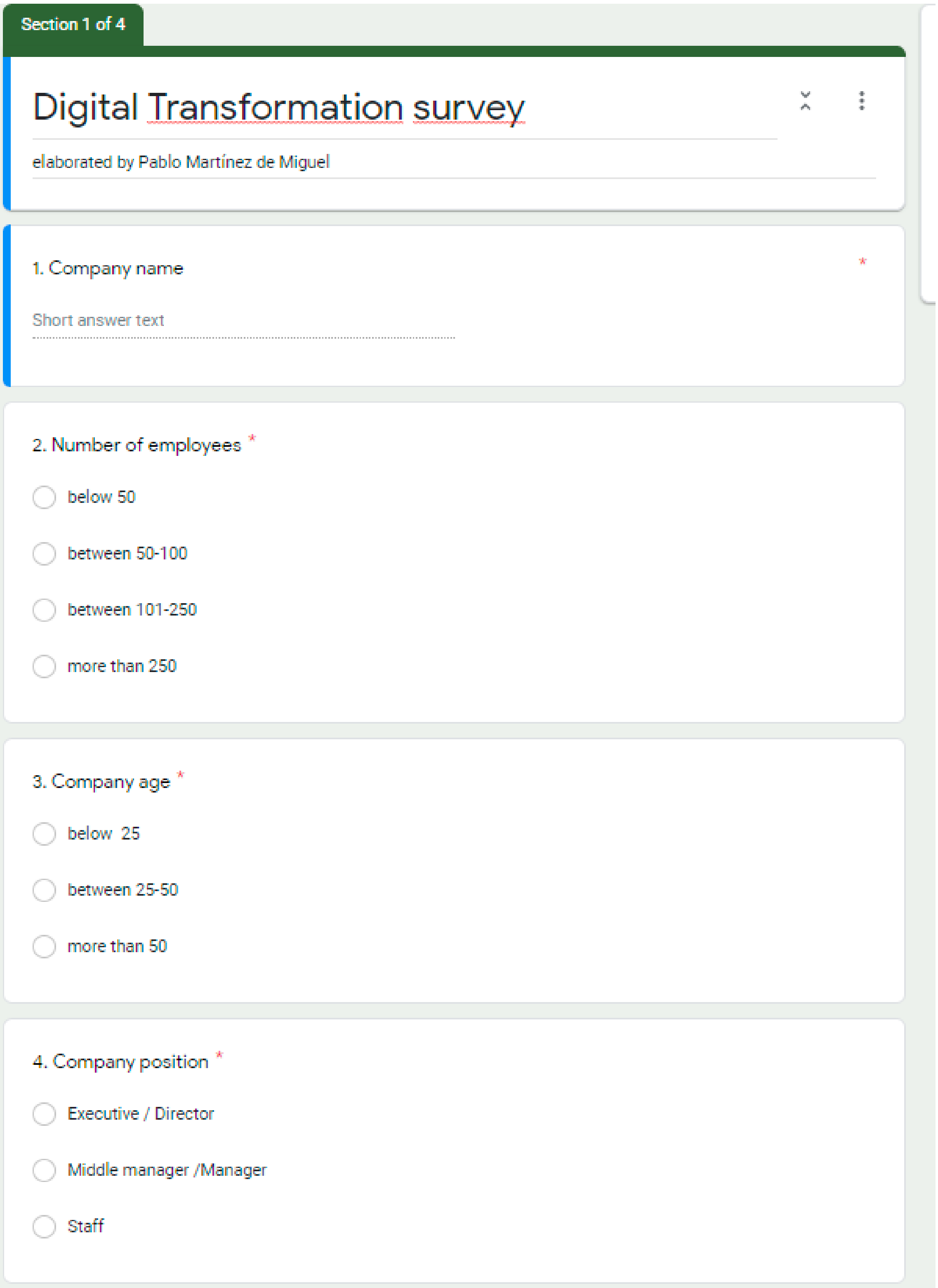
CHAPTER 8.

ANNEXES

Annex 1. Survey (link)

https://docs.google.com/forms/d/1xk7Ek6IoeNi6SyxsTroKrT10Ir34bn9MwT9LCejiAq0/edit



Section 1 of 4

Digital Transformation survey

elaborated by Pablo Martínez de Miguel

1. Company name *

Short answer text

2. Number of employees *

- below 50
- between 50-100
- between 101-250
- more than 250

3. Company age *

- below 25
- between 25-50
- more than 50

4. Company position *

- Executive / Director
- Middle manager /Manager
- Staff

5. Gender *

- ◯ Male
- ◯ Female

6. Age *

- ◯ below 25
- ◯ 25-50
- ◯ more than 50

7. Sector *

- ◯ Automotive
- ◯ Automotive components, accessories and spare parts

8. Company operations *

- ◯ Spain (only)
- ◯ Europe (only)
- ◯ Global

9. How often do you use RFID technology to optimise the vehicle production chain, improve logistics and quality mechanisms? *

- ◯ Never (once per year or none)
- ◯ Rarely (once per semester)
- ◯ Occasionally (every three months)
- ◯ Frequently (on a monthly basis)
- ◯ Constantly (on a weekly basis)

10. How often do you use ARTIFICIAL INTELLIGENCE? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

11. How often do you use TECHNOLOGY INFORMATION (sensors, etc.) in decision-making (manufacturing, logistics, human resources, etc.)? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

12. How often do you create PREDICTIVE MODELS by cross-referencing data collected from devices and sensors? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

13. How often do you use DIGITAL TECHNOLOGY (IoT, IA, Big Data) to get to know the customer? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

14. How often do you use BIG DATA for purchasing behavior analysis? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

15. How often do YOU USE ALERTS installed in customers' *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

16. How often is the DEGREE OF INNOVATION OF COMPETITION IDENTIFIED through networked devices? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

17. How often do YOU USE NETWORKING WITH OTHER *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

18. How often does technology UNIFY SYSTEMS GLOBALLY across your plants and logistics centers? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

19. How often are PREDICTIVE MODELS used to ANTICIPATE WEAR of parts have had an impact on the vehicle's maintenance cost? *

- Never (once per year or none)
- Rara vez (una vez por semestre)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

20. How often has digital technology enabled the sales force to OPTIMIZE ROUTES? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

21. How often has digital technology made it possible to CONNECT ALL BUSINESS DIVISIONS under one direction? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

22. How often has digital technology allowed us to make decisions about ORGANISATIONAL CHANGES? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

23. How often has digital technology developed solutions to PREVENT ACCIDENTS? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

24. How often do you use sensor integration or data management to make COMMERCIAL ALLIANCES with suppliers or/and customers? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

25. How often do insurance companies contact your company to offer a CUSTOMIZED PRODUCT depending on the driving style by the data you collect directly from the vehicle? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

26. How often is it able to advance in the PRODUCT DESIGN to acceptance according to real tastes, education, geographical areas, etc. through Big Data? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

27. How often does digital technology allow you to estimate THE DURABILITY of the different parts that make up the product? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

28. How often do you use digital technology to know when the customer WILL CHANGE THE PRODUCT, the type of product you are going to look for, color, features in order to anticipate it and thus launch the user a communication that makes you purchasing it? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

29. How often does the digital transformation allow your company to ANTICIPATE FUTURE CAR FAILURES allowing the connection with the workshop, being able to make an appointment, even before such a failure occurs? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

30. How much has digital transformation allowed us to increase our MARGIN ON SALES? *

- Nothing
- A few (0,5-0.99%)
- Average (1% - 1,49%)
- Quite (between 1,5% - 2.99%)
- A lot (more than 3%)

31. How much has digital transformation allowed us to increase the production process (PRODUCTIVITY)? *

- Nothing
- A few (0,5-0.99%)
- Average (1% - 1,49%)
- Quite (between 1,5% - 2.99%)
- A lot (more than 3%)

32. How much has the digital transformation allowed us to increase FINANCIAL PROFITABILITY (EBIT)? *

- Nothing
- A few (0,5-0.99%)
- Average (1% - 1,49%)
- Quite (between 1,5% - 2.99%)
- A lot (more than 3%)

33. How much market share has digital transformation allowed us to win? *

- Nothing
- A few (0,5-0.99%)
- Average (1ppt - 1,49ppt)
- Quite (between 1,5ppt - 2.99ppt)
- A lot (more than 3ppt)

34. To what extent has digital transformation enabled us to identify the REAL needs of customers? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

35. To what extent has it enabled us to CONTACT customers and solve the problems of digital transformation? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

36. To what extent has it allowed us to be in direct contact with the customer by allowing us to collect data in order to OFFER PRODUCTS and/or ADDITIONAL SERVICES to the current ones anticipating your digital transformation needs? *

- Never (once per year or none)
- Rarely (once per semester)
- Occasionally (every three months)
- Frequently (on a monthly basis)
- Constantly (on a weekly basis)

37. To what extent has the digital transformation made it possible to REDUCE VEHICLE ACCIDENTS? *

- Nothing
- A few (0,5-0.99%)
- Average (1% - 1,49%)
- Quite (between 1,5% - 2.99%)
- A lot (more than 3%)

38. To what extent has the installation of sensors, predictive models and algorithm learning achieved MORE EFFICIENT DRIVING? *

- Nothing
- A few (0,5-0.99%)
- Average (1% - 1,49%)
- Quite (between 1,5% - 2.99%)
- A lot (more than 3%)

39. VALUE ADDED SUPPLY THROUGH DIGITAL TRANSFORMATION *

- Improved
- Deteriorated

40. Our BUSINESS MODEL through digital transformation has: *

- Improved
- Deteriorated

41. Digital transformation has allowed us to DIFFERENTIATE ourselves from competition in time *

- Nothing
- Little: by identifying opportunities
- Average: taking advantage of such opportunities
- Quite a lot: innovation products/services
- Totally creating a sustainable advantage for at least 1 year

Annex 2. Email sent

De : Pablo Martinez De Miguel
Enviado : viernes, 3 de julio de 2020 18:45
A : XXXXXXXXXX
Cc : p.martinezde@alumnos.urjc.es
Objeto : Cuestionario_Tesis

Dear Colleague:

This questionnaire is part of my doctoral project.

This survey is for an academic use only and is completely confidential.

Your name will never be associated with any response. The results will be presented only in statistical form and in an overall summary format.

Please click on the following link to start the survey:

https://forms.gle/5TrKS8VsCdgHc31f9

Thanks to your participation, I will be able to provide you with the results during the last quarter of the year.

Thank you in advance for taking the time to complete this questionnaire.

Atentamente,
Pablo Martínez de Miguel.
Doctorando en Organización y Dirección de Empresas
Email: p.martinezde@alumnos.urjc.es
Móvil: 609.126.393

****

Estimad@ compañer@:

Este cuestionario es parte del proyecto de mi tesis doctoral.

Esta encuesta es de uso exclusivo para un propósito académico y es completamente confidencial.

Tú nombre nunca será asociado a ninguna respuesta. Los resultados serán presentados sólo de forma estadística y en un formato de resumen global.

Por favor, para comenzar la encuesta, haga clic en el siguiente link:

https://forms.gle/5TrKS8VsCdgHc31f9

Gracias a su participación, le podré hacer llegar los resultados durante el último trimestre del año.

Le agradecemos de antemano el tiempo dedicado a cumplimentar dicho cuestionario.

Atentamente,
Pablo Martínez de Miguel.
Doctorando en Organización y Dirección de Empresas
Email: p.martinezde@alumnos.urjc.es
Móvil: 609.126.393

A gentle reminder was sent to the entire audience to reinforce the need of having answers to the survey.

De : Pablo Martinez De Miguel
Enviado : jueves, 3 de septiembre de 2020 10:13
A : XXXXXXXXXX
Cc : p.martinezde@alumnos.urjc.es
Objeto : Cuestionario_Tesis_gentle reminder

Dear Colleague,

Would like to remind you the need of getting your response.

The collection data will be initiated by the month of November. Therefore the survey will be closed by the end of October.

Kindly ask you to respond to the following link:

https://forms.gle/5TrKS8VsCdgHc31f9

Thank you in advance.

Pablo Martínez de Miguel.
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Annex 3. Article 1

Esic Market Economics and Business Journal
vol. 53, n.º 1, enero-abril 2022, e283

Revisión de la medición de las Capacidades Dinámicas: una propuesta de indicadores para la industria del automóvil

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Recibido: 10-10-2021; Aceptado: 09-12-2021; Publicado: 31-03-2022

Resumen

Objetivo: El objetivo del trabajo es identificar las relaciones entre la transformación digital y los microfundamentos de las capacidades dinámicas dentro del sector de la automoción.

Metodología: Para lograr el objetivo anterior, el análisis se basa en una revisión bibliográfica y en juicios de expertos a través de una encuesta. Posteriormente, desde una metodología cuantitativa de análisis exploratorio se ha utilizado la correcta asignación de los indicadores, así como un análisis SEM de ecuaciones estructurales con variables latentes como técnica estadística.

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ESIC Business & Marketing School
https://revistasinvestigacion.esic.edu/esicmarket

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Martínez de Miguel, P., García Martínez, A., & Montes-Botella, J.-L., Revisión de la medición de las Capacidades Dinámicas: una propuesta de indicadores para la industria del automóvil. *Esic Market Economics and Business Journal*, *53*(1). e283 DOI: 10.7200/esicm.53.283

Resultados: Por tanto, a partir de los indicadores ya presentados, se ha podido establecer el modelo de relación. Se ha podido presentar cómo todos estos indicadores corresponden a capacidades dinámicas, y son las transformaciones digitales las que las generan.

Limitaciones: La investigación presenta algunas limitaciones que deben ser consideradas a la hora de contextualizar el trabajo realizado. La más representativa es la dificultad de obtener una muestra más amplia, ya que de 142 encuestas sólo se obtuvieron 42 respuestas, debido al escaso tiempo que tenían los encuestados para atender la investigación.

Implicaciones prácticas: la industria del automóvil se ve continuamente afectada por la introducción de nuevas tecnologías, lo que hace necesario que las organizaciones se adapten al rápido ritmo de crecimiento. Además, las empresas que entienden la importancia de la transformación digital muestran estilos de trabajo más modernos, consideran las preferencias de los usuarios y la información que pueden obtener del contexto.

Palabras clave: transformación digital; capacidades dinámicas; industria del automóvil; ventajas competitivas; capacidades de innovación

Códigos JEL: O15; J14; L26

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测量动态能力文献回顾：汽车行业指标建议

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Recibido: 10-10-2021; Aceptado: 09-12-2021; Publicado: 31-03-2022

文章摘要

研究目标：本研究的目标是确定数字化转型与汽车行业动态能力的微观基础之间的关系。

分析方法：为实现本研究的目标，本分析基于文献回顾和专家判断的调查结果。 随后，通过探索性分析的定量方法，正确使用了指标的分配，以及用潜在变量的结构方程的 SEM 分析作为统计技术。

研究结论：因此，基于已经提出的指标，建立关系模型。 已及在其模型的基础上展示这些数字化转型产生的指标如何与动态能力相对应。

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研究局限：本研究的局限性，最具代表性的是难以获得更大的样本，由于受访者参加调查的时间限制，在 142 次调查中仅获得了 42 份答复。

实际应用：汽车行业不断受到新技术引入的影响，因此组织有必要适应快速增长的步伐。此外，了解数字化转型重要性的公司表现出更现代的工作方式，考虑用户偏好以及他们可以从环境中获得的信息。

关键词：数字化转型、动态能力、汽车产业、竞争优势，创新能力

JEL 分类号：O15; J14; L26

1. Introducción

La industria de la automoción es un importante motor de crecimiento y prosperidad a nivel mundial, debido a su contribución social, al facilitar la movilidad de las personas de forma eficiente, segura y asequible, y a su contribución económica, como motor de innovación, generador de empleo de calidad y pilar del comercio internacional. En el caso de España, se ha convertido en un elemento clave de nuestra industria y en un referente a escala mundial, gracias a una gran capacidad de producción y a una elevada productividad, derivada de una mano de obra cualificada y de un alto nivel de automatización de las plantas. La crisis económica generada por la pandemia ha hecho mella en un sector que se encuentra en plena transformación tecnológica hacia la electrificación (Montoriol-Garriga y Díaz, 2021).

Las organizaciones deben ser capaces de reconfigurarse ante un mercado tan competitivo. Estas Capacidades Dinámicas (CD) permiten a las organizaciones sentir y dar forma a las oportunidades y amenazas, aprovechar las oportunidades y mantener la competitividad a través de la mejora, combinación, protección y reconfiguración de los activos intangibles y tangibles (Rotjanakorn *et al*., 2020).

Además, la necesidad que tienen las empresas en momentos críticos e inesperados, como el que estamos viviendo actualmente como consecuencia de la pandemia del Covid-19, de desarrollar procesos que permitan operar en el contexto virtual está siendo una de las motivaciones de este trabajo. Además, el 57% de los directores ejecutivos del sector de la automoción creen que no recuperarán el volumen de negocio anterior a la Covid hasta después de 2022 (KPMG, 2021)

Las capacidades dinámicas permiten a las empresas crear, desplegar y proteger los activos intangibles en un rendimiento sostenible (Teece, 2009). A efectos analíticos en el documento, vamos a desglosar las capacidades dinámicas en la capacidad de detectar y dar forma a las oportunidades y amenazas, aprovechar esas oportunidades y mantener la competitividad mediante la innovación. Teniendo en cuenta las inversiones que la industria del automóvil ha realizado en transformación digital en las últimas décadas (Faconauto, edición especial 2019 sobre movilidad y conectividad), determinar si el grado de transformación digital produce una mejora en los resultados financieros, una mayor satisfacción de los clientes y, por tanto, permite obtener una ventaja competitiva sostenible en el tiempo es clave.

El objetivo del trabajo es identificar las relaciones entre la transformación digital y los microfundamentos de las capacidades dinámicas dentro del sector del automóvil. El documento pretende investigar la naturaleza de la construcción de capacidades dinámicas para la innovación del modelo de negocio hacia la transformación digital en curso. Estos beneficios están en línea con los propuestos por De Pablos y López (2012), aunque el autor también hace referencia a la importancia de la información como activo, el proceso de cambio en las empresas y el aprendizaje organizativo.

Tras la introducción, a continuación, se presenta un marco conceptual en el que se realiza una completa revisión de la literatura sobre la medición de estas capacidades para identificar indicadores específicos para el sector de la automoción. A continuación, se ha construido un modelo de ecuaciones estructurales (SEM) para contrastar las relaciones entre los indicadores y las variables latentes. Para finalizar, se discute cómo estas capacidades permitirán obtener conocimiento sobre cada operación en comparación con la media y con las mejores prácticas.

2. Marco Conceptual

El análisis de la literatura realizado en este trabajo permite corroborar que existen pocos trabajos escritos previos que relacionen la transformación digital y las capacidades dinámicas aplicadas al sector de la automoción. Sin embargo, existen estudios que demuestran que la transformación digital ayuda a crear valor (Reddy y Reinartz, 2017), y artículos académicos que confirman la influencia que tiene la digitalización en los procesos de innovación de las empresas (Rachinger *et al*., 2018).

En base a esto, proponemos el siguiente diseño de investigación que se abordará a través de la Figura 1.

Figura 1. Diseño de la investigación

Fuente propia, 2020

2.1. Transformación digital

Con el auge de las nuevas tecnologías digitales, como la inteligencia artificial (IA), el internet de las cosas (IoT), el internet móvil y social, el blockchain y el big data, las empresas de casi todos los sectores están llevando a cabo múltiples iniciativas para explorar y explotar los beneficios de estas tecnologías (Fitzgerald *et al*., 2013; Ross *et al*., 2017). Esto implica necesariamente transformaciones de las operaciones empresariales clave y afecta a los productos y procesos, así como a las estructuras organizativas y los conceptos de gestión para llevar a cabo estas complejas transformaciones en toda la empresa (Matt *et al*., 2015)

Mientras tanto, la sociedad se enfrenta a cambios rápidos y radicales debido a la maduración de las tecnologías digitales y su poder para penetrar rápidamente en los mercados, al tiempo que aumentan las exigencias de los clientes y las organizaciones se enfrentan a una competencia más dura debido a la globalización (Bharadwaj *et al.*, 2013; Li *et al.*, 2018).

Warner y Wäger (2019) han observado que la transformación digital es utilizada de manera inconsistente por los líderes dentro y a través de las industrias para describir diversas actividades de estrategia y organización, lo que reafirma la importancia de definir este concepto, ya que no existe una categorización formal en la literatura académica y los límites del término son a menudo no muy claros (Reis *et al.*, 2018).

La Tabla 1 muestra una visión completa de las definiciones típicas según la literatura.

Tabla 1. Definiciones de Transformación Digital

Autor	Definición
Gaiardelli *et al.* (2011)	La transformación digital es un proceso de reinvención y reingeniería de un negocio para digitalizar una empresa. Esta transformación es la evolución digital deliberada y continua del modelo de negocio de una empresa, desde el punto de vista estratégico, táctico y operativo.
Schaible y Bouée (2015)	Es un proceso de cambio de mentalidad en el que las organizaciones deben descubrir las oportunidades que ofrece el mundo moderno en materia de digitalización.
Matt *et al.* (2015)	Las estrategias de transformación se centran en la transformación de los productos, los procesos y otros aspectos organizativos, incluida la interacción del usuario con la tecnología como parte integrante del producto o servicio.
Heilig *et al.* (2017)	Es sólo una aplicación de las TIC a los procesos de la organización.
Crespo y Pariente (2018)	Es el proceso de gestión que dirige la cultura, la estrategia, las metodologías y las capacidades de una organización basada en las tecnologías digitales.
Morakanyane *et al.* (2017)	Comprensión integral de la transformación digital basada en el proceso evolutivo, las capacidades digitales, los modelos de negocio de las tecnologías digitales, los procesos operativos y las experiencias de los clientes y la creación de valor
Linares (2018); Sánchez (2015)	Surge con un cambio en la forma de pensar, que requiere una modificación en la cultura, estructura y operaciones de las organizaciones.
Skog *et al.* (2018)	Es una disrupción total y un caos en el mundo de los negocios.

Fuente propia, 2020

2.2. Capacidades Dinámicas

Teece *et al.* (1997, pp. 509-510) definieron las capacidades dinámicas como "la capacidad de una organización para integrar, construir y reconfigurar competencias internas y externas para hacer frente a entornos extremadamente cambiantes". Para que una capacidad sea estratégica, debe cubrir una necesidad del cliente (para que haya una fuente de ingresos), debe ser única (para que a los productos/servicios producidos se les pueda asignar un precio sin tener en cuenta demasiado a la competencia) y difícil de replicar (para que los beneficios no tengan competencia). La Tabla 2 indica la definición de las Capacidades Dinámicas.

Tabla 2. Definiciones de las capacidades dinámicas

Autor	Definición
Collins (1994)	Capacidad de innovar y desarrollarse rápidamente.
Helfat (1997)	Competencias o capacidades que tiene la empresa para crear nuevos productos y responder así a las cambiantes demandas del mercado.
Teece *et al.* (1997)	Capacidad de la organización para integrar, construir y reconfigurar competencias internas y externas para su aplicación inmediata a entornos cambiantes.
Eisenhard and Martin (2000)	Hábitos estratégicos de la organización mediante los cuales realiza nuevas configuraciones de sus recursos para seguir el ritmo del mercado.
Zahra and George (2002)	Son las capacidades de las organizaciones para redistribuir y reconfigurar sus bases de recursos para satisfacer las demandas de los clientes y hacer frente a las exigencias de la competencia.
Winter (2003)	Capacidades para actuar y así ampliar, modificar o generar capacidades extraordinarias.
Vivas (2005)	Son procesos organizativos complejos y de alto nivel que crean las condiciones adecuadas para modificar y renovar los activos de la organización.
Peláez *et al.*(2008)	Coordinación de las competencias internas y externas, para adaptar la organización a un entorno rápidamente cambiante.
Tondolo *et al.* (2015)	Es la creación, renovación o integración de recursos, activos, capacidades, competencias y rutinas que permitirán a la empresa seguir el ritmo de los cambios que ofrece el entorno competitivo.
Teece and Leih (2016)	Son actividades de alto nivel que permiten a una empresa centrarse en la producción de bienes y servicios que ya tienen o pueden tener una gran demanda en el mercado.
Rotjanakorn *et al.* (2020)	La capacidad de una organización para cambiar y modificar la base de recursos actual mediante la exploración.

Fuente propia 2020

2.3. Transformación digital, capacidades dinámicas y sector del automóvil

El objetivo de la parte era identificar las relaciones entre la transformación digital con los microfundamentos de las capacidades dinámicas (detección, aprovechamiento e innovación) dentro del sector de la automoción.

El creciente ritmo de desarrollo de la tecnología digital afecta y aporta grandes cambios a todas las industrias (Schwertner, 2017). La aparición de innovaciones digitales está acelerando e interviniendo los modelos de negocio existentes al ofrecer oportunidades para nuevos servicios. Tomando como ejemplo el sector de la automoción, las principales tendencias, como los coches autónomos, la conectividad y el uso compartido de vehículos, están creando nuevos modelos de negocio. Al mismo tiempo, están dando lugar a nuevos participantes en el mercado, que empiezan a transformar la industria del automóvil (Llopis *et al.*, 2021).

En la Tabla 3 se hace una síntesis de la literatura encontrada:

Tabla 3. Resultado de la investigación: Transformación digital, capacidades dinámicas y sector de la automoción

Sección	Subsección	Referencia
Transformación Digital		Cohen and Schmidt (2013) Gaiardelli *et al.* (2011) Schaible y Bouée (2015) Warner y Wäger2019) Loonam *et al.* (2018) Reis *et al.* (2018) Fitzgerald *et al.* (2013) Ross *et al.* (2017) Matt *et al.* (2015) Bharadwaj *et al.* (2013) Li *et al.* (2018) Kaufman y Horton (2015) Schuchmann y Seufert (2015) Hess *et al.* (2016) Abdelaal y Zaki (2018) Venkatraman (1994) Vendrell-Herrero *et al.* (2016) Nochta *et al.* (2019) Hanelt *et al.* (2015) Rijswijk (2020)
	Digitalización, digitización y transformación digital	Kääriäinen *et al.* (2017) Brennen y Kreiss (2014) Bloomberg (2018) Stolterman y Fors (2004) Henriette *et al.* (2015) Jacobi y Brenner (2017) Schwertner (2017)
	Elementos de la transformación digital: IoT, Inteligencia artificital y Big Data	Ashton (2009) Gubbi *et al.* (2013) Mukherjee *et al.* (2017) Makridakis (2017) Schwab (2016) McAfee *et al.* (2012)

(Continúa)

Tabla 3. Resultado de la investigación: Transformación digital, capacidades dinámicas y sector de la automoción

Sección	Subsección	Referencia
Capacidades Dinámicas		Henderson y Cockburn (1994) Kogut y Zander (1992) Teece *et al.* (1997) Qaiyum y Wang (2018) Bendig *et al.* (2018) Roy y Khokle (2016) Karimi y Walter (2015) Kevill *et al.* (2017) Rotjanakorn et al. (2020) Helfat *et al.* (2007) Ambrosini y Bowman (2009) Huang y Li (2017) Cezarino et al. (2019) Akram y Hilman (2018) Tondolo *et al.* (2015) Schwertner (2017) Wagner y Wäger (2019) Eisenhardt y Martin (2000) Bharadwaj *et al.* (2013) Teece (2007) Kindström *et al.* (2013) Fisher *et al.* (2010)
	Micro-fundaciones	Bendig *et al.* (2018) Roy y Khokle (2016) Kevill *et al.* (2017) Teece (2007) Dixon *et al.* (2014) Kindström *et al.* (2013) Helfat y Peteraf (2015) Battisti y Deakins (2017)
	Sensing	Teece (2007) Helfat y Peteraf (2015) Roy y Khokle (2016) Akram y Hilman (2018) Zhou *et al.* (2019) Bendig *et al.* (2018) Battisti y Deakins (2017) Jacobi y Brenner (2017)
	Seizing	Matysiak *et al.* (2018) Teece (2007) Roy y Khokle (2016) Helfat y Peteraf (2015) Teece *et al.* (2016) Rigby *et al.* (2016)

(Continúa)

Tabla 3. Resultado de la investigación: Transformación digital, capacidades dinámicas y sector de la automoción

Sección	Subsección	Referencia
Capacidades Dinámicas		Kindström *et al.* (2013) Wang *et al.* (2018) Yeow *et al.* (2018) Karimi y Walter (2015)
	Innovación/transformación	Teece (2007) Helfat y Peteraf (2015) Bendig *et al.* (2018) Kindström *et al.* (2013) Hodgkinson y Healey (2011) Yeow *et al.* (2018) Eisenhardt y Martin (2000) Rotjanakorn *et al.* (2020) Teece et al. (1997)
Transformación digital y Capacidades Dinámicas		Jacobi y Brenner (2017) Schwertner (2017) Helfat *et al.* (2007) Jacobi y Brenner (2017) Teece *et al.* (1997) Matt *et al.* (2015) Eisenhardt y Martin (2000)
Sector de Automoción		Llopis *et al.* (2021) Fichman *et al.* (2014) Yoo *et al.* (2010) Simonji-Elias *et al.* (2014) Hanelt *et al.* (2015) Gao *et al.* (2016) Letiche *et al.* (2008) Perrott (2008) Möller *et al.* (2011) Berman y Bell (2011) Chanias y Hess (2016) Hildebrandt *et al.* (2015) Keller y Hüsig (2009) Piccinini *et al.* (2015) Fitzgerald *et al.* (2013) Lucas *et al.* (2013) Gregory *et al.* (2015) Remane *et al.* (2016)
	Transformación digital y sector automoción	Fichman *et al.* (2014) Gao *et al.* (2016) Yoo *et al.* (2010) Hanelt *et al.* (2015) Letiche *et al.* (2008) Perrott (2008) Möller *et al.* (2011)

(Continúa)

Tabla 3. Resultado de la investigación: Transformación digital, capacidades dinámicas y sector de la automoción

Sección	Subsección	Referencia
		Fitzgerald *et al.* (2013) Lucas *et al.* (2013) Berman y Bell (2011) Matt *et al.* (2015) Riasanow *et al.* (2017) Böhm *et al.* (2010). Remane *et al.* (2016) Hildebrandt *et al.* (2015) Llopis *et al.*(2021) World Economic Forum (2016) CCOO (2018) Farahani *et al. (*2017) Keller y Hüsig (2009) Ben-Zeev *et al.* (2017) Rubio *et al.* (2019) Rubio y Llopis-Albert (2019) Piccinini *et al. (*2015) Kern y Wolff (2019) Pfleeger y Pfleeger (2003)
	Capacidades dinámicas y sector automoción	Rotjanakorn *et al. (*2020) Leite *et al. (*2017) Tondolo *et al.* (2015) Leite (2013) Teece y Leih (2016) Camuffo y Volpato (1996) Leite (2013) Christensen (2011) Alves (2011) Mesquita *et al. (*2013) Lee (2012) Maynez *et al. (*2018) Nakano *et al. (*2013) Makkonen *et al. (*2014) Mamun *et al. (*2017)

Fuente propia 2019

3. Material y Metodología

Desde el punto de vista metodológico, se ha realizado una revisión de la literatura destinada a identificar las capacidades dinámicas y los indicadores que las miden en el sector del automóvil. Los términos buscados son: "Transformación digital y capacidades dinámicas", "Transformación digital y sector del automóvil", "Capacidades dinámicas y sector del automóvil". Las bases de datos más importantes utilizadas han sido: ABI Research, Econlit, Academic Search Premiere, Google scholar, Springer, Science Direct del periodo comprendido entre los años 2001 y 2020.

Para ello, en primer lugar, a partir de la revisión de la literatura y los juicios de expertos se asignan. En segundo lugar, a partir de una metodología cuantitativa de análisis exploratorio se verifica la correcta asignación de los indicadores a cada variable latente (capacidades).

3.1. Planteamiento de las hipótesis

En nuestra base principal de este estudio, se asume que las capacidades dinámicas son capaces de desarrollar capacidades de detección, captación e innovación en las organizaciones, para lo cual se han desarrollado las siguientes hipótesis. Asimismo, se realiza un análisis SEM de ecuaciones estructurales con variables latentes, como técnica estadística que se ha utilizado principalmente en los sectores de marketing e investigación de mercados (Caballero, 2006). En consecuencia, este trabajo pretende corroborar si las capacidades dinámicas emergen en las empresas de automoción como consecuencia de la transformación digital.

Hipótesis 1. La capacidad de detección influye en la capacidad de aprovechamiento.

Garrido *et al*. (2020) afirman que la naturaleza de la capacidad de la dimensión de *sensing* implica invertir en esfuerzos de investigación, búsqueda de información y asignación de recursos que no producen retornos inmediatos, es decir, el *sensing* implica actividades que requieren inversiones. Por ello, según estos autores, la dimensión de *sensing* es un prerrequisito para las otras dimensiones, es decir, el aprovechamiento y la gestión de las amenazas y la reconfiguración. Según Lee y Yoo (2019), la capacidad de detección actúa positivamente sobre la capacidad de captura. En consecuencia, la capacidad de detección influye en la capacidad de aprovechamiento porque permite conocer las oportunidades y los recursos identificados para aprovecharlos y transformar las ideas en nuevos productos, servicios y procesos que, empleados estratégicamente mediante un plan de negocio bien organizado, influirán en el rendimiento de la organización. Las organizaciones que participan con frecuencia en la detección de mercados están preparadas para aprovechar las oportunidades que se presentan para desarrollar habilidades competitivas (Teece, 2007).

Hipótesis 2. La capacidad de aprovechar influye en la capacidad de innovación

El aprovechamiento influye directamente en la capacidad de innovación, porque las nuevas oportunidades detectadas se utilizan para crear nuevos productos y servicios (Garrido *et al*., 2020). Con la adopción de nuevas tecnologías y modelos de negocio apropiados, se consiguen ventajas competitivas, ya que la empresa produce combinaciones y arreglos de activos de una manera particular que sería difícil de imitar por otras organizaciones (Teece, 2007). Para la innovación es fundamental la transformación de los conocimientos adquiridos desde el exterior, lo que requiere fusionar los nuevos conocimientos adquiridos con los existentes y mejorar la adaptación a la evolución del entorno, utilizando los recursos existentes en la organización como nuevas herramientas para hacer frente a los cambios del entorno (Pavlou y Sawy, 2011). En consecuencia, se utilizan las oportunidades más adecuadas en el momento oportuno para crear resultados innovadores (Lee y Yoo, 2019).

Hipótesis 3. La capacidad de detección influye en la capacidad de innovación.

Las actividades de innovación se llevan a cabo con el propósito de mantener la supervivencia y el crecimiento de la empresa, ya que una empresa que ofrece un valor superior al de la competencia, interviene en la intención de compra y el comportamiento de los clientes, dando lugar a una ventaja competitiva (Morgan *et al*., 2004). Las oportunidades de innovación de productos dependen del conocimiento del entorno externo, es decir, de la capacidad de detección, lo que significa que las empresas deben perseguir estrategias de innovación de productos que les permitan crecer a corto, medio y largo plazo (Lee y Yoo, 2019). El conocimiento de una empresa de su entorno externo va a depender del propósito; es decir, si las actividades de exploración se desarrollan para el desarrollo de nuevos productos, o si las actividades de explotación se llevan a cabo para mejorar los existentes (Hwang y Lee, 2010).

Hipótesis 4. La secuencia del proceso de adaptación de las capacidades dinámicas es detectar, aprovechar e innovar.

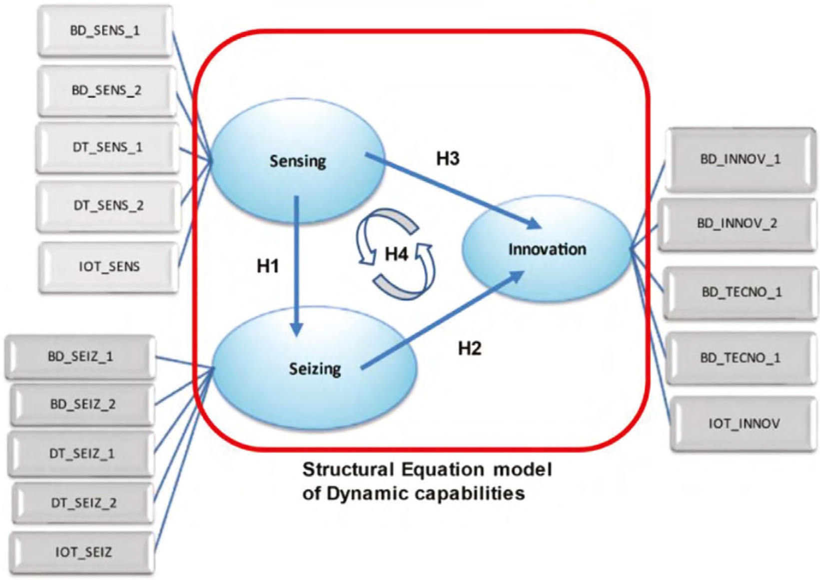
La capacidad de búsqueda y formación de oportunidades (*sensing*) permite a los directivos conocer los retos actuales en entornos competitivos dinámicos (Jiao *et al*., 2011); esto implica desarrollar las capacidades dinámicas para implementar estrategias y acciones que permitan aprovechar al máximo las oportunidades y afrontar los retos y amenazas en un entorno cambiante (Miranda, 2015). Una vez identificadas las oportunidades, los directivos aprovechan su potencial (*seizing*) para transformar y explotar el conocimiento en la creación, innovación, mejora de procesos y definición de estrategias para combinar el nuevo conocimiento con el existente. El aprovechamiento está relacionado con los procesos estratégicos para aumentar el rendimiento organizativo y la ventaja competitiva (Foss *et al*., 2013). La capacidad de aprovechar se aplica a la configuración del modelo de negocio (Teece, 2007), por lo que las organizaciones utilizan las competencias dinámicas para crear, reconfigurar o modificar las competencias y los recursos que tienen en función de los cambios que se producen en el contexto (Mezger, 2014).

En la Figura 2 se muestra la relación entre las hipótesis según los indicadores asignados.

3.2. La muestra

Se enviaron un total de 142 solicitudes de respuesta a la encuesta, correspondientes a las empresas identificadas que cumplían los requisitos de pertenecer al sector de la automoción y los componentes. De ellas, se obtuvieron un total de 42 respuestas, que constituyen la muestra con la que se estimó el modelo. El público objetivo son los perfiles de directivos y gerentes que trabajan en estas empresas. De las empresas consultadas, tres de ellas operan sólo en España, dos en la Unión Europea y el resto, 37, son reconocidas como multinacionales que operan en un entorno global. Por otro lado, 30 son empresas puramente de automoción, mientras que los 12 restantes se centran en el sector de los recambios, como baterías, neumáticos, etc.

Figura 2. Indicadores asignados a cada variable latente



Fuente propia, 2020

4. Resultados

Los criterios de selección de estos indicadores han sido principalmente su validez, según la bibliografía pertinente, para la medición de las capacidades dinámicas que se han propuesto. Para ello, hemos elegido nueve elementos representativos. La selección de las capacidades se ha basado en trabajos anteriores sobre capacidades dinámicas. Además, la estimación de las capacidades se ha utilizado, a su vez, para determinar su influencia en los respectivos indicadores a través de los cuales se manifiestan. Así, hemos construido la Tabla 4 como resumen de la revisión de la literatura para nuestro modelo.

Para comprobar las relaciones entre los indicadores y las variables latentes, así como las relaciones establecidas entre las hipótesis y los constructos que representan las capacidades, se especificó y estimó un modelo de ecuaciones estructurales (SEM). Todas las capacidades presentes en el modelo -sensación, aprovechamiento e innovación- se reflejan en la Figura 3. Los coeficientes, en las flechas del esquema del modelo, se muestran en una escala normalizada de -1 a 1.

La Tabla 5 indica los resultados de la aceptación o el rechazo de nuestra hipótesis:

- Hipótesis 1 (H1): la capacidad de detección medida a través de los indicadores (BD_SENS_1; BD_SENS_2; DT_SENS_1; DT_SENS_2; IOT_SENS) influye positivamente en la capacidad de apoderamiento se acepta ya que esta relación se considera probada.

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Tabla 4. RESUMEN de la revision literararia de los indicadores utilizados en el modelo

INDICADORES	PREGUNTAS	REVISIÓN LITERARIA
BD_SENS	¿Con qué frecuencia utiliza BIG DATA para el análisis del comportamiento de compra?	Hofacker *et al.* (2016) Kennett *et al. (*2011) Montgomery (2007)
	¿Cuántas veces se puede avanzar en el DISEÑO DE PRODUCTOS para su aceptación según los gustos reales, la educación, las zonas geográficas, etc. a través del Big Data?	Chuang y Lin (2015) Cooper y Kleinschmidt (2011) Lichtenthale (2016) Zhan *et al. (*2018)
DT_SENS	¿Cuántas veces la tecnología digital ha permitido a la fuerza de ventas OPTIMIZAR LAS RUTAS?	Kotler y Armstrong (2003) Sandhusen (2002)
	¿Cuántas veces la tecnología digital ha desarrollado soluciones para PREVENIR ACCIDENTES?	Bhatti *et al. (*2019) Pansambal (2020)
IoT_SENS	¿Con qué frecuencia utilizas la red con otras plataformas?	Sandoval Almazán (2011) Utz y Breuer (2019) Wolff y Moser (2006)
BD_SEIZ	¿Con qué frecuencia utiliza la integración de sensores o la gestión de datos para realizar alianzas comerciales con proveedores o/y clientes?	Akter *et al.* (2016) Holmlund *et al.* (2020) LaValle *et al. (*2011)
	¿Con qué frecuencia la tecnología digital permite estimar la DURABILIDAD de las diferentes piezas que componen el producto?	Ran *et al.* (2019) Zhang *et al.* (2019)
DT_SEIZ	¿Con qué frecuencia la tecnología unifica los sistemas de forma global en sus plantas y centros logísticos?	Dvorak *et al.* (2013) Laudon y Laudon (2006)
	¿Cuántas veces la tecnología digital ha permitido CONECTAR TODAS LAS DIVISIONES DE LA EMPRESA bajo una misma dirección?	Bharadwaj *et al.* (2013) Hildebrandt *et al.* (2015) Lucas *et al.* (2013) Yoo (2010)
IoT_SEIZ	¿Con qué frecuencia utiliza usted las alertas instaladas en los vehículos de los clientes?	Abulkhair *et al.* (2015) Koo *et al. (*2016)
BD_INNOV	¿Con qué frecuencia las compañías de seguros se ponen en contacto con su empresa para ofrecer un PRODUCTO PERSONALIZADO en función del estilo de conducción por los datos que recoge directamente del vehículo?	Bian *et al.* (2018)
	¿Con qué frecuencia se utilizan los MODELOS PREDICTIVOS para ANTICIPAR EL DESGASTE de las piezas han tenido un impacto en el coste de mantenimiento del vehículo?	Candanedo *et al. (*2018) Murat *et al.* (2020)

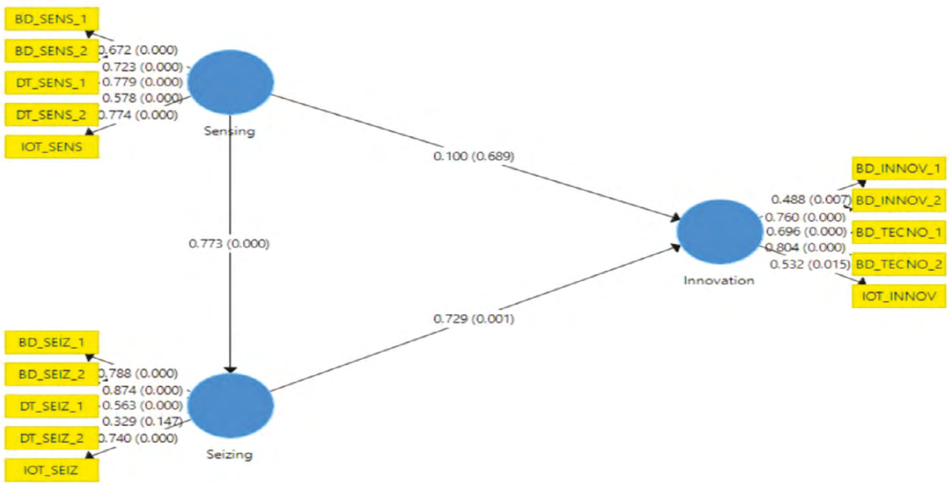
(Continúa)

Tabla 4. RESUMEN de la revision literararia de los indicadores utilizados en el modelo

BD_TECNO	¿Cuántas veces la tecnología digital nos ha permitido tomar decisiones sobre cambios organizativos?	Attaran *et* al. (2019) Dority (2016)
	¿Cuántas veces se utiliza la tecnología digital para saber cuándo el cliente va a cambiar el producto, el tipo de producto que va a buscar, el color, las características para poder anticiparse y así lanzar al usuario una comunicación que le haga comprarlo?	Ahmadinia *et al. (*2015) Anderson y Bolton (2015) Foroudi *et al.* (2017) Pantano y Timmermans (2014)
	¿Cuántas veces la transformación digital permite a su empresa ANTICIPAR FALLOS FUTURAS DEL COCHE permitiendo la conexión con el taller, pudiendo concertar una cita, incluso antes de que se produzca dicha avería?	Borgi *et al.* (2017). Murat Çınar *et al.* (2020).
IoT_INNOV	¿Con qué frecuencia se identifica el GRADO DE INNOVACIÓN DE LA COMPETENCIA a través de dispositivos en red?	Koch y Windsperger (2017) Hana (2013)

Fuente propia, 2020

Figura 3. Modelo de ecuación estructural de las capacidades identificadas



Fuente propia, 2021

- Hipótesis 2 (H2): la capacidad de aprovechamiento medida a través de los indicadores (BD_SEIZ_1; BD_SEIZ_2; DT_SEIZ_1; IOT_SEIZ) influye positivamente en la capacidad de innovación se acepta ya que esta relación se considera probada.
- Hipótesis 3 (H3) La capacidad de detección medida a través de los indicadores (BD_SENS_1; BD_SENS_2; DT_SENS_1; DT_SENS_2; IOT_SENS) no influye positivamente en la capacidad de innovación, por lo que no se acepta al considerarse probada esta relación.
- Hipótesis (H4): La secuencia del proceso de adaptación de las capacidades dinámicas, la asimilación y la innovación se acepta ya que esta relación se considera probada. Aunque H3 no tiene una influencia directa en la innovación, sí tiene una influencia indirecta en la innovación, la influencia es doble, directa e indirecta.

Tabla 5. Resultados de las Hipótesis

	Valor de parámetro	**P-Valor**	**Aceptación/No aceptación de las hipótesis**
H1 Función	0.773	0,000	Accepted
H2 Función	0.729	0,000	Accepted
H3 Función	0,100	0,689	No accepted
H4 Función	0,564		Accepted

Fuente propia, 2021

5. Discusión

A partir del estudio desarrollado se pudo comprobar el cumplimiento de la hipótesis 1, es decir, la capacidad de *sensing* medida a través de los indicadores BD_SENS_1; BD_SENS_2; DT_SENS_1; DT_SENS_2; IOT_SENS, influye positivamente en la capacidad de *seizing*, se acepta ya que se considera probada esta relación. Esta afirmación se realiza con base en la revisión teórica, la cual resalta la importancia de la información que las empresas obtienen de parte del contexto; prueba de ello es el Big Data, el cual es utilizado para conocer las oportunidades y amenazas que presenta el entorno; pues a partir de los datos, la empresa puede conocer las necesidades de los clientes (Zhan *et al.*, 2018). El Big Data también proporciona información sobre el número de clientes que visitan en sitio web. Además, los gráficos pueden utilizarse para analizar las encuestas de satisfacción de los clientes (Kennett *et al.*,2011) y comprender el proceso de toma de decisiones de los consumidores (Hofacker *et al.*, 2016).

Por otro lado, la automatización de los procesos que se llevan a cabo dentro de la organización, como la fuerza de ventas, gestionada a través de recursos tecnológicos como teléfonos móviles y tabletas, permite a la empresa mantener el contacto con los clientes, realizar operaciones de venta y mantenerse informada de lo que ocurre en el mercado (Kotler y Armstrong, 2003). Asimismo, el uso de las redes sociales ayuda a las empresas a compartir información con las personas interesadas en sus productos en tiempo real y a construir una relación más estrecha con sus clientes (Utz y Breuer, 2019). En el caso de la industria automotriz, además, la tecnología digital ha permitido la introducción de sensores en los vehículos que permiten el contacto con los clientes, la detección de situaciones de peligro y la prevención de accidentes, incluso se desarrollan aplicaciones para teléfonos celulares que estiman la situación de peligro en las carreteras y ayudan al conductor a evitar accidentes (Bhatti e*t al*., 2019).

En consecuencia, la capacidad de detección influye positivamente en la capacidad de aprovechamiento como expresan Lee y Yoo (2019), ya que la empresa al desarrollar la capacidad puede conocer las oportunidades y necesidades del entorno y aprovechar esta información para crear nuevos productos y procesos que le hagan desarrollar ventajas competitivas (Teece, 2007).

En cuanto a la hipótesis 2 (H2), la capacidad de *seizing* medida a través de los indicadores BD_SEIZ_1; BD_SEIZ_2; DT_SEIZ_1; IOT_SEIZ, influye positivamente en la capacidad de innovación, se acepta, ya que se considera probada esta relación. Esta afirmación se realiza en base a que el análisis de Big Data se ha convertido en una fuente de innovación y competencia, porque cada vez aporta más valor gracias a la información que obtiene de los clientes (Holmlund *et al*., 2020), estos datos se transforman en conocimiento para tomar decisiones de negocio y abordar los problemas de los clientes (Akter y Wamba, 2016). En el sector de la automoción, la evolución de la tecnología digital a través de herramientas como Internet, la inteligencia artificial y la tecnología de detección han influido en el modelo de mantenimiento. Gracias a la tecnología, el mantenimiento predictivo se ha convertido en una solución para abordar la fabricación inteligente y estimar el estado de los equipos, diagnosticar los fallos y evaluar la vida útil restante (Zhang *et al*., 2019). La posibilidad de fabricar y colocar sensores en los vehículos aumentará a medida que lo haga el auge del internet de las cosas, ya que con el aumento de los sensores, también aumentará la cantidad de datos que serán fuente para el desarrollo de algoritmos de machine learning para el mantenimiento preventivo (Borgi *et al*., 2017).

Por lo tanto, en las empresas que van de la mano de la transformación digital, los recursos tecnológicos disponibles, como equipos técnicos, dispositivos de almacenamiento de datos, software, redes de comunicación, entre otros, son utilizados para brindar el servicio al cliente (Laudon y Laudon, 2006). En este sentido, autores como Lucas *et al*. (2013), y Lee *et al*., (2012) consideran que las tecnologías digitales ofrecen entornos más flexibles para crear nuevas formas organizativas con los clientes, y como expresan Hildebrandt *et al*., (2015), los OEMs de vehículos que tienen un conocimiento heterogéneo de las tecnologías digitales, que pueden integrarlas en sus empresas y comercializar este conocimiento, están mejor preparados para afrontar la transformación digital.

En cuanto a la hipótesis 3 (H3), la capacidad de sensir medida a través de los indicadores BD_SENS_1; BD_SENS_2; DT_SENS_1; DT_SENS_2; IOT_SENS, no influye positivamente en la capacidad de innovación, por lo que no se acepta al no considerarse probada esta relación. Aunque cabe destacar que según Teece (2007), con la información sobre las oportunidades y amenazas obtenidas de su entorno, la organización puede tomar decisiones para modificar o crear nuevos productos y procesos, por lo que el seising sí influye en la capacidad de innovación, pero en este estudio no se ha comprobado esta relación a través de los indicadores utilizados para medirla.

Por último, para la hipótesis (H4), se acepta que la secuencia del proceso de adaptación de las capacidades dinámicas es *sensing*, *seizing* e innovación, ya que esta relación se considera probada. Aunque H3 no ejerce una influencia directa sobre la innovación, sí que tiene una influencia indirecta, por lo que la influencia es doble, directa e indirecta. Esto apoya la opinión de Teece (2007), quien afirma que el desarrollo de las capacidades dinámicas consiste principalmente en detectar y aprovechar nuevas oportunidades, así como en transformar o reconfigurar los recursos para aumentar el rendimiento, más que en analizar y optimizar la base de recursos actual. Las capacidades dinámicas no tienen necesariamente un efecto directo en el rendimiento, sino más bien un efecto indirecto a través de su influencia en la base de recursos de la empresa (Battisti y Deakins, 2017). Por consiguiente, estas capacidades dinámicas son esenciales para promover la creatividad y, cuando son fuertes, hacen que cualquier empresa pueda hacer frente a la incertidumbre de la innovación y la competencia (Rotjanakorn et al., 2020). En relación con este punto, cabe señalar que la industria del automóvil se ve continuamente afectada por la introducción de nuevas tecnologías, lo que hace necesario que las organizaciones se adapten al rápido ritmo de crecimiento. En consecuencia, es necesario tener en cuenta las capacidades dinámicas que tienen estas empresas, que además superan las competencias básicas, para estar en continua observación de los cambios del entorno y así asegurar la permanencia de la industria en el mercado.

6. Conclusión

La transformación digital se ha convertido en una fuente de innovación y competencia, ya que aporta cada vez más valor gracias a la información que obtiene de los clientes, luego estos datos se transforman en conocimiento para tomar decisiones de negocio y atender los problemas de los clientes.

Hay que tener en cuenta que la industria de la automoción se ve continuamente impactada con la introducción de nuevas tecnologías, lo que hace necesario que las organizaciones se adapten al rápido ritmo de crecimiento. En consecuencia, es necesario tener en cuenta las capacidades dinámicas que tienen estas empresas, que además superan las competencias básicas, para estar en continua observación de los cambios del entorno y así asegurar la permanencia de la industria en el mercado.

Las empresas que entienden la importancia de la transformación digital muestran estilos de trabajo más modernos, consideran las preferencias de los usuarios y la información que pueden obtener del contexto. El tratamiento adecuado de esta información es la clave de la ventaja competitiva, por lo que los empleados deben tener acceso a la información adecuada para poder ejecutar correctamente sus tareas y así aumentar la calidad y la productividad.

Aunque existe consenso en la literatura académica sobre la importancia del desarrollo de las capacidades dinámicas para conseguir ventajas competitivas sostenibles en el tiempo, esta revisión realizada sobre la medición de las capacidades dinámicas pone de manifiesto la diversidad de estudios en este campo, con indicadores definidos para medir estas capacidades en la práctica.

Todas las acciones de innovación buscan mejorar los resultados económicos, ya sea aumentando las ventas o reduciendo los costes, es decir, la innovación pretende aumentar los beneficios, por lo que se espera que las nuevas innovaciones superen las soluciones técnicas y económicas que ya existen en el mercado y, por tanto, generen grandes beneficios para la empresa

En conclusión, y en cumplimiento de cada uno de los objetivos específicos planteados en este trabajo, se puede afirmar que a la hora de evaluar la eficacia de los indicadores utilizados para determinar cada una de las capacidades dinámicas, los indicadores utilizados para determinar la influencia de la capacidad de aprovechar e innovar han sido adecuados para este fin, ya que han podido determinar la relación entre cada una de las capacidades dinámicas y sus efectos dentro del sector del automóvil.

En este trabajo, aplicando los conceptos de los diferentes tipos de capacidades dinámicas del sector de la automoción, se han identificado nueve indicadores adecuados para realizar esta medición. Por lo tanto, este estudio ofrece una herramienta útil para el sector académico y el mercado que permite a las empresas de automoción medir sus capacidades dinámicas y compararlas con otras en relación con la transformación digital.

Sin embargo, la investigación presenta algunas limitaciones que deben ser consideradas a la hora de contextualizar el trabajo realizado. La más representativa es la dificultad de obtener una muestra mayor, ya que de 142 encuestas, sólo se obtuvieron 42 respuestas, debido al poco tiempo que los encuestados tenían para atender al investigador.

Esta medición les ayudará a desarrollar estrategias activas de mejora de procesos para elevar su capacidad de detección, aprovechamiento e innovación del mercado, y de esta manera, mejorar su desempeño gerencial y buscar un mejor posicionamiento en el sector.

Una futura línea de investigación sería ampliar este estudio a otro tipo de empresas, para poder medir el éxito de las organizaciones en función de sus capacidades dinámicas.

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Declaración de conflicto de intereses

Todos los autores han contribuido significativamente a este estudio y han aceptado su publicación. Además, todos los autores declaran que no hay conflictos de intereses en este estudio.

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Annex 4. Article

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Article

Impact of Dynamic Capabilities on Customer Satisfaction through Digital Transformation in the Automotive Sector

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Abstract: Technology has impacted businesses in different areas, and, consequently, many companies have found it necessary to make changes in their structures and business models to improve customer satisfaction. The objective was to quantify the effect of dynamic capabilities on customer satisfaction, through digital transformation within the automotive sector. A random sample of 42 questionnaires on 127 surveyed industries was collected during the period 2019–2020 in a pre-COVID-19 context. A structural equation model (SEM) in two stages was applied. In the first stage, two reflective models were built. In a second stage, a structural equation model was evaluated. The results obtained in this study showed that the capabilities of sensing, seizing and innovation were suitably grouped in a construct called "Dynamic Capabilities". A positive influence of Dynamic Capabilities on customer satisfaction was found. Therefore, the companies in this industry should focus on developing dynamic capabilities to improve customer satisfaction. Once the opportunities have been identified, managers take advantage of their potential (seizing) to transform and exploit knowledge in the creation, innovation, process improvement, and definition of strategies to combine new knowledge with that already existing. The digital transformation has contributed to identify the real needs for customers, to contact them and solve their problems, as well as offering products and services by anticipating their needs.

Keywords: digital transformation; dynamic capabilities; customer satisfaction; automotive industry; structural equation model (SEM)

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1. Introduction

Automotive and component manufacturing companies form a tandem of recognized prestige in terms of competitiveness and results. The automotive industry has an important multiplier effect in the economy as it maintains clear links to other sectors. It is an important sector for upstream industries such as steel, chemicals, and textiles, as well as downstream industries such as, for example, ICT, repair, and mobility services. Employment—around 13.8 million people work in the EU automotive sector. Manufacturing (direct and indirect) accounts for 3.5 million jobs, sales, and maintenance for 4.5 million, and transport for 5.1 million. From the economic perspective, the turnover generated by the automotive industry represents over 7% of EU GDP [1–3].

This sector is undergoing a profound restructuring and disruptive innovation, aggravated by the COVID-19 pandemic [3]. Apart from this, customers are looking for more energy efficient and environmentally friendly vehicles, mainly hybrid and electric vehicles [4]. Furthermore, COVID-19 is accelerating the digital transformation process. The development of dynamic capabilities plays an important role in managing the organization's strategy [5–7].

The automotive business, like many others, has been impacted by digital technologies, leading to the need for companies to innovate their business models by developing their dynamic capabilities, understood as the organization's abilities to reconfigure itself according to the demands offered by the changing environment [8]. Through digitization, the company has the opportunity to interact with customers, which has helped in the creation of new business models [9–13].

Digital transformation exposes new ways in which the organization can stay in touch with customers and consumers and thus create value for them [14]. Customers are active entities, who know their needs and know that they have product and service alternatives to satisfy them [15]. Although the success of a company depends on different factors, one of the most important is to increase its competitiveness in the market to achieve customer satisfaction [16].

Digital transformation is a process of reinvention and reengineering of a business to digitize a company [17]. With the emergence of new digital technologies, such as artificial intelligence (AI), Internet of Things (IoT), mobile and social Internet, blockchain, and big data, companies in almost all industries are undertaking multiple initiatives to explore and exploit the benefits of these technologies [18,19]. Meanwhile, society is facing rapid and radical changes due to the maturation of digital technologies and their power to rapidly penetrate markets, while customer demands are increasing and organizations are facing stiffer competition due to globalization [20,21].

The emergence of digital innovations is accelerating and disrupting existing business models by providing opportunities for new services [22]. Based on the automotive industry, major trends such as autonomous cars, connectivity, and car sharing are creating new business models. These are simultaneously giving rise to new competitors in the market, which are beginning to transform the industry [23].

Due to the increasing number of new entrants in the market, Original Equipment Manufacturers (OEMs) are no longer alone, and have to align their strategies based on what the competition offers, which provides customer-centric mobility and substantially interferes in the market [24–26].

Consequently, digital transformation changes the creation of value in companies, specifically in those where value is generated by physical elements, as is the case of the automotive industry [27]. The automotive industry is mainly being revolutionized by digital innovations, such as social networks, autonomous cars, connectivity, and big data [26,28], forcing them to adjust their business models to keep pace with technology, advances, and their effects [29–31], which are manifested, for example, through car sharing platforms or telematic services [18,32].

A dynamic capability is a learned and stable pattern of collective activity, through which the organization is capable of generating and constantly changing its operating routines, in the search for increased efficiency [33]. Dynamic Capabilities consist of detecting, capturing, and transforming microfoundations [4]. In this sense, with dynamic capabilities, the company can capture business opportunities, address threats, and create new opportunities, thus maintaining its competitiveness in the market [6]. In previous research, dynamic capabilities (DC) were classified into three types [7]:

(i) Sensing capability refers to the ability to diagnose the environment and understand the needs of the customers better than competitors; the ability to detect and shape opportunities and threats; the ability to seize these opportunities and the ability to maintain competitiveness by reconfiguring the organization's tangible and intangible assets [34–36]. By identifying potential qualified collaborating customers—lead users [37], firms operating in the automotive industry create a capability of detection—given that contact with customers at car dealerships enables a better understanding of their needs [38].

(ii) Seizing capability refers to the activity of addressing opportunities and threats [39]; the process in which substantial investments are devoted to address new opportunities and threats, which are encountered through sensing [34]. More specifically, supported by empirical findings, it is argued that this can be through the introduction of new products and services [37], as well as making incremental changes to existing business models [35]. Firms in the automotive industry acquire and assimilate external information and record it as part of the company's knowledge base to improve processes and products [40,41].

(iii) Innovation capability: describes the transformation process as the ability to configure organizational assets for the purpose of not becoming static and passive in the face of future changes [34]. The success of the product in the automotive industry is measured by the number of units sold per day and store. In addition to that, the definition and measurement of the number of units sold per store/day allow detecting product's commercial success [42]. In addition, in this industry, firms produce a limited number of products' units according to defined requirements [43]. Some previous articles have analyzed the contribution of dynamic capabilities to customer satisfaction [44–47], but in different industries rather than the automotive one.

A review of the literature aimed at identifying dynamic capabilities and indicators that measure these in the automotive sector has been carried out. The terms searched were: "Digital Transformation & Dynamic Capabilities", "Digital Transformation & Automotive Sector", and "Dynamic Capabilities & Automotive Sector". The most important databases used were: ABI Research, Econlit, Academic Search Premiere, Google Scholar, Springer, and Science Direct, from the period between years 2001 and 2020 [7].

The automotive industry is continuously impacted with the introduction of new technologies, which makes it necessary for organizations to adapt to the fast pace of growth [48]. Consequently, it is necessary to take into account the dynamic capabilities that these companies have, which also exceed core competencies, to be in continuous observation of changes in the environment and thus ensure the permanence of the industry in the market [49]. One of the most important results of deploying dynamic capabilities is the creation, renewal, and development of competencies and capabilities that allow the company to be constantly updated according to the changes occurring in the market [50]. The direct customer participation model in the automotive industry allows firms to increase the probability that the products offered under its own brands were more accepted and attractive than leading recognized brands [51]. Secondly, it also helps customers to perceive them differently, and achieve a positive welcome: "if you listen to your customers, it is easier to innovate successfully, with fewer risks; success is based on knowing how to connect" [52].

Customer satisfaction. The success of digital transformation will depend on creating customer value and understanding the need to improve processes and not just automate them [53]. In this sense, customer satisfaction through digital transformation is oriented to give them information regarding whether the chosen company is doing the right thing to respond to their demands [54].

In the automotive industry, thanks to the Internet of Things, artificial intelligence, and big data, new maintenance models have been developed, among which predictive maintenance stands out as an innovation for smart manufacturing, fault diagnosis, and assessment of the remaining lifetime of the vehicle [55].

The focus of digital transformation within an automotive company must be connected to the customer to improve their experience, either from the point of view of product quality or by improving connectivity [55]. In essence, companies capable of reducing costs, engaging customers, and making an efficient use of their assets with the implementation of digital technology will be among the winners of digital disruption [56].

In previous research of this group, dynamic capabilities-observed variables were assigned to the indicators from literature review and expert judgments. In addition, from a quantitative methodology of exploratory analysis, the correct assignment of the indicators to each latent variable or dynamic capability was verified [7].

The research questions were focused on determining whether the generation of dynamic capabilities through digital transformation influences customer satisfaction in the automotive industry and its components (Table S1. Questionnaire Dynamic Capabilities).

Therefore, the main objective of this research was to verify if the dimensions of the dynamic capabilities (seizing, sensing, and innovation) can be grouped into a reliable construct for the automotive sector and assess the positive influence of dynamic capabilities on the creation of organizational value, with the consequent improvement in customer satisfaction.

Three partial objectives were raised in this paper; First, to build a construct of dynamic capabilities that incorporates the dimensions of seizing, sensing, and innovation. Second, to generate a factor with the variables of customer satisfaction. Finally, to quantify the influence of digital transformation in the building of dynamic capabilities on customer satisfaction in the automotive industry.

Research questions were evaluated by applying a mixed methods approach, combining qualitative and quantitative methodologies. For the approach of the theoretical model, a selection and assignment of the capabilities' indicators, the bibliography was used, and they were validated. Later, a structural equation model (SEM) was built to evaluate the influence of dynamic capabilities on customer satisfaction.

This work contributes to the grouping of the dimensions of the dynamic capabilities, which are internal to the organization, in a construct that was related to customer satisfaction (an external aspect to the organization) by considering that the digitalization issue is a clear priority. With the results of this research, we seek to help managers of organizations so that they can make a quick analysis of their market conditions, based on the effects of the development of dynamic capabilities on such a strategic dimension for any firm as it is on customer satisfaction. Hence, this research will validate the generation of dynamic capabilities through digital transformation in the automotive sector on customer satisfaction.

The article is structured as follows: after this introduction; where the theoretical framework to which the key concepts of digital transformation, dynamic capabilities, and these same concepts applied to the automotive industry are referred; in part 2, Material and Methods, the formulation of the hypotheses, the methodology, the sources of information, and the sample and the data collection instrument are described; in part 3, Results, the validation of the model is shown. Part 4 presents the discussion and conclusions that arise from verifying the results obtained in this research with the data provided by the literature review.

2. Materials and Methods

2.1. Hypothesis Approach

In previous work [7], a correct assignment of 15 observed variables to the dynamic capabilities' dimensions of sensing, seizing, and innovation was estimated (Table S1. Questionnaire of Dynamic Capabilities and Figure 1).

From the framework shown in Figure 1, in which the assignment of the observed variables to the dimensions of sensing, seizing, and innovation is made, the following research questions were presented: Could the dimensions of sensing, seizing, and innovation be grouped into a construct called "Dynamic Capabilities"? Did dynamic capabilities positively show influence on customer satisfaction? Therefore, two measurement models and a structural equation model were proposed (Figure 2).

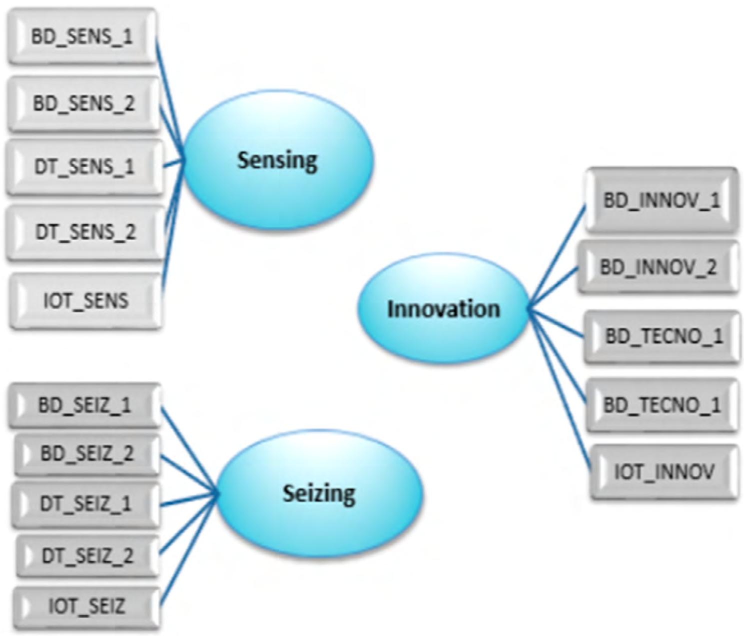

Figure 1. Indicators assigned to each latent variable.

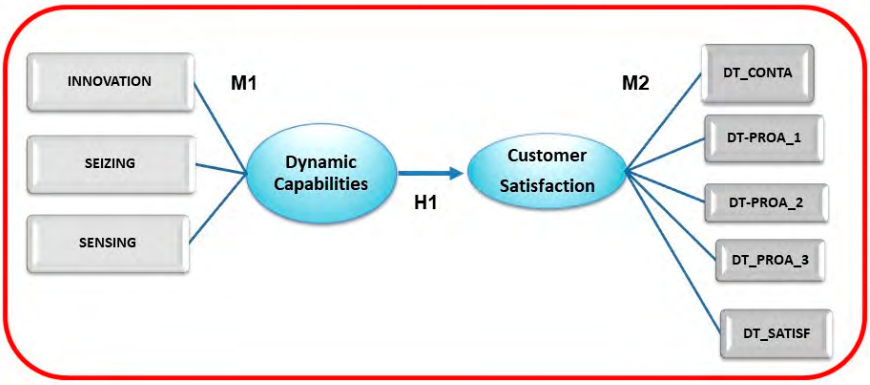

Figure 2. Models and hypotheses in theoretical model.

The proposed hypotheses were represented by means of a system of structural equations models in two stages. In the first stage, two reflective models (M1 and M2) were constructed. In a second stage, in Hypothesis 1, a structural equation model was built in which the relationships between dynamic capabilities (DynCap) and customer satisfaction (CustSatis) were evaluated.

Table 1 presents the inspiring literature review for the dynamic capabilities' indicators.

Table 1. Dynamic capabilities' indicators.

Indicator	Authors
Sensing	Teece, [34]; Helfat and Peteraf, [35]; Roy and Khokle [36]; Akram and Hilman [57]; Zhou et al., [58]; Bendig et al., [59]; Battisti and Deakins, [60]; Jacobi and Brenner [61].
Seizing	Matysiak et al., [39]; Teece, [34]; Roy and Khokle [36]; Helfat and Peteraf [35]; Rigby et al., [62]; Kindström et al. [63]; Wang et al., [64]; Yeow, Soh and Hansen, [65]; Karimi and Walterm, [66]
Innovation	Helfat and Peteraf, [35]; Bendig et al., [59]; Kindström et al., [63]; Hodgkinson and Healey, [67]; Yeow, Soh and Hansen, [65]; Eisenhardt and Martin, [68]; Rotjanakorn, Sadangharn and Na-Nan, [6]; Teece, Pisano and Schuen, [69].

The applied questionnaire collected the following variables associated with customer satisfaction (Table S2. Review of satisfaction variables).

DT_CONTA. To what extent has digital transformation enabled us to identify the real needs of customers? Nowadays, traditional marketing methods are not sufficient to understand customer needs [70]. Consumer buying and selling behavior has rapidly evolved towards the use of mobile technology, online shopping, co-creation of value, among others, which has led to the development of new models for assessing the nature of consumer demand [71].

DT_PROA_1. To what extent the digital transformation has it enabled us to contact customers and solve the problems? Digital transformation has been focused on transforming customer experience, relationships, and processes [49]. This collaboration with the customer was the modern basis for innovation, as well as being an effective system to enable successful organizations to learn from the needs of their customers to meet their demands and improve performance. The success of digital transformation will depend on creating customer value and understanding the need to improve processes and not just automate them [53].

DT_PROA_2. To what extent the digital transformation has enabled us to be in direct contact with the customer by allowing us to collect data in order to offer products and additional services to the current ones anticipating your digital transformation needs? Customers are increasingly informed and connected, which allows them multiple alternatives of products and services [72]. In addition to liking the product, they must like the way it is being offered, which requires not only thinking about the product, but also thinking about the service [73].

DT_PROA_3. To what extent has the digital transformation made it possible to reduce vehicle accidents? Autonomous and assisted driving of vehicles will be made possible by the integration of advanced technologies, including GPS and sensors, cameras, connectivity, and algorithms [74]. The goal would be to make this type of driving available in less expensive vehicle models to help prevent accidents and save more lives [75].

DT_SATISF. To what extent has the installation of sensors, predictive models, and algorithm learning achieved more efficient driving? The vehicle is becoming an efficient machine that functions as a real time data transfer center [76]. These vehicles were designed to limit distractions and offer a personalized driving experience [77]. The system learns preferences passengers; in addition, it integrates with cell phones and offers coaching options, calendars, and navigation guidance [78].

Hypothesis 1. *Dynamic capabilities (DynCap) positively influence customer satisfaction (CustSatis) (Figure 2). This hypothesis is aimed at examining the direct effect of dynamic capabilities on firm results, using customer satisfaction as a proxy variable. The structural model for the relationship between dynamic capabilities and customer satisfaction is shown in Figure 2.*

2.2. Data Collection and Survey

In the classification of CNAE 29: Manufacture of motor vehicles, trailers, and semi-trailers; 1800 motor vehicle companies and 9060 automotive component companies appear in the annual detailed Enterprise statistics for industry [79]. The study population was composed by 106 automobile manufacturers and component manufacturers [3]. A random sample composed of 42 questionnaires in127 surveyed industries was collected during the period 2019–2020 in a pre-COVID-19 context. Incomplete surveys and those that showed logical inconsistencies were deleted. The sample size was calculated with a confidence of 95% (Z = 1.96), an unknown expected proportion (p = 0.5).

The survey included 28 items: 8 socioeconomic (age, gender, company size, professional profile, among others), 15 related to DC, and 5 related to customer satisfaction. The survey's reliability was verified through Cronbach's alpha, with values greater than 0.7, acceptable to confirm internal consistency. The complete survey showed a Cronbach's alpha of 0.93.

In Table S1, Questionnaire Dynamic Capabilities, a previous work where the 15 variables of dynamic capabilities were grouped in the dimensions of sensing, seizing, and innovation, is shown. Table 2 shows the high degree of association between the three dimensions considered in this analysis. Table 3 shows the statistical description of each indicator, showing the heterogeneity of the data and their degree of dispersion. In a previous work [7], the variables innovation, seizing, and sensing, as well as the SEM model relating the three dimensions of dynamic capabilities are described extensively.

Table 2. Correlations among latent variables.

Correlation (*p*-Value)	Innovation	Seizing	Sensing
INNOVATION	-	0.8051 (0.0000)	0.6620 (0.0000)
SEIZING		-	0.7780 (0.0000)

Table 3. Dynamic capabilities values for each latent variable.

Variable	Scores (Median)	SD [1]	Minimum	Maximum	Q1 [2]	Q3 [3]
INNOVATION	0.215	1.01214	−2.522	1.996	−0.654	0.643
SEIZING	0.173	1.01209	−2.032	1.575	−0.814	0.867
SENSING	0.311	1.01209	−2.072	1.526	−0.731	0.946

[1] Standard deviation, points, [2] First quartile, points, [3] Third quartile, points.

The customer satisfaction variables were evaluated by the Likert scale in this research. A Likert scale metric was used, from 1 (not important) to 5 (very important). In this case, the intervals between the points on the scale corresponded to empirical observations in the metric sense. A visual analog scale was displayed on each survey question presented to the interviewee.

Table 4 presents the statistical values for customer satisfaction according to each of the dynamic capabilities considered.

Table 4. Customer satisfaction values for each variable.

Variable Observed	Scores (Mean)	SD [1] (CV [2] %)
DT_CONTA	4.048	1.058 (26.14)
DT_PROA_1	3.857	1.117 (28.95)
DT_PROA_2	3.405	1.432 (42.07)
DT_PROA_3	3.786	1.423 (37.60)
DT_SATISF	3.786	1.048 (27.66)

[1] Standard deviation, points, [2] Coefficient of variation.

According to the results shown in Table 4, the five satisfaction variables showed high mean values and coefficients of variation greater than 25%. Cronbach's Alpha was greater than 0.7, and the questionnaire was validated for each of the indicators.

2.3. Statistical Analysis

The analyses were carried out in two stages. In the first phase, two reflective measurement models (M1 and M2) were used (Figure 2), which assessed the relationships between the constructs dynamic capabilities (DynCap) and customer satisfaction (CustSatis) and the indicators used. For this purpose, the internal consistency of each construct was measured (Cronbach's alpha and composite reliability); secondly, its convergent validity through the reliability of the indicator and the variance was extracted; and, finally, the discriminant validity between indicators and latent variables (Fornell Larcker criterion) and cross-loadings was found [80].

The causal relationships between dynamic capabilities (DynCap) and customer satisfaction (CustSatis) were measured in a second stage. To validate Hypothesis 1, a structural equation model (SEM) was developed (Figure 2). Both models were estimated using the partial least squares (PLS) procedure applying SmartPLS3 software [81], to test the relationships between indicators and latent constructs, as well as the hypothesized structural relationships between the latent constructs [82]. The criteria for choosing the algorithm were: the novelty of the phenomenon, its modeling is at an emerging stage, minimum PLS recommendations on sample size, prediction accuracy, and comparatively low demands on the multinormality requirements of the data were met [83].

Finally, bootstrapping was used to test the statistical significance of various PLS-SEM results such as path coefficients, Cronbach's alpha, HTMT, and R^2 values. In this research bootstrapping procedure was repeated until 5000 random samples were created [84].

3. Results

Table 5 shows the typology of the companies and the socio-demographic profile of the respondents. A total of 78.6% of the companies have more than 100 employees and 90% of the companies are consolidated with an age of more than 25 years, belonging to the automotive sector (71.4%) and with local and international activity (88%). The respondents were evenly distributed among staff, managers, and directors. The majority were men (97.6%) between 25 and 50 years of age (95.2%).

Table 5. Descriptive Data.

Variable	Relative Frequency (%)
Number of employees	
Below 50	9.5
Between 50 and 100	11.9
Between 101 and 250	26.2
More than 250	52.4
Company age (y)	
below 25	9.5
between 25 and 50	35.7
more than 50	54.8
Company position	
Staff	31.0
Middle manager/Manager	38.1
Executive/Director	31.0
Gender	
Male	97.6
Female	2.4
Age (y)	
between 25 and 50	95.2
more than 50	4.8

Table 5. *Cont.*

Variable	Relative Frequency (%)
Sector	
Automotive	71.4
Automotive components	28.6
Company operations	
Spain (only)	7.1
Europe (only)	4.8
Global	88.1

Models and Hypothesis Assessment

The model was estimated in two phases, firstly, the constructs used; and, secondly, the relationship between dynamic capabilities on customer satisfaction (Figures 1 and 3). All the capabilities presented in the model—sensing, seizing, and innovation—are shown in the Figure 1 of the introduction. In addition, an overview of the quality criteria is presented in Table 1 of methodology.

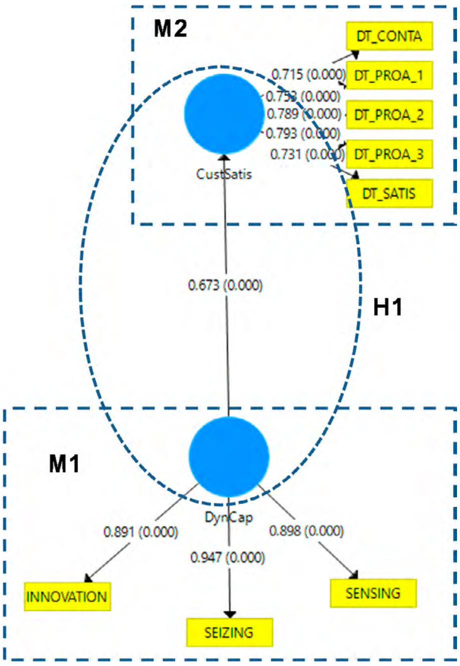

Figure 3. Models and hypothesis of the Dynamic Capabilities model on Customer Satisfaction.

Figure 3 and Tables 6–8 present the reflective and structural models, testing the hypotheses presented above. On the arrows of the model scheme, the coefficients are shown on a standardized scale from −1 to 1. Each construct was validated for its reliability and validity. Statistically significant relationships have p-values lower than 0.05. Dynamic capabilities showed a high impact on customer satisfaction (p = 0.000).

Table 6. Construct Reliability and Validity.

	Cronbach's Alpha	Rho_A	Composite Reliability	AVE [1]
CustSatis	0.814	0.822	0.870	0.573
DynCap	0.899	0.906	0.937	0.832

Table 7. Fornell Larcker Criterion.

	CustSatis	DynCap
CustSatis	0.757	
DynCap	0.673	0.912

Table 8. Cross Loadings.

	CustSatis	DynCap
DT_CONTA	0.715	0.379
DT_PROA_1	0.753	0.527
DT_PROA_2	0.789	0.492
DT_PROA_3	0.793	0.590
DT_SATIS	0.731	0.520
INNOVATION	0.549	0.891
SEIZING	0.650	0.947
SENSING	0.637	0.898

In summary, the DC models' goodness-of-fit was adequate. Bootstrapping results are shown in Table 9. Confidence intervals assist in determining the significance of the relationships examined [85]. At a 95% confidence level, dynamic capabilities did impact customer satisfaction in the automobile industry, given the available data.

Table 9. Bootstrapping final results.

	Sample [1]	SD [2]	T [3]	*p*-Value	Confidence Intervals	
					2.5%	97.5%
DT_CONTA <- CustSatis	0.695	0.128	5.588	0.000	0.376	0.869
DT_PROA_1 <- CustSatis	0.748	0.096	7.847	0.000	0.501	0.886
DT_PROA_2 <- CustSatis	0.776	0.088	8.997	0.000	0.553	0.897
DT_PROA_3 <- CustSatis	0.792	0.077	10.295	0.000	0.537	0.888
DT_SATIS <- CustSatis	0.731	0.103	7.078	0.000	0.436	0.872
INNOVATION <- DynCap	0.890	0.034	25.940	0.000	0.793	0.937
SEIZING <- DynCap	0.946	0.019	50.598	0.000	0.897	0.973
SENSING <- DynCap	0.897	0.040	22.250	0.000	0.789	0.954

[1] Mean; [2] Standard deviation; [3] T Statistics.

The step-by-step results showed the following statistical indicators:

(a) From the parameters in Table 6, the reliability and validity of the two proposed constructs are accepted. Convergent validity was determined by the average variance extracted (AVE), defined as the mean value of the construct's indicators squared loadings. According to Fornell and Larcker, [86] the shared covariance is higher than the AVE for each of the two constructs. The resulting values (Table 6) show that the AVE values for customer satisfaction and dynamic capabilities were high (0.573 and 0.832, respectively) above the admitted value of 0.500 [87]. In terms of reliability, internal consistency reliability was assessed using Cronbach's alpha coefficient and composite reliability. Almost all measures exceeded the 0.700 threshold [88–90].

(b) Discriminant validity by Fornell and Larcker has been chosen as criteria for evaluating measurement scales that define latent constructs in our model (Table 7). All the correlations showed in Table 7 were greater than those obtained between the observed variables. Therefore, the indicators of both variables meet the required discriminant validity criteria [91].

In Table 8, the cross loadings of each indicator on latent variable are shown. It compares the cross-factor loadings of the indicators of a latent variable with the loadings of the other latent variables. As required, the factor loadings show higher values on its own than on than the others constructs.

Finally, the impact that dynamic capabilities had on the customer satisfaction was significant: 0.673 (path coefficient) and 0.0000 *p*-value. The structural equation model goodness-of-fit with a coefficient of determination R2 of 0.453, and size effect (f2) of 0.829. According to Cohen [92] an f2 greater than 0.35 is considered high.

4. Discussion

In this research, we evaluated how digital transformation has impacted through the deployment of dynamic capabilities, concretely sensing, seizing, and innovating, on customer satisfaction in the automotive industry [93]. These relationships among dynamic capabilities and customer satisfaction are clearly visible actions from the marketing perspective, as the dynamic capabilities are mainly happening inside the company, while the customer satisfaction is outside the company in the market place. Subsequently, both constructors were related through an SEM analysis. Our primary focus was to investigate whether dynamic capabilities of sensing, seizing, and innovation could be grouped to build a reliable indicator. In addition, dynamic capabilities were also examined to see how their deployment might increase customer satisfaction [94]. Therefore, the main interest of this work was the theoretical contribution to the development of the dynamic capabilities construct, such as the integration of innovation capabilities, sensing, and seizing, and the quantitative link of dynamic capabilities through digital transformation on customer satisfaction in the automotive sector.

4.1. Dynamic Capabilities Construct

Dynamic capabilities enable enterprises to develop the intangible assets to maintain processes in a sustainable performance [34]. Several researchers have focused on a double aspect; on the one hand, identifying the dimensions of dynamic capabilities, which disaggregated into the dimensions of sensing, seizing, and innovation, as reported by several authors such as: Bendig et al. [59], Roy and Khokle [36], Kevill et al. [95], Dixon et al. [96], and Martinez de Miguel, et al. [7]. On the other hand, dynamic capabilities in the automotive sector were widely described by Rotjanakorn, Sadangharn, and Na-Nan [6]; Leite, Borges, Dos Santos, Yutaka, and Castro [97]; Tondolo, Tondolo, Puffal, and Bittencourt [50]; Leite, [98]; Teece and Leih [99]; Camuffo and Volpato [100]; Christensen [101]; Alves [102]; Mesquita, Borges, Sugano, and Santos [103]; Lee [104]; Maynez, Valles, and Hernández [105]; Nakano, Akikawa, and Shimazu [106]; Makkonen, Pohjola, Olkkonen, and Koponen [107]; and Mamun, Muhammad, and Ismail [108].

This work is novel because the dimensions of sensing, seizing, and innovation in the automotive sector were grouped for the first time into a construct, which we have called Dynamic Capabilities. Similar models have been constructed by Mutmainah, et al. [109] in Higher Education (HE).

Subsequently, the dimensions of dynamic capabilities considered independently of each other were linked to the results, technological development, or innovation [6].

According to Lee and Yoo [110] sensing capability acts positively on seizing capability. Seizing directly influences the capability for innovation, because the new opportunities identified are used to create new products and services [111]. Consequently, the capability of sensing, positively influences the capability of seizing, as expressed by Lee and Yoo (2019), because the company can know the opportunities and needs of the environment and take advantage of this information to create new products and processes that will lead to the development of innovation [34]. Innovation activities are carried out with the purpose of favoring the survival and growth of the company, because a company that offers superior value to the competition, intervenes in the purchase intention and behavior of customers, resulting in best results [112]. The fact that, as reflected in the theory, companies obtain valuable information from this context and, in this way, they can learn about the needs of their customers and act accordingly [113]. The research presents some limitations that should be considered when contextualizing the work undertaken. The most representative one is the difficulty in obtaining a larger sample, because out of 142 surveys, only 42 responses were obtained, due to the lack of vision on the usefulness of the study and the limited time respondents had to attend to the researcher, among other reasons. It is recommended to extend the sample to increase diversity and heterogeneity.

This measurement will help to develop active process improvement strategies to raise their market sensing, seizing, and innovation capabilities, and in this way, improve their managerial performance and seek a better positioning in the sector.

A future line of research would be to extend this study to other types of companies in different sector, in order to be able to measure the success of the dimensions selected grouped into the construct of DC.

4.2. Customer Satisfaction Construct

The customer satisfaction construct showed a high relationship with the five indicators of satisfaction considered. These results showed how the market is changing in a bidirectional way, to the extent that digital transformation has enabled the companies to identify the real needs of customers, contact them, and solve their problems [49]. On the one hand, customers are increasingly demanding more information and are looking for products adapted to their demand [114]. On the other hand, the market increases its diversity and offers them multiple options from which they can choose [115].

In view of the fact that the market offers them multiple options from which they can choose, they will demand personalized attention, quality, and novelty in terms of products and services [116]; consequently, as expressed by Stark [117], so that companies manage to adapt to the needs of their customers, they must offer innovative, quality, and environmentally friendly products. Consumers know that any company can satisfy their tastes and preferences, and this is something that every company that wants to have a differentiation must understand [118]. Companies that listen to their customers' needs and understand them hold the key to the development of new products and services [119].

Dynamic capabilities support new strategic designs that contribute to improve the viability and the sustainability of the automotive sector; the increasing pace of digital technology development also affects and brings major changes to all industries [116]. In addition, the automotive sector is heading from traditional engines to electrification with a clear focus on sustainability. The emergence of digital innovations is accelerating and intervening existing business models by delivering opportunities for new services. In this case, the automotive sector is leading trends such as car sharing, connectivity, and self-driving, creating new business models. Therefore, the capabilities that are generating increased added value could promptly develop a sustainable competitive advantage.

Customer satisfaction through digital transformation is oriented (connected to customer, improve their experience, and influence their purchase decision, mainly) to give them information regarding whether the chosen company is doing the right thing to respond to their demands [14]. The focus of digital transformation within an automotive company must be to be connected to the customer to improve their experience, either from the point of view of product quality or by improving connectivity [54].

In the case of the automotive industry, the information of the environment through technological tools is obtained from big data [120], the automation of sales forces using technological resources such as cell phones and tablets to maintain direct contact with customers [121], use of social networks, and the use of sensors in vehicles for autonomous driving and accident prevention [122].

This research, with its models and hypotheses, is focused on increasing customer knowledge and making processes more efficient, for which quantitative models are provided. Digitalization transforms the nature of products and the value creation process, so that companies can make unlimited combinations of products and services and thus integrate customer preferences into the joint creation of value [53]. Therefore, in companies that go hand in hand with digital transformation, the available technological resources, such as technical equipment, data storage devices, software, communication networks, among others, are used to provide customer service [123]. In this regard, authors such as Lucas, Agarwal, Clemons, El Sawy and Weber [32], and Yoo, [124] have reported that digital technologies offer more flexible environments to create new organizational forms with customers, and as expressed by Hildebrant, Hanetl, Firk, and Kolbe [125] vehicle OEMs that have heterogeneous knowledge of digital technologies, and can integrate them into their companies and commercialize this knowledge, are better prepared to face the digital transformation.

Companies know that it is important to have the initiative to know what customers' needs are, and what opportunities they have to satisfy them [126]. Once the organization has detected the customer's need and the opportunities offered by the environment, managers focus on developing skills to exploit the potential of the opportunities detected and use them in the development of new products, processes, business, and services [127].

This measurement will help to develop active process improvement strategies to raise their customer satisfaction and assess the customers, and in this way, improve their managerial performance and seek better results in the sector.

A future line of research would be to extend this study to other types of companies, to be able to measure the customer satisfaction based on their dynamic capabilities.

4.3. Effect of Dynamic Capabilities on Customer Satisfaction

There is a lack of research examining customer satisfaction in the context of digital transformation, and we found an insufficient number of papers that have investigated the link between customer satisfaction and dynamic capabilities in the automotive sector [128]; even though, massive investments have been made in digital transformation and technology acceleration by both global and domestic IT companies [129].

In this paper, Hypothesis 1 was accepted, in which dynamic capabilities contribute positively to customer satisfaction in the automotive industry. Knowing this quantitative relationship through SEM is of great value to the company, as an improvement in dynamic capabilities contributes to an increase in customer satisfaction [99,130].

The dynamic capabilities selected are essential to promote creativity, and when strong, they make any firm able to cope with the uncertainty of innovation and competition [6]. Consequently, it is necessary to take into account the dynamic capabilities that these companies have, which also exceed the core competencies, to be in continuous observation of the changes in the environment and thus ensure the viability of the firm.

The digital transformation brings benefits for the automotive industry, among which the following can be highlighted: (a) improvements for the products adapted to customers demand; (b) development of new offers to multiple options from which customers can choose; (c) change in commercial strategies to sell a product, this time focusing on the customer experience; and (d) personalized attention, quality in terms of products and services. One of the greatest benefits that digital transformation brings to companies is the number of channels of interaction with customers, which allows them to obtain the necessary information about their requirements, preferences, and experiences [24].

Customers can access information from any device with internet access, and in any language, which allows them to compare quality attributes, prices, and recommendations from other users or customers [114]. In this sense, customer satisfaction through digital transformation is oriented to give them information regarding whether the chosen company is doing the right thing to respond to their demands [131].

5. Conclusions

This research opens new paths for knowledge regarding the automotive sector. Sensing, seizing, and innovation dimensions were grouped in a reliable indicator called "Dynamic Capabilities". The relationship between the dynamic capabilities construct and customer satisfaction by the SEM modeling was the main finding of this research.

In compliance with each specific objective set out in this research, the indicators used to determine each of the dynamic capabilities were suitable. In addition, the indicators used to determine the influence of sensing, seizing, and innovation capability have been adequate for this purpose. In addition, the five indicators proposed to determine customer satisfaction through digital transformation were also suitable. Finally, the relationship between the dynamic capabilities and their effects on customer satisfaction has been quantified.

Of all the dynamic capabilities evaluated, the one that has the greatest influence on customer satisfaction is the capability of sensing, at least in this study, which could be explained because the company, having implemented the technological tools that allow closer contact with the customer, can detect what their needs and priorities are, which is the first step in making decisions that will give rise to business objectives, and from there, make the customer feel cared for, and taken into account for the decisions carried out by the organization.

Future research could delve into the relationship between the construct of dynamic capabilities with company results and the acquisition of competitive advantages by digital transformation within the automotive sector.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su14084772/s1, Table S1. Questionnaire Dynamic Capabilities. Table S2. Review of satisfaction variables. Refs [132–137] has been cited in Table S2.

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Annex 5.

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Leveraging new business technology for a sustainable economic recoverment

Área

ÁREA DE TRANSFORMACIÓN DIGITAL

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FUNDACIÓN CAMILO PRADO

A LA MEJOR INVESTIGACIÓN DEL CONGRESO ANUAL DE AEDEM

REALIZADO POR

Pablo Martínez de Miguel, Carmen de Pablos Heredero
Antón Rafael García Martínez y José Luis Montes Botella

Universidad de Córdoba y Universidad Rey Juan Carlos

"IMPACT OF DYNAMIC CAPABILITIES THROUGH DIGITAL TRANSFORMATION ON FINANCIAL RESULTS IN THE AUTOMOTIVE INDUSTRY"

FUNDACIÓN CAMILO PRADO

Pozuelo de Alarcón
02 de junio 2022

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Presidente de la Fundación Camilo Prado