UNIVERSIDADE ABERTA INSTITUTO SUPERIOR TÉCNICO

Framework for Digital Transition and Transformation in the Automotive Sector

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Mestrado em Informação e Sistemas Empresariais
(mestrado em associação)

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Tese orientada pelo Professor Doutor Arnaldo Manuel Pinto dos Santos

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Abstract

Companies in the automotive sector need to invest in digital transformation and their employee's appropriate use of technological solutions when carrying out the Organization's daily processes.

In this context and considering a specific organization in the automotive sector with several employees and several buildings, it was found that there was no technological platform to support the daily processes of the Organization studied.

The employees often carry out these processes on paper, representing organizational and functional problems. In addition to the time spent carrying out internal processes, there are additional costs to properly functioning the Organization studied.

This research study aims to design, develop and present a Framework to support organizations in the automotive sector in the context of digital transformation.

To this end, the different existing reference models for implementing digital transformation in an organization were analyzed, along with their requirements and benefits and how to implement them in organizations in the automotive sector.

In addition to studying the state of the art on the subject, a specific review was carried out on the proposed research questions, and a Questionnaire survey was applied to extract and analyze data for 76 people.

Keywords: *Framework; Company; Corporate; Automotive; Automotive Technologies; Digital Transformation.*

Resumo

As empresas do sector automóvel debatem-se, atualmente, com a necessidade de uma aposta na transformação digital e na utilização adequada de soluções tecnológicas por parte dos seus colaboradores na realização dos processos diários da organização.

Neste contexto, e considerando uma organização específica do sector automóvel com vários colaboradores e vários edifícios, constatou-se a inexistência de uma plataforma tecnológica de suporte aos processos diários da organização estudada.

Estes processos são muitas vezes realizados em papel pelos vários colaboradores, o que representa um conjunto de problemas organizativos e funcionais. Para além do tempo despendido na execução dos processos internos, existem custos adicionais ao funcionamento adequado da organização estudada.

Desta forma, este estudo de investigação pretende conceber, desenvolver e apresentar uma Framework de apoio às organizações do setor automóvel em contexto de transformação digital.

Para o efeito, foram analisados os diferentes modelos de referência existentes para implementação da transformação digital numa organização, os seus requisitos e benefícios assim como a forma de implementação em organizações do setor automóvel.

Para além do estudo do estado da arte da temática, realizou-se uma revisão específica sobre as questões de investigação propostas e aplicou-se um inquérito por questionário para uma extração e análise de dados para 76 pessoas.

Palavras-chave: *Empresa; Modelo de referência; Setor Automóvel; Tecnologias, Transformação digital.*

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List of Abbreviations and Acronyms

AI	Artificial Intelligence
API	Application Programming Interface
CEO	Chief Executive Officer
COO	Chief Operating Officer
CRM	Customer Relationship Management
ERP	Enterprise Resource Planning
IoT	Internet of Things
SLR	Systematic Literature Review
SME	Small and Medium-sized Enterprise
SMS	Short Message Service

1. Introduction

Organizations are facing a digital revolution that brings opportunities but also threats, and this transition to digital causes new business models to emerge for companies [22]. With Digitalization, Technology assumes a central role in an organization, thus also taking over the business processes, which increases employee productivity, translating into an increase in innovation and production [8].

However, the transformation of an Organization to the digital age requires it to update its strategic mindset more than its technological structure [36]. Digitalization can be seen as the ability to transform products or services into a digital version of them, thus offering advantages over tangible products [13].

This transformation should be done through digital technologies, whose purpose is to transform data into information [27]. Organizations see themselves as forced to keep up with digital changes [31]; thus, in an Organization, it may be essential to create a new business model or to redesign the existing model due to several factors, such as the fragility of the Organization and its business processes in the face of new technologies or the opportunity to extend the market reach through the Internet and mobile devices [20].

An Organization's transition to digital can be enhanced by customer expectations, which result from new customer needs. Thus, the Organization must identify the product or service that needs innovation to create customer value [21].

Resorting to a Digital Transformation, an organization can improve its relationship with customers, which will allow obtaining information about the needs and expectations they value in an Organization [2].

To carry out this transformation in an Organization, it is necessary to analyze the Organization's processes and resources, the market, the customers and the new technologies, and, with that, to define a strategy for this implementation based on new business hypotheses [32].

The aim of this research is to identify and collect information on the implementation of Digital Transformations in the Automotive sector, more specifically in the Automobile Workshop sub-sector, and to develop a Framework for these implementations. The Framework must be specific to this sector, and its creation is due to the lack of specific Frameworks/Reference Models for the Automotive sector and for car repair shops. In

order to create this Framework, an interview was conducted with a specialist in the automotive sector (to design the requirements and validate the Framework's dimensions) and a survey was carried out with employees from various automotive workshops in the Lisbon region, with different dimensions and where the participants have different roles within them.

Therefore, this research is structured in different chapters that help to answer the research problem, first presenting a theoretical background on the subject presented, then the Systematic Literature Review, where the research questions are answered, the Survey section and finally the presentation of the Framework.

This chapter, the **Introduction**, presents a framework for the topic of this dissertation, the objectives and the document's structure.

The second chapter contains a **Theoretical Framework** on Digital Transformation and the automotive sector, which discusses the automotive industry's digital evolution and details on Digital Transformation and how companies can be classified by level of Digitalization.

The third chapter presents the **Systematic Literature Review**, which sets out the research questions and answers them based on the research.

The fourth chapter sets out the problem proposed in this master's thesis and the **Research Methodology** used to answer the research questions. Along with the methodology to be used, a theoretical framework is presented, with a brief definition, objectives, definition of the target audience and the structure of the Questionnaire to be presented to the participants. This chapter also presents the stages of the methodology used in this research.

The fifth chapter presents an in-depth analysis of each section of the **Questionnaire (Survey)**. The data from each question is interpreted to help develop the Framework to be presented.

After analyzing the survey and making minor adjustments, the **Framework developed is presented and proposed in the sixth chapter.**

Finally, the **last chapter** contains the **conclusion** of the dissertation, the limitations encountered, and the future work to be done.

2. Theoretical Background

2.1. Technological Evolution of the Industry

The introduction of technologies and new ways of working (resulting from the introduction of these) in organizations had a strong influence on the labour market, which caused the change in the structure of organizations and their business models [18].

The automotive sector will be one of the sectors most affected by this digital revolution [38], since automotive products and software are some of the largest and most complex in the industry [9]. In the last two centuries, there have been three industrial revolutions, which have led to enormous technological progress, but this progress has been greater in the last two decades, giving rise to a digital revolution [25].

We are facing a new industrial revolution (Industry 4.0) that aims to evolve the existing Technology in order to enhance the productivity and efficiency of employees and organizations [19]. This revolution is supported by various technologies such as Big Data, IoT, Virtual Reality, Integrated Systems and Robotics [6], with the aim of facilitating the decision-making of organizations, based on the possible impacts of these [1].

According to [33] the adoption of this type of technologies, has led to products becoming more complex, combining Hardware (sensors, microprocessors, etc.) and Software (data storage, connectivity, etc.). We have Tesla's software as an example, where all the cars are connected to this software and it is Tesla that carries out remote maintenance and updates for all the cars at the same time, as if it were a mobile phone, which improves the consumer experience. [33]. In addition, some brands such as Audi, Honda and Hyundai use the Android system in their vehicles, which can connect to the owners' cell phones [33].

By using these technologies, organizations are expected to gain competitive advantages such as increased efficiency, productivity, and flexibility in their production, which could result in an increase in competitive advantage [1].

2.2. Digital Transformation

Digital Transformation can be seen as adoption disruptive technologies by an organization to increasing productivity, value creation and social well-being [9].

A Digital Transformation should be seen as a competitive advantage over the Organization's competitors, as it offers plenty of opportunities, but there is always an associated risk as not all Organizations are prepared for this change [3].

In order to successfully implement a Digital Transformation, it is not only necessary to document the strategy to be used, but also to communicate it internally within the organization to all employees regardless of their position, and also to provide all the necessary support to implement this process [3].

This strategy must be constantly updated with market trends and tested by the organization and the company must also check that it has sufficient resources such as technological and financial resources [3].

Thus, to implement a Digital Transformation, it is necessary to reorganize the Organization's processes in order to change the existing work logic, resources and routines to use digital technologies [24].

This transformation can be stimulated by increased competition, however, not all organizations know how to start this process [42]. The lack of digital strategy and the focus on competing priorities are some of the barriers to organizations implementing a Digital Transformation. In an organization not close to its digital maturity, digital security can be an associated barriers [15].

Digital Transformation can bring numerous benefits to Organizations, such as improving the customer experience and the relationship with the customer, improving the products/services offered by the Company, simplifying daily operations by automating processes, new business models, among other benefits [11].

On the other hand, there are some obstacles to implementing Digital Transformation activities in Organizations. The lack of clarity in the results due to Companies being uncertain about the benefits resulting from this change, the lack of urgency in implementation due to the lack of strategy and the obvious need for change, and the difficulty in adapting and reluctance on the part of employees to new technologies, are the main obstacles to implementing this change [11]. Lack of funding on the part of SMEs

can result in an obstacle to Digital Transformation because they are unable to purchase new equipment and innovative technologies [9].

The Digital Transformation process is defined according to three levels of maturity: Digitization, Digitalization and Digital Transformation. Digitization consists of converting information from analogue to digital format. Digitalization consists of creating innovation benefiting from digital opportunities, increasing the efficiency of processes, and creating new ways of generating value. Digital Transformation is a customer-oriented process of implementing digital technologies that requires changes in the organization [3].

Organizations can be divided into 4 categories: Beginner, Conservative, Fashionista and Digirati. A Beginner organization only uses email and the Internet for basic situations and does not envisage adopting other technologies. A Conservative organization has technological capacity, but the Organization does not exploit this capacity. A Fashionista organization is considered a Fashionista because it wishes to adapt new technologies but does not have a defined strategy for implementation. On the other hand, a Digirati organization is considered a digitally mature organization that benefits greatly from digital transformations, since it has the strategy and capacity to implement these transformations [11].

3. Systematic Literature Review

3.1. Planning

This Systematic Literature Review followed Kitchenham's [23] guidelines, in which the process was divided into three stages: Planning, Reporting and Conducting.

3.1.1. Research Questions

This systematic review aims to provide an overview of Digital Transformation today and obtain answers on how to implement it in organizations (specifically in the automotive sector), what are its benefits and requirements and what frameworks exist for its implementation. As a result, this research plans to answer the following questions:

- ***RQ1:*** *What reference models or frameworks exist for implementing a Digital Transformation in an organization?*
- ***RQ2****: What are the requirements and benefits of adopting Digital Transformation in an organization?*
- ***RQ3:*** *How to implement Digital Transformation in an organization in the automotive sector?*

3.1.2. Data Sources and Search Criteria

The selection of articles for this research was made based on the search criteria mentioned in the table below, resulting in a total of 575 papers as a result of this search. This search was done in two different databases (EBSCO and Scopus), and only articles in academic or conference journals between 2017 and 2023 and that were in English were selected.

Table 1 - Search Criteria

ELEMENT	RESEARCH DETAILS
Source	EBSCO and Scopus
Final Search String	(Organization OR enterprise OR corporate OR company) AND ("digital transformation" OR digitalization) AND (Framework OR "Reference Model") AND ("Automotive sector" OR "Automotive Area" OR "Car Repair Shop")
Search Strategy	Articles in academic journals or conference materials, between 2017 and 2023 and in English
Results	575 Papers

3.2. Conducting

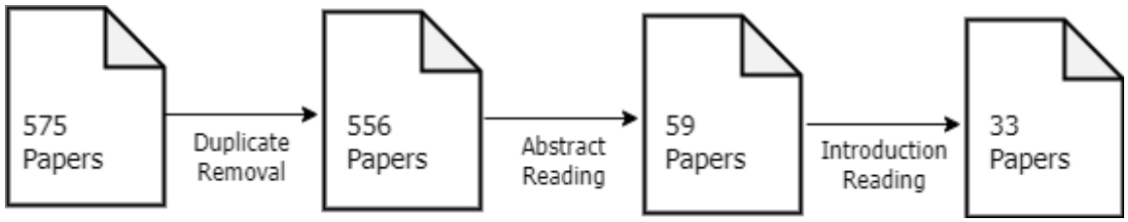
In this section, the articles selected through the search string were filtered according to inclusion and exclusion criteria. After the selection of articles, we proceeded to data extraction and analysis.

In order to obtain the set of articles based on the defined criteria, a process with several filtering stages was performed. Initially there were 575 articles; after removing duplicates, the articles became 556 elements.

After reading the title and abstract of each article, a total of 59 papers were obtained.

At the end, and after reading the introduction of each article, the final set of articles was left with **33 elements**.

Figure 1 - Papers Filtering Process



3.2.1. Inclusion and Exclusion Criteria

The titles and abstracts of each article were read, and articles were either accepted or rejected because they did not match the topic of this research. In total, 497 articles were excluded because they did not meet the selection criteria. Subsequently, the introductions of the remaining 59 articles were read.

They resulted in the exclusion of 26 articles due to not being relevant to the research questions' answers and for being of different themes than expected. In the end, 33 articles from different journals and academic conferences (Table 3) were obtained to answer the defined research questions.

Table 2 - Inclusion and Exclusion Criteria

INCLUSION CRITERIA	EXCLUSION CRITERIA
- Full Text	- Duplicates
- Peer Reviewed	- Different Subject
- Academic Journal	- Unable to get full document
- Conference Papers	- Outside the time limit (2017 to 2023)
	- Not to be in English

The substantial increase in the number of papers over the years (Figure 3.4) shows that organizations and their manages increasingly seek this topic, which is being explored and implemented in today's world.

Figure 2 - Publishing year of selected Articles

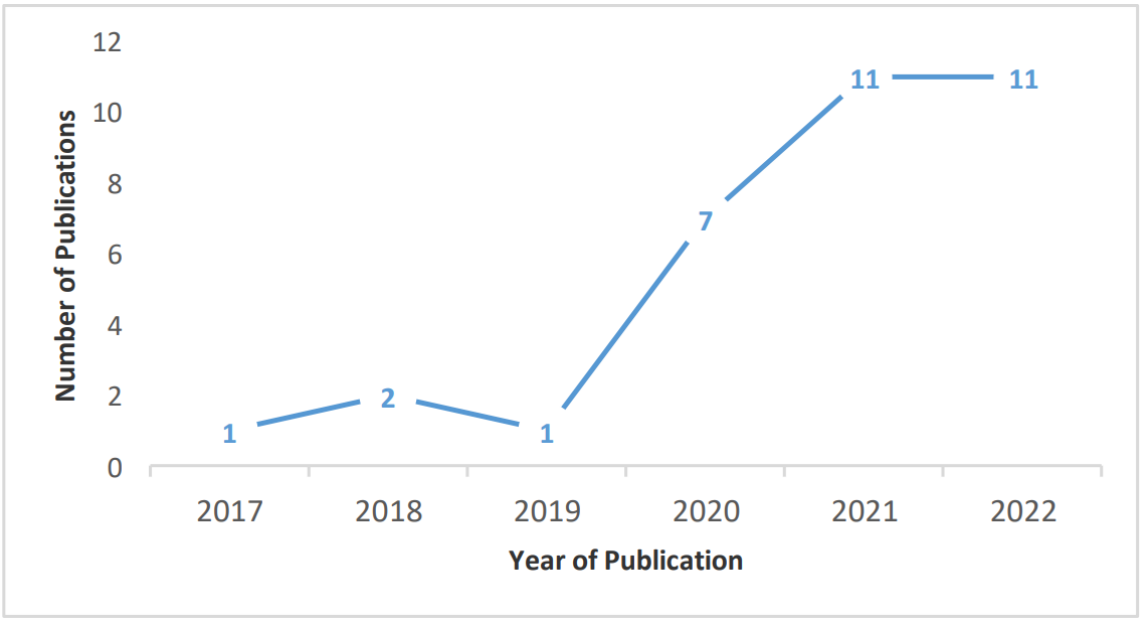


Table 3 - Publisher Papers

PUBLICATION, PUBLISHER	NUMBER OF PUBLICATIONS
Sustainability, MDPI	10
Energies, MDPI	2
MIS Quarterly Executive, Association for Information Systems	1
The South African Journal of Industrial Engineering, South African Institute of Industrial Engineers	1
Applied Sciences, MDPI	1
Organizacija, Sciendo	1
Istanbul Business Research, Istanbul University	1
Serbian Journal of Management	1
Production, Planning & Control	1
OPSEARCH, Springer	1
International Entrepreneurship & Management Journal, Springer	1
Quality Innovation Prosperity, Technical University of Kosice	1
IEEE Transactions on Engineering Management	1
Production, Brazilian Production Engineering Association	1
IEEE Engineering Management Review	1
Agricultural Management, Banat University of Agricultural Sciences & Veterinary Medicine	1
Societies, MDPI	1
South African Journal of Human Resource Management	1
Proceedings of the Institution of Mechanical Engineers, SAGE	1
European Management Journal	1
Research Policy, Science Direct	1
Procedia CIRP, Science Direct	1
Procedia Manufacturing, Science Direct	1

3.3. Reporting

In this section, and according to the reading and analysis of the articles, the answers to the research questions proposed for this research will be provided.

RQ1: What reference models or frameworks exist for implementing a Digital Transformation in an organization?

A framework for implementing Digital Transformation in an organization allows for assessing the company's maturity at the moment, and suggesting areas where it is possible to improve and implement more technologies [44].

After assessing the company's current state, it should develop a strategy to implement the technologies in the various sectors [29]. A maturity model is a sequence of steps that helps companies understand how they are doing in relation to their Digitalization and identify their strengths and weaknesses [44].

This model allows the diagnosis of the Organization, that is, to assess the level of implementation of certain technologies, as well as the planning of future implementations that will enable the level of maturity of the Organization [40].

Thus, with the assessment of the digital maturity of an organization, it is expected that this assessment will guide the Organization and its employees in the various stages of the digital transformation process more effectively and efficiently [44]. The table below shows some frameworks that can be used by any organization for the implementation of a Digital Transformation, regardless of its industry sector.

Table 4 -Digital Transformation Frameworks

Model Name/Framework	Description	Sources
IMPULS – 4.0 Readiness	The objective is to define barriers for the next implementation phase and create an action plan based on six dimensions and six maturity levels.	[40], [39]
I4.0 Maturity Model	Focus on strategic decisions and defining specific projects and programmes (nine dimensions and five maturity levels).	[40], [39]
Seven-Step I4.0 and Q4.0 Learning and Development Model	Assessing the maturity level of an organization in the automotive sector.	[39]
Theoretical Framework of enterprise DT	Digital Transformation Assessment according to the I-P-O model (input, process and output).	[17]
Digital Maturity Model - Capgemini	Evaluation of the maturity of the Organization based on four dimensions and four levels of maturity.	[39]
I4.0 Digital Operations Self-Assessment - PwC	Identify needs and assess the areas of the Organization based on six dimensions and four maturity levels.	[39]
Multi-Methodological research approach for the development of Industry 4.0 Maturity Model (MM)	Assess the situation of the Organization and suggest areas for improvement based on thirty-eight items and seven dimensions.	[44]
The development of the maturity model to evaluate the smart SMEs 4.0 readiness	Assess the situation of the Organization and its various sectors based on five dimensions and forty-three sub-dimensions.	[35]

RQ2: What are the requirements and benefits of adopting Digital Transformation in an organization?

The success of a company currently depends on how a Digital Transformation process is implemented, being that this process has a great impact on the Organization's development, regardless of its size, especially in the creation of new business models and in the enrichment of the consumer's experience [30].

With Digitalization, Organizations can obtain consumers feedback, such as their needs at the level of products and services, thus improving their quality [17]. Analyzing the selected articles made it possible to identify a set of benefits (Table 5) and requirements (Table 6) similar to all Organizations with the adoption of Digital Transformation.

Table 5 - Digital Transformation Benefits

Benefits	Sources
Best Product/Service Quality	[17], [46], [26], [10]
Competitive Advantage over Competitors	[26], [10]
Cost Savings	[41], [10]
Better Consumer Experience	[17], [26]
Productivity Increase	[41], [26]
Waste Reduction	[41]
Consumer Feedback	[17]
Raw Materials Reduction and Optimization	[41]
Creation of new Products/Services	[46]
Greater Organizational Efficiency and Effectiveness	[26]

The level of Digitalization of an organization may represent a barrier to adopting Digital Transformation, so the different requirements and strategic objectives should be aligned and specified, as well as the different actions to be performed [30].

Moreover, to better define the digitalization framework, the organization leaders must clarify all the factors that will affect the employees to understand the objectives and benefits of this transformation [45].

Sometimes, and despite the compliance with the resources specified by the Organization, some barriers block the implementation of a Digital Transformation, such as the lack of understanding of the strategy, insufficient financial and human resources, and lack of qualification of employees, among others [28].

Thus, many requirements are common to Digitalization and that should be considered before implementing technologies in the Organization, such as a high internet network capacity, financial capacity for change, and qualified employees, among other requirements mentioned below [14].

Table 6 - Digital Transformation Requisites

Requisites	**Sources**
Financial Capability	[14], [28], [30]
Network Capacity	[14], [28]
Qualified Employees	[14], [17]
Alteration of the Organisational Structure	[45], [10]
Business Model Assessment	[10]
Evaluation of the Implementation Strategy	[10]
Market and Competition Assessment	[10]
Employee Development (Skills and Competencies)	[10]
Change in the decision focus of Leaders	[17]

RQ3: How to implement Digital Transformation in an organization in the automotive sector?

Trends in the automotive sector impose the adoption of new technologies and business models by organizations in this sector [39]. However, Digital Transformation is not only that but also the ability to respond to customer needs [30].

For the Digitalization of an organization to exist, there needs to be recognition of the need for change, explanation and involvement of all the company's employees, along with planning of the changes that will be made. Subsequently, this transformation is implemented, and feedback will be obtained on the changes made [45].

According to [17], Digital Transformation refers to completely changing the business (such as the business model, organization structure, and strategies) to adopt digital technologies to create a data-driven value creation system. This process consists of three phases: **Informatization, Datafication, and Intelligence.**

In the Informatization phase, the Organization must plan the transformation according to its characteristics and its industry to subsequently adopt the technologies and support the digitalization process. During this phase, the company must undergo restructuring to keep up with the development of this process.

In the Datafication phase, organizations must introduce the technologies, as well as adjust their strategies according to their development and innovation needs. With this, organizations are expected to have digital systems and platforms at the end of this phase. Finally, in the Intelligence phase, the company should be dynamic and constantly updating, and thus responding to the permanent emergence of new technologies in the market ensuring that these technologies are implemented in the Organization. At this stage, companies should already be fully digitized and be able to develop a long-term growth strategy to increase their potential in the future.

On the other hand, according to [12], not all processes for implementing a Digital Transformation are equal since it is not possible to develop a universal process for all companies due to the different characteristics in the functioning of each Organization.

However, in the presented case studies, a path is suggested for the implementation of digital technologies in an organization with the following phases:

- Preliminary work - Planning, internal auditing and preparing the company for the first projects (such as setting up IT systems).
- Definition of a Strategic Objective
- Development of a Pilot Project
- Launching the project (launching intelligent production)
- Increasing emerging technologies in the Organization's processes (related to cybersecurity, IoT)

For the transformation of an organization, it is not only necessary to integrate technologies but also to include innovative approaches and business models, just as it is also important to raise awareness and train employees about this implementation and its importance for the Organization.

This path is always trial-and-error and may not always go well; there is always the risk of failure in this implementation because not all companies have the same size and technologies, so not all can follow this path [12].

A Digital Transformation in an automotive SME should start with the initial assessment of the implementation of technologies. A pilot project should be developed and implemented where the technologies desired by the Organization are integrated, and this project should include a strategic plan [10].

4. Research Methodology

This section presents the problem that gave rise to this research, the process followed to solve the problem, the Framework, and the definition and implementation of the Questionnaire.

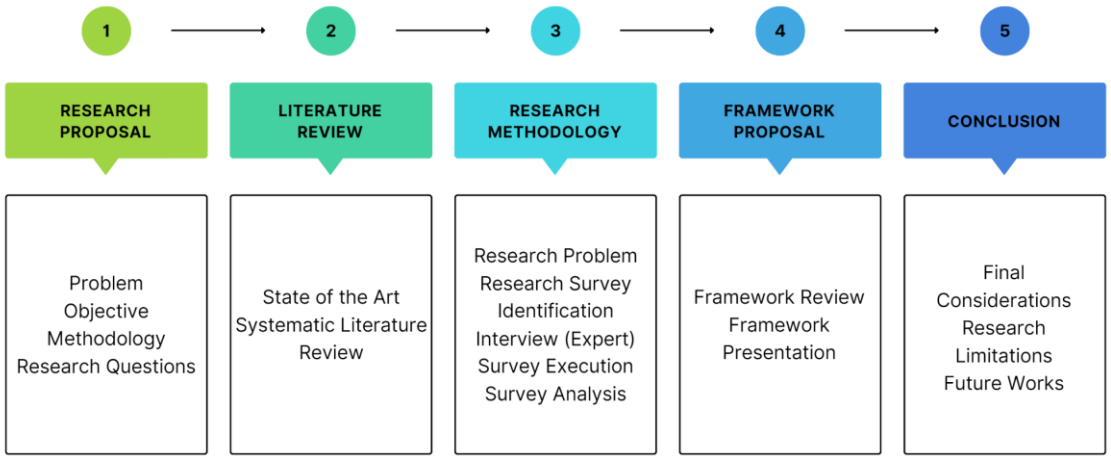
4.1. Research Problem

Currently, companies in the Automotive sector are struggling with using technological solutions by the employees to perform the Organization's daily processes. In this context, and considering an organization in the Automotive sector with several employees and buildings, we can see the lack of a technological platform to support the Organization's daily processes. These processes are often supported by paper, presenting a high-risk problem due to the use of paper (in case it gets lost or torn or dirty).

4.2. Research Methodology Process

This research considers two main methodologies: the Systematic Research Review (based on answering the Research Questions) and the Questionnaire Survey. Figure 3 illustrates the work phases developed in this research.

Figure 3 - Research Methodology Process



4.3. Survey Research

A questionnaire is a data collection technique applied to a group of respondents to collect information so that it can be analyzed, interpreted and conclusions drawn, with a view to answering the research objectives [37].

In this type of survey, there is no contact with the respondent, i.e. the survey is carried out remotely. For this reason, the questions must be well organized, coherent and logical for the respondent to answer since there is no clarification of doubts at completion [4]. In addition, the Questionnaire should not be too long [34]. However, it should be structured and composed of open, closed, and general questions to collect quantitative and qualitative data.

In order to answer this Questionnaire, respondents were sent the link to the survey developed on Google Forms, as well as being informed of the purpose of the survey, why they were selected and the importance of their answers for the research.

Objectives

- Validate the interviewed's skills/knowledge on the subject;
- Validate the importance of the topic presented;
- Validate and evaluate a set of areas to be considered in the Framework;
- Gather relevant information that contributes to the development of the artefact and future approaches.

Target Audience

Three aspects must be considered when defining the target audience sample: identification, selection and size [5]. Thus, to guarantee adequate information to answer the proposed research problem, the population identified to answer the survey must have similar characteristics [16].

Around 100 employees from companies in the automotive sector were selected to answer this Questionnaire, as this dissertation is about the automotive sector. The initial aim was for all the selected participants to respond, but this was not the case. In the end, it was only possible to count on the responses of 76 of those selected for this Questionnaire. The participants work in 13 automotive workshops in the Lisbon district, from SME to international brand workshops. Thus, the segmentation was based on

several people for each company, and these people had different functions within the organization.

Questionnaire Structure

The sections proposed for this questionnaire were defined on the basis of the interview with the Automotive Expert. The Framework dimensions were developed based on these sections and the questions. The sections are as follows:

Introduction/Presentation: At this stage, the respondents should be informed about the aims and objectives of the Questionnaire and the time they will spend answering it. They should also be aware that the data collected is anonymous and confidential.

Sociodemographic characteristics of the respondent: In the first part of the Questionnaire, the questions focus on the demographic characteristics of the respondent, i.e. questions relating to age, gender and educational qualifications.

Sociodemographic Characteristics of the Organization: In the second part of the Questionnaire, the questions are related to the sociodemographic characteristics of the Organization, i.e. questions about the size of the company and the respondent's role within it.

Dimension 1 - Digital Strategy: In the first dimension of our Framework, the questions are related to the Organization's Strategy and include questions about the Evaluation of the Strategy used, Planning, Changes to the Business Model, Resources and Investment in other Business Areas.

Dimension 2 - Technology: In the second dimension of the Framework, the questions are related to the Technology used by the Organization and include questions about the importance of Technology for the Organization, what equipment the company uses and what technological tools it uses.

Dimension 3 - Processes: In the Framework's third dimension, the questions are related to the Organization's daily processes and include questions about the use of Technology in the Organization's daily processes.

Dimension 4 - Costumer: In the fourth dimension of the Framework, the questions are related to customers and include questions about how the customer has access to the Organization's products/services, the interaction channels between the company and the

customer, the adjudication/sales process and how the Organization notifies the customer.

Dimension 5 - Employees: In the fifth dimension of the Framework, the questions are related to the Organization's employees and check whether there is an investment in their training, whether the Organization is receptive to employees' opinions, whether there is internal support, whether there is a welcome when the employee joins the Organization and whether there is an Intranet in the Organization.

Dimension 6 – Artificial Intelligence and Automation: In the sixth dimension of the Framework, the questions are related to the Automation of processes, i.e. whether there are daily processes in the Organization that could be automated and which ones (if any) and whether the introduction of Artificial Intelligence into the organizations processes would be beneficial for the company.

In the table below are the questions provided in the Questionnaire used to validate the proposed Framework presented in this research.

These questions were drawn up based on the Systematic Literature Review and validated in an interview with a specialist in the automotive sector.

Table 7 - Survey Questions

Section	Item	Question	Objective
Sociodemographic Characteristics of the Respondent	Age	Age	Characterize the respondent's age
	Educational Qualifications	Educational Qualifications	Characterize the respondent's academic degree
	Level of Technology Knowledge	Level of Technology Knowledge	Characterize the level of knowledge of technologies
Sociodemographic Characteristics of the Company	Dimension	How many employees does the Organization/Company have?	Characterize the Organization's size.
	Function	What is your role within the Organization?	Characterize the respondent's role within the Organization.

Dimension 1 - Digital Strategy	Strategy Evaluation	What is your overall assessment of your company's innovation strategy?	Global assessment of the Organization's strategy
	Planning	Is the implementation of innovation activities in your Organization planned in advance?	Check the existence of planning for innovation activities.
	Changes to the Business Model	Did the Organization need to change its business model and/or daily processes in order to carry out some kind of innovation?	Check the need to change the Business Model and/or Daily Processes.
	Resources	Before implementation, does the Organization check that the available resources are sufficient for implementation? (e.g. Internet, financial resources, etc.)	Check the resources for implementation.
	Investment	Has your Organization invested or planned to invest in any of these business areas?	Check which areas the Organization has innovated in and which areas are planned.
	Reference Model/Framework	Which Reference Models and/or Frameworks for implementing Digital Transformation have been used by your Organization?	Verify the use of Reference Models/Frameworks in implementing Digital Transformation.
Dimension 2 - Technology	Importance of Technology	How important is Technology to your Organization?	Identify the importance of Technology for the Organization.
	Equipment	What technological equipment does your company use?	Identify the Organization's technological equipment.
	Tools and Applications	What tools and applications does the company use?	Identify the Organization's tools and/or applications.
Dimension 3 - Processes	Use of Technology	From the moment a vehicle enters your Organization's premises until it is delivered to	Identify the processes that use Technology.

		the customer after the service, do you use any kind of Technology? & Which processes in your Organization use Technology?	
Dimension 4 – Costumer	Availability of Products/Services	How does the customer know about the Products/Services offered by the Organization?	Identify how the Organization makes its products/services available.
	Customer Interaction Channels	What are the channels through which customers can interact with your company?	Identification of the Organization's Customer Interaction Channels
	Adjudication/Sale Process	How is the Awarding/Selling of the Organization's Products/Services carried out?	Identification of the Organization's Product/Service Procurement/Sales process
	Notification	When the service performed by your Organization on a car is finished/complete, how is the customer notified?	Identify how the Organization notifies the customer.
Dimension 5 – Employees	Investment in Training	Does your Organization invest in employee training?	Identify whether there is an investment in employee training.
	Employees' Opinion	Is your Organization receptive to employees' opinions/ideas on Innovation or Digital Transformation?	Checking the Organization's receptiveness to the opinion of its employees.
	Internal Support	Is there internal support (Helpdesk, etc.) from the Organization for employees?	Check the existence of internal support within the Organization (e.g. HelpDesk)
	Welcome	Is there a welcome for new employees using digital solutions?	Check the existence of a welcome for new employees.
	Intranet	Does your Organization provide its employees with an Intranet?	Check the existence of an Intranet in the Organization.

Dimension 6 – Artificial Intelligence and Automation	Process Automation	In your opinion, are there any daily processes in your Organization that could be automated?	Check for processes that can be automated
	Automated Processes	Which processes do you think would make sense to introduce Automation/Artificial Intelligence?	Identification of the Organization's daily processes that are already automated.
	Performance	In your opinion, would the introduction of Artificial Intelligence and/or the Automation of processes lead to performance gains in the day-to-day work of employees?	Verification of opinion on the introduction of Artificial Intelligence in the Organization.

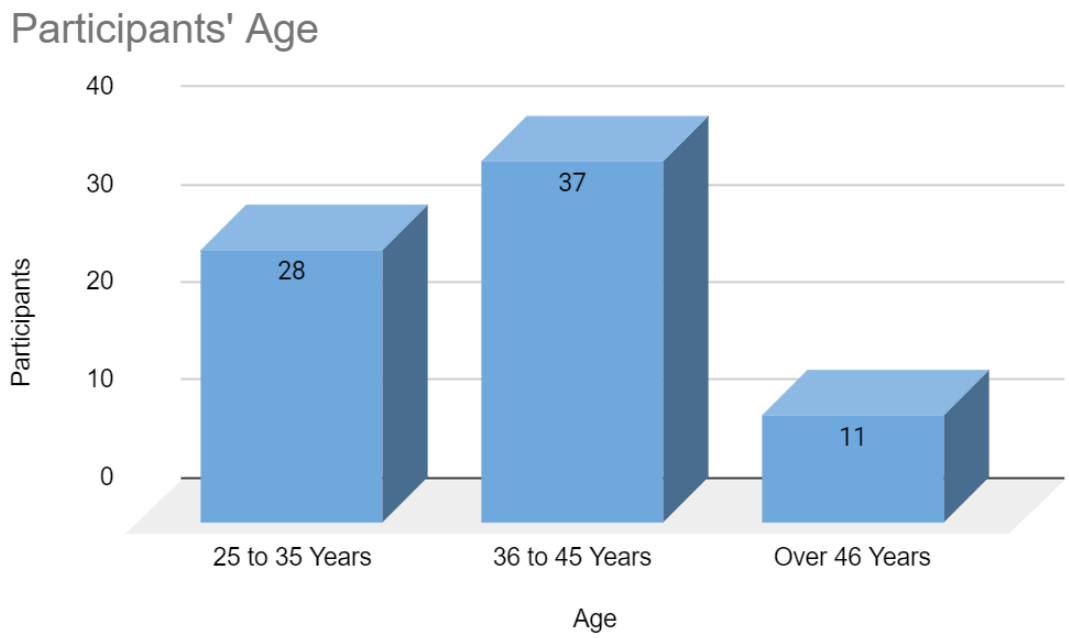
5. Data Extraction and Analysis

The data was collected using a Google questionnaire (Google Forms), sent to around 100 people linked to the automotive sector, from which a sample of 76 people was obtained, characterizing around 70% of the target audience. By free consent and anonymously, the participants answered this Questionnaire according to the results presented below.

5.1. Sociodemographic Characteristics of the Respondent

At the beginning of the Questionnaire, the first question was intended to put the age group of each respondent into context. Figure 4 shows that the most participants (37) are between 36 and 45 years old, 28 are between 25 and 35, and only 11 are over 46.

Figure 4 - Age

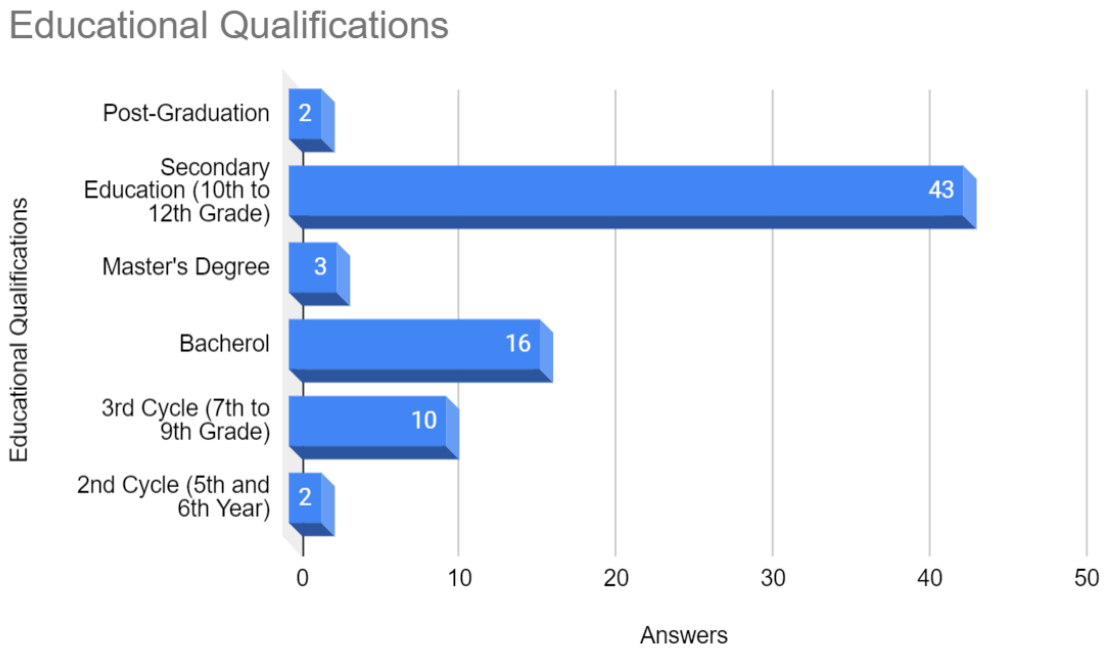


Another essential characteristic that this Questionnaire aims to collect is the educational background of each respondent. Educational qualifications also allow us to validate whether each participant knows the existing Reference Models/Frameworks.

The data in Figure 5 illustrates that the largest percentage of participants (56.6% - 43 participants) have a secondary education (from 10th to 12th grade), 21% (16 participants)

have a degree, 13% (10 participants) have a third cycle education (from 7th to 9th grade). In addition, 3 respondents have a Master's degree, 2 respondents have a Postgraduate degree, and 2 participants have a 2nd Cycle degree (5th and 6th Year).

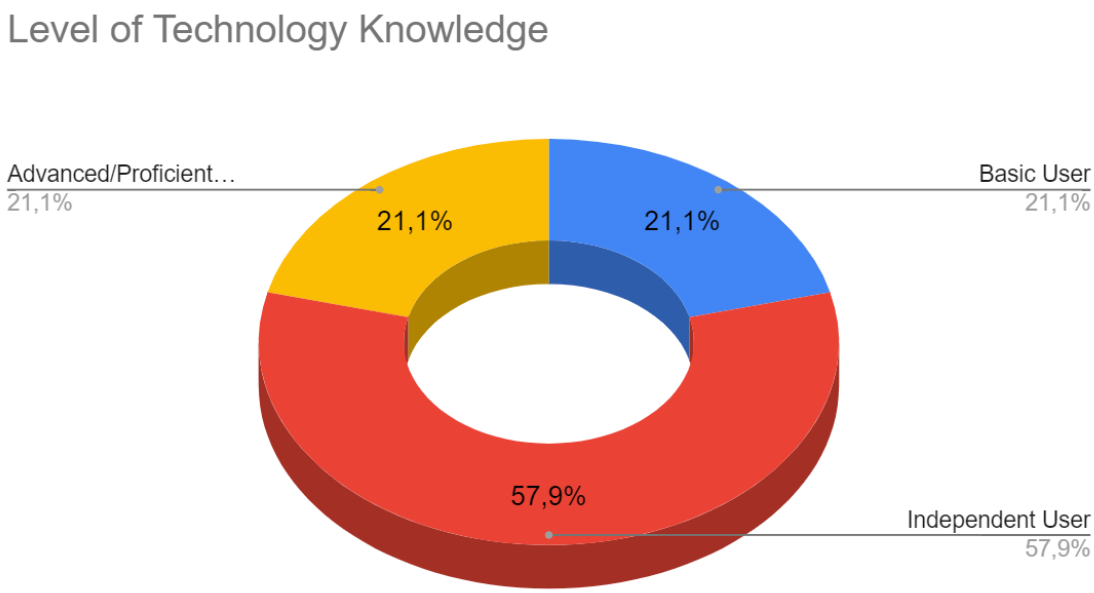
Figure 5 - Educational Qualifications



The third and final question regarding the respondents' sociodemographic characteristics aims to validate each respondent's knowledge of Technology (Figure 6).

The majority of participants (44 participants - 57.9%) are characterized as Independent Users, and the same number of participants (16 participants - 21.1%) are characterized as Basic Users or Advanced/Proficient Users. The answer to this question lets us know that the respondents have some knowledge of Technology to enable them to answer this Questionnaire.

Figure 6 - Level of Technology Knowledge

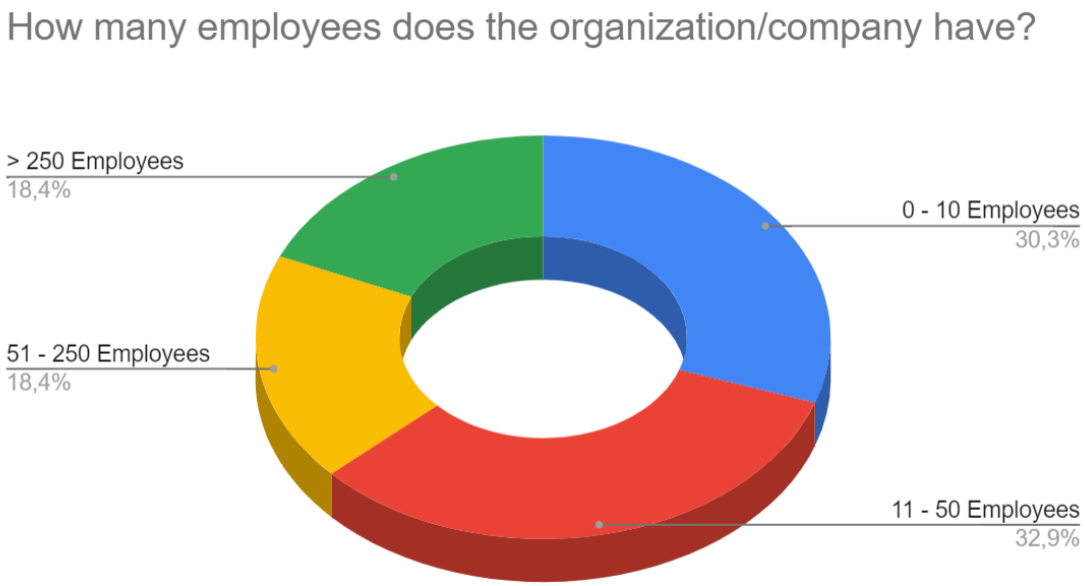


5.2. Sociodemographic Characteristics of the Organization/Company

This section aimed to collect each company's characteristics (such as the size and function of the respondent) for statistical analysis and to validate the participant's knowledge of the research topic.

In order to have an idea of the size of the Organization that employ the participants in this Questionnaire, the majority of companies (25 companies - 32.9%) have between 11 and 50 employees, 23 companies (30.3%) have between 1 and 10 employees and the same number of companies (18 companies - 18.4%) have between 51 and 250 employees and/or more than 250 employees.

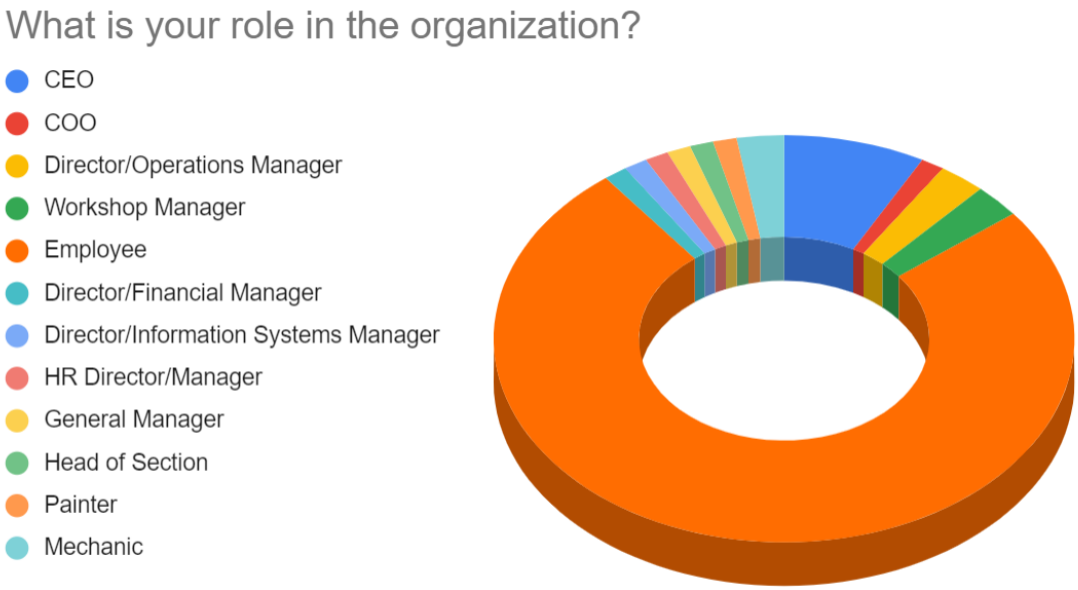
Figure 7 - Dimension



Within the organizations, 75% (57 participants) of the respondents did not specify their role, and they just mentioned that they were employees of the Organization.

Of the total participants, 6 (around 8% of the responses) are company CEOs. Of the remaining participants, 2 are Directors/Operations Managers, 2 Workshop Managers, 2 Mechanics, 1 COO, 1 Section Manager, 1 Painter, 1 General Manager, 1 Director/Financial Manager, 1 Director/Information Systems Manager and 1 Director/Human Resources Manager.

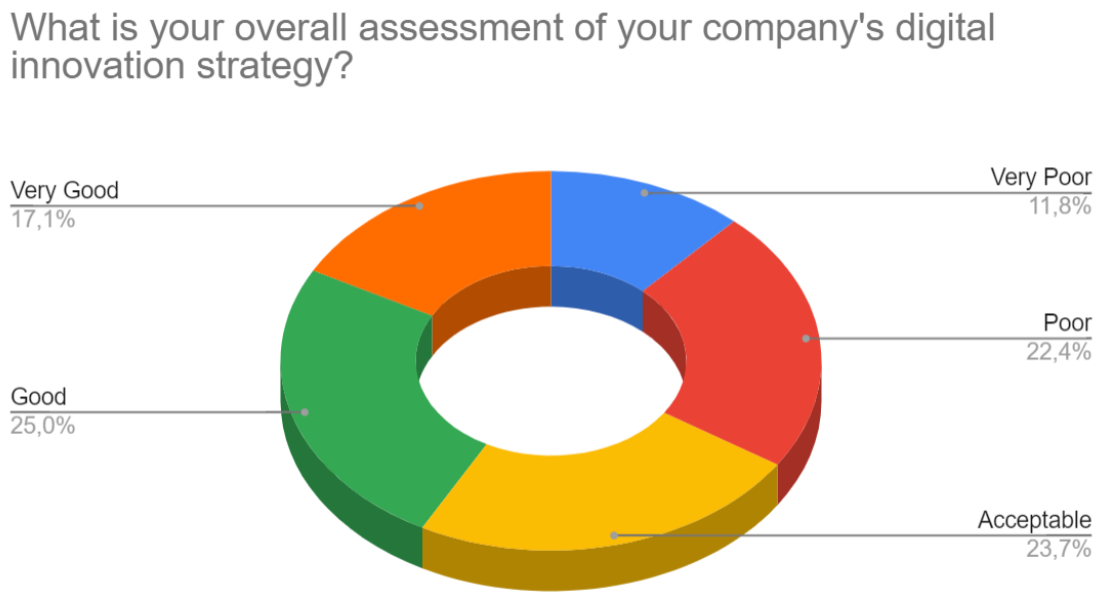
Figure 8 - Function



5.3. Dimension 1 - Digital Strategy

This question was designed to determine what employees think of their company's digital innovation strategy. The majority of respondents (25% - 19 respondents) chose their company's strategy as Good, 18 respondents (23.7% of responses) chose their strategy as Acceptable, around 22% (17 respondents) chose it as Poor and around 12% of respondents chose their company's strategy as Very Poor. However, 13 participants (around 17% of responses) describe their company's innovation strategy as Very Good.

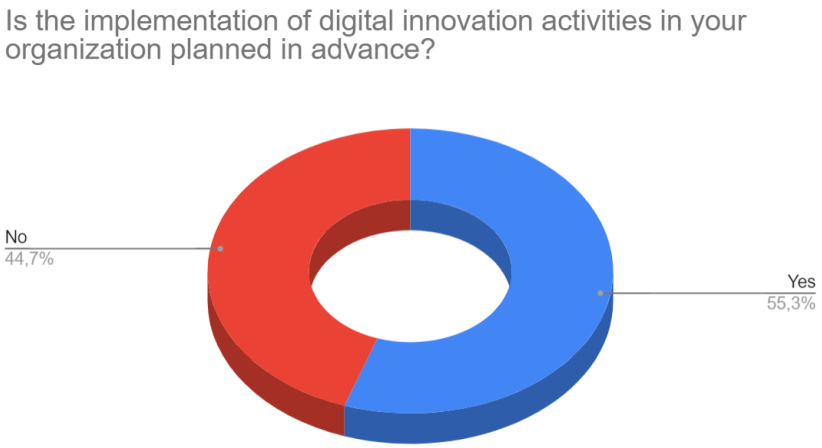
Figure 9 - Strategy Evaluation



The question below aimed to validate the existence of planning for the implementation of digital innovation activities in the Organization.

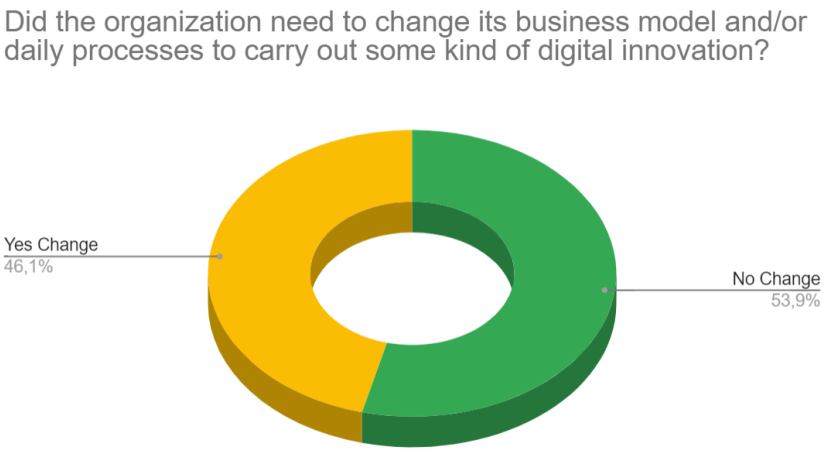
More than half of the respondents (42 participants - 55.3% of the answers) revealed that the implementation of innovation activities in their company is planned, while the remaining participants (34 participants - 44.7% of the answers) replied that these implementations are not planned by the Organization in which they work.

Figure 10 - Planning



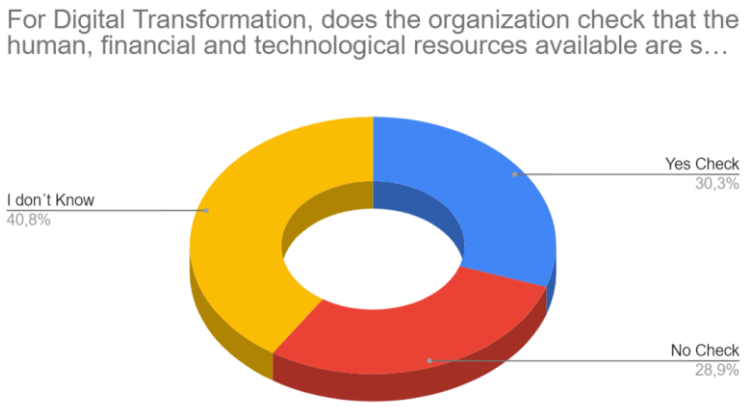
Furthermore, changing the business model or daily processes is necessary when Digital Transformations are implemented in an Organization. Around 46% of respondents replied that their company had to make changes. In contrast, the remainder replied that their company had not changed the business model and/or daily processes during these implementations.

Figure 11 - Changes to the Business Model



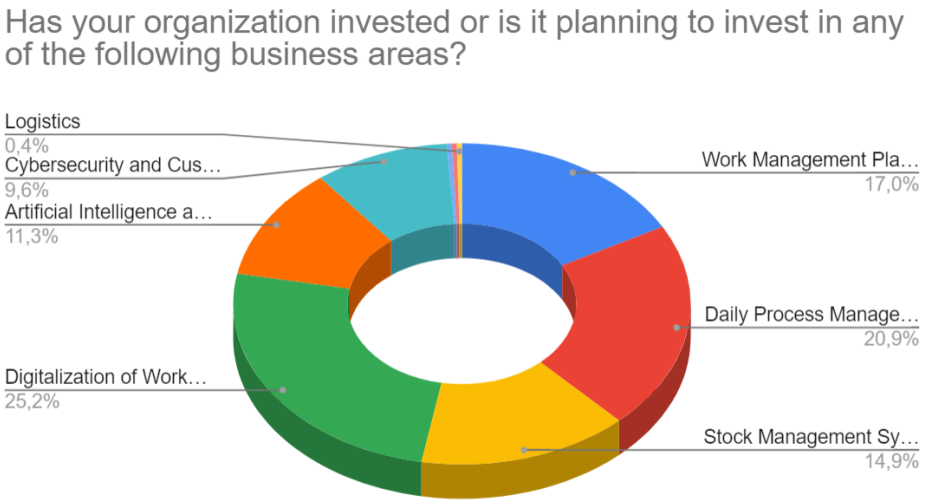
According to Figure 12, 30% of companies (23) check that resources (human, financial and technological) are sufficient before making digital implementations. Around 29% of companies (22) do not check resources before making these changes. Finally, 40% of the participants (31 people) do not have enough knowledge about the subject to be able to answer this question.

Figure 12 - Resources



The question in the figure below aims to reveal the areas in which companies have most invested or plan to invest. Thus, according to the answers obtained, companies have invested/plan to invest, in the majority of cases, in the Digitalization of Work Tools (such as Automotive Diagnostic Machines and lifting Platforms, among others) and Daily Process Management Software (such as Worksheet Writing, Customer Data Recording, Appointments, among others).

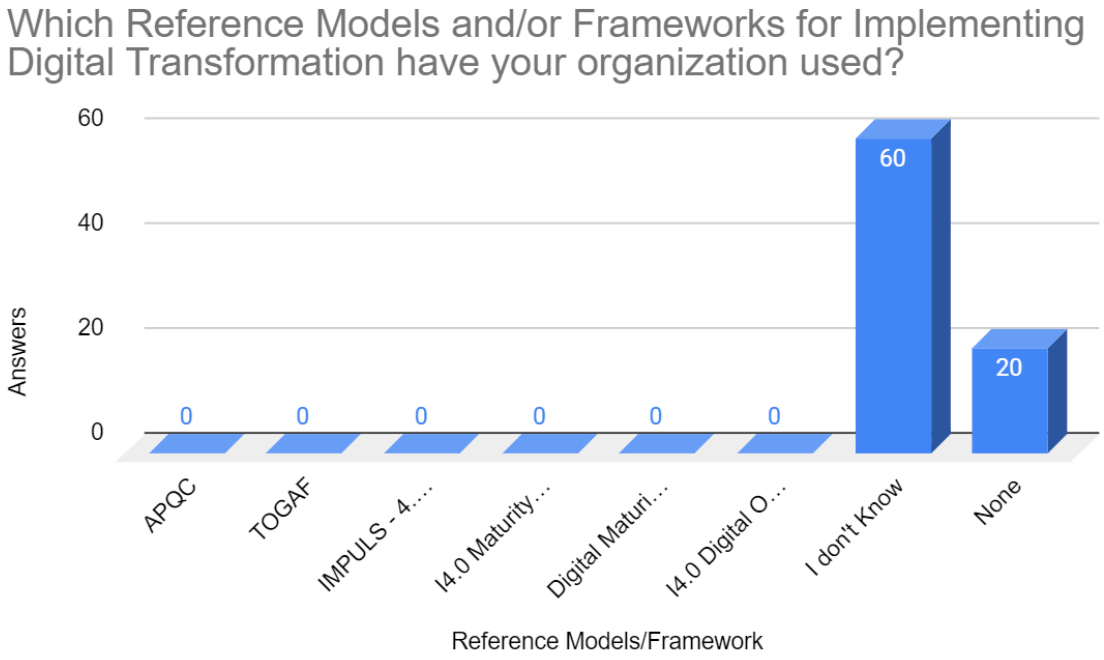
Figure 13 - Investment in Business Areas



The question mentioned in the figure below ("*Which Reference Models and/or Frameworks for the Implementation of Digital Transformation have been used by your organization?*") was intended to validate the respondents' knowledge of the existence of Reference Models or Frameworks and their application in the implementation of the Organization's Digital Transformation.

No Reference Model/Framework was chosen as the answer to this question. Only answers such as "I don't know" or "None" were obtained, so it can be concluded that the respondents do not know the Reference Models or Frameworks used in the implementation of Digital Transformation in their Organization.

Figure 14 - Reference Models/Frameworks

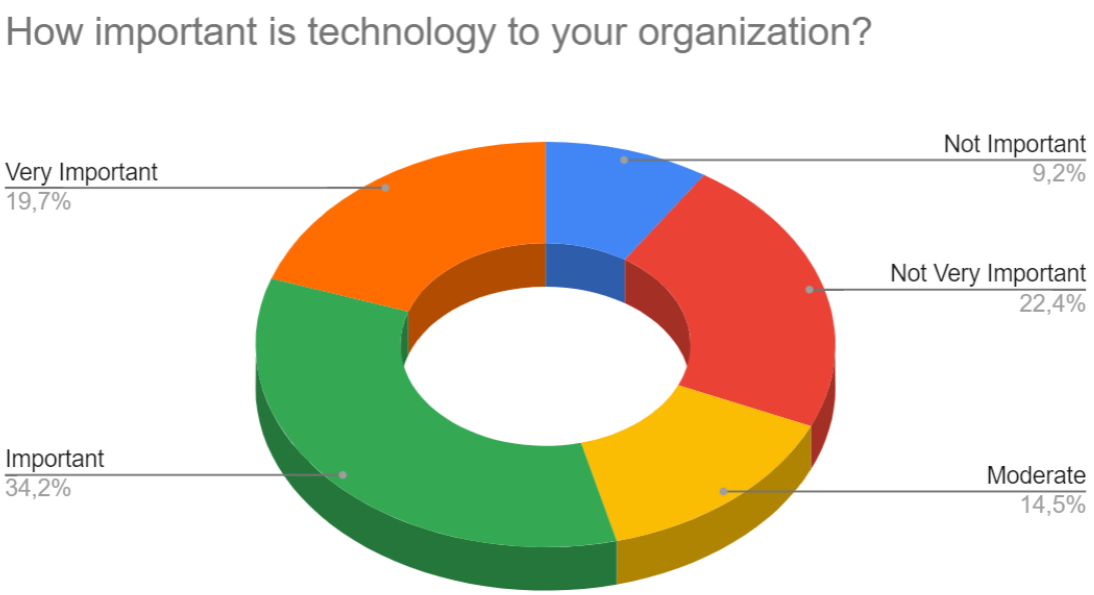


5.4. Dimension 2 - Technology

Technology is important to most of the companies in this Questionnaire. More than 30% of respondents consider Technology "Important" for their Organization, while around 20% consider It "*Very Important*".

On the other hand, 11 respondents consider the importance of Technology to their company to be "*Moderate*". In contrast, around 22% of respondents consider Technology "*Not very important*" to their Organization, and 9% consider it "*Not at all important*".

Figure 15 - The importance of Technology



This question was asked to find out what technological equipment each company has, and a list of various pieces of equipment was presented, giving the respondent the option of adding any missing equipment to the list.

Analyzing the answers to this question, the equipment most used by the companies are Computers, Printers, Mobile Devices (such as Smartphones and tablets, among others), Car Diagnostic Machines and some equipment specific to the automotive sector (such as Vehicle Lifts, Air Conditioning Charging Machines, among others).

Table 8 - Technological Equipment

Technological Equipment	Answers
Computers	76
Printers	76
Mobile Devices (Smartphones, Tablets, etc.)	75
Car Diagnostic Machines (Scanner)	74
Vehicle Elevator	74
Painting Booth	59
Steering Aligner	61
Tire Balancing Machine	61
Headlight Focusing Machine	66
Air Conditioning Charging Machine	66
Video Surveillance System	1

In the same vein as the previous question, this question aimed to find out which tools and applications are used in the day-to-day running of organizations. All companies in the various sectors in Portugal must have invoicing software (which is why it was the tool with the highest number of responses). In addition to this, and based on the number of responses, most companies also have a website or cloud storage.

Table 9 - Tools and Applications

Tools and Applications	Answers
Website	55
Billing Software	75
Work Platform (Intranet)	33
CRM and ERP Solutions	27
Data Analysis/Decision Support Solutions (Business Intelligence, Tableau)	22
Digital Marketing Solutions (SEO, Email Marketing)	27
Antivirus and Antimalware	33
Authentication and Access Control Solutions	23
Data Encryption	24
Cloud Storage	42

5.5. Dimension 3 - Processes

In order to understand whether the Organization used Technology in their daily processes, the question "*Which of your organization's processes use technology?*" was asked to find out which processes are used in the day-to-day running of the Organization. One of the processes that uses Technology in the largest number of organizations is Vehicle Problem Diagnosis, followed by Vehicle Maintenance/Repair Service and Steering Alignment Service. There was only one response in which the respondent's Organization does not have any processes that use Technology.

Table 10 - Processes

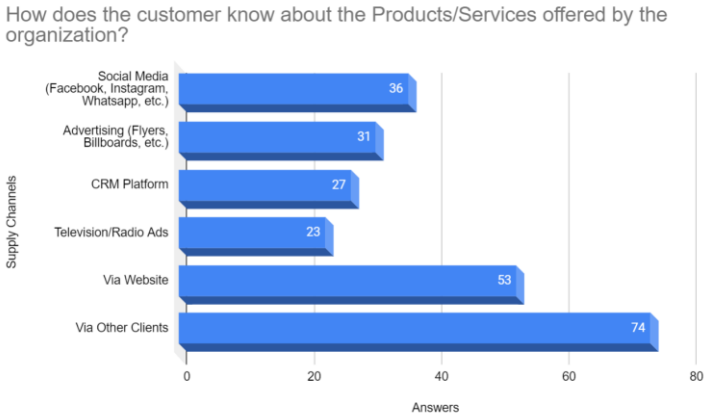
Processes	Answers
Vehicle Repair/Maintenance Service	73
Vehicle Direction Alignment Service	71
Vehicle Painting Service	65
Car Wash Service	65
Creation of Worksheets (with Vehicle and Customer Data)	66
Creating/Sending Invoices to Customers	69
Diagnosis of Vehicle Problems	75
Administrative Processes	62
Payments	68
Contact with Suppliers	57
Logistics	49
Does not use Technology in any Process	1

5.6. Dimension 4 - Costumer

This section aims to validate some aspects that link the company to the customer, such as the form of interaction between the company and the customer, how the Organization makes its products/services available, how the procurement process is carried out and how the company notifies the customer.

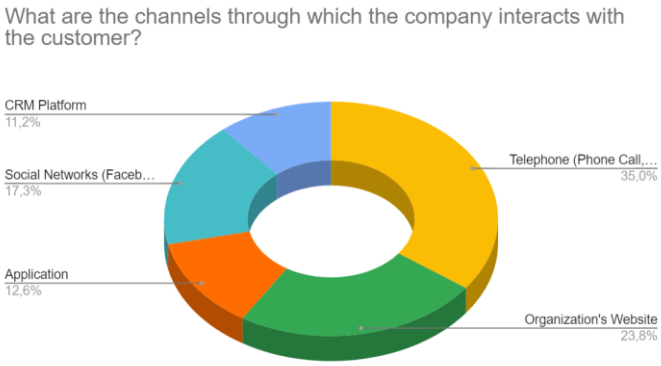
According to most of the answers to this question, customers find out about the Organization's products/services mainly through its website or from other customers. In addition, it is sometimes possible to find out via social networks or advertising.

Figure 16 - Availability of Products/Services



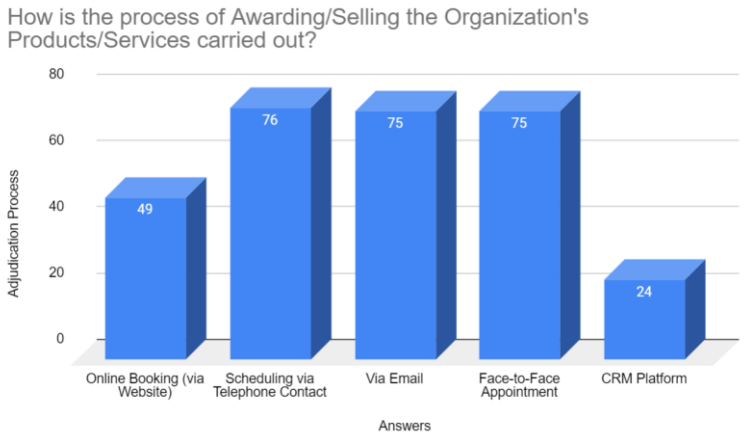
The question below aims to validate companies' channels to interact with their customers. The most used channel for the company to interact with the customer is via telephone since it is easy to access and interact with the customer. It is also the channel most used by the customer to communicate with the company. In addition, many companies communicate with customers via their websites or social networks.

Figure 17 - Customer Interaction Channels



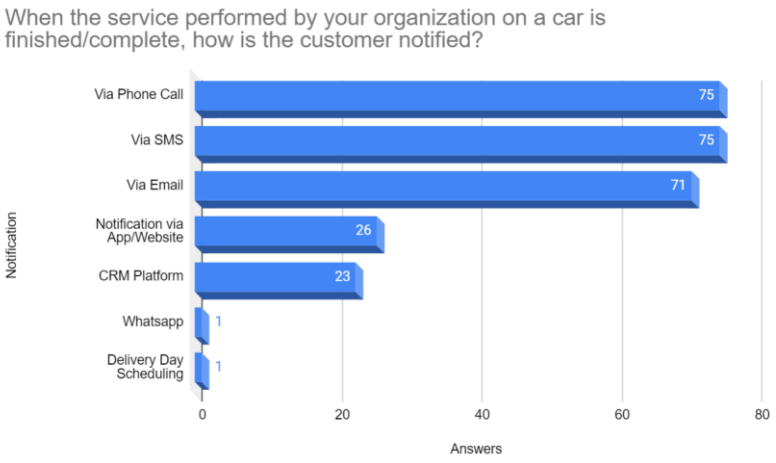
The question below was asked to find out how the process of selling the Organization's products/services is carried out, based on the options listed in the question. Most of the time, according to the answers to the question shown in the figure below, selling the Organization's services/products is carried out through telephone contact, email or in person.

Figure 18 - Adjudication/Sale Process



The question "*When the service performed by your organization on a motor vehicle is finished/complete, how is the customer notified?*" aims to analyze the main channels through which the company contacts the customer when the service performed by the company is finished. When the Organization wants to contact the customer to notify them that the service is complete/finished, most Organizations, according to the number of answers shown in Figure 19, contact the customer via phone call, SMS or email.

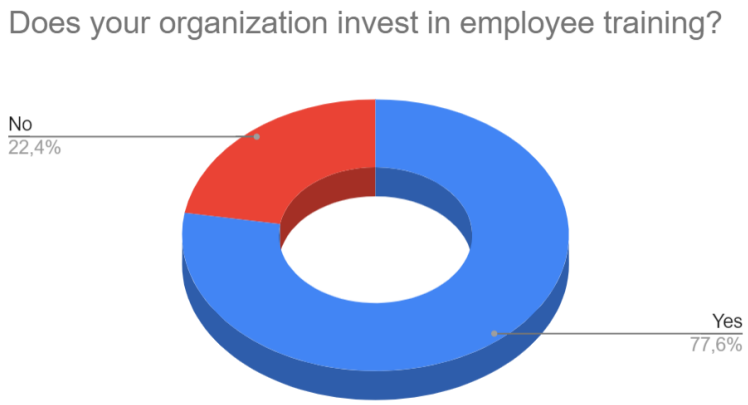
Figure 19 - Notifications



5.7. Dimension 5 - Employees

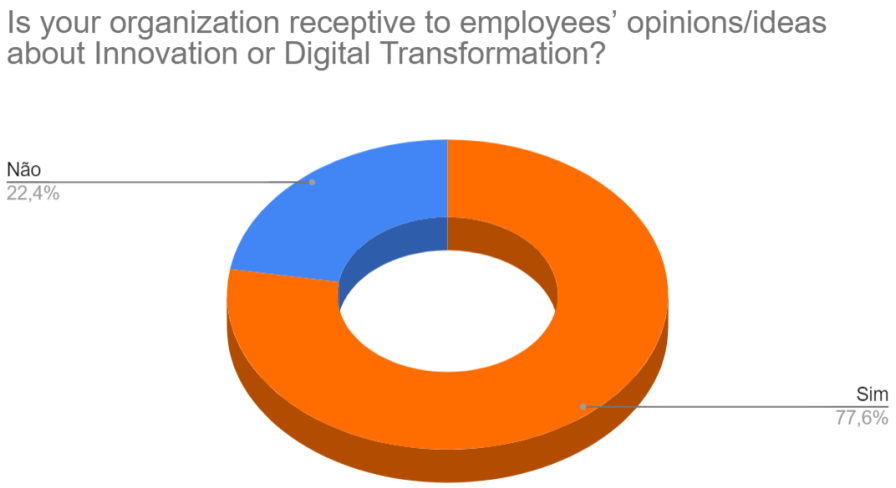
The first question in this dimension aims to validate whether Organizations invest in employee training. Most participants (around 78% of the respondents) answered that the company they work for invests in employee training, while the remaining (around 22%) answered that the Organization does not invest in employee training.

Figure 20 - Training



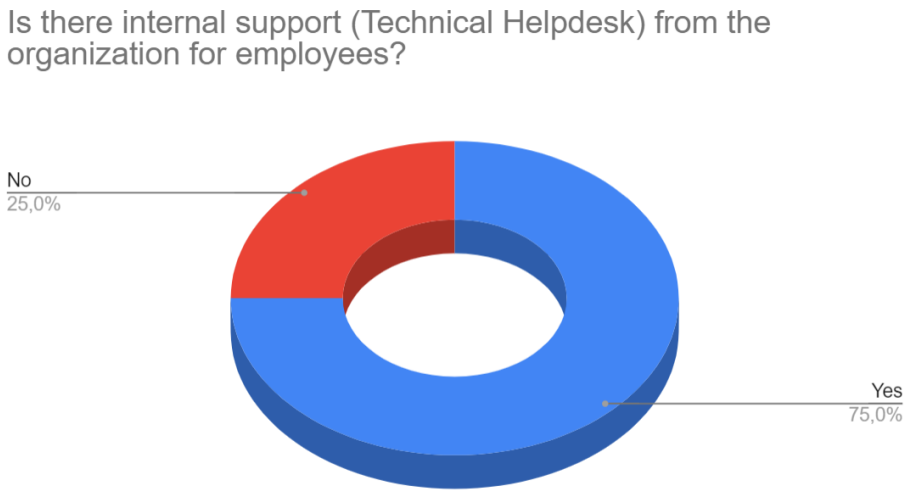
One of the questions presented in this Questionnaire aimed to find out whether the Organization is receptive to its employees' ideas on Innovation or Digital Transformation. Most respondents (77.6% - 59) indicated that their Organization is receptive, while the remaining participants indicated that their Organization is not receptive to their ideas for improving the company.

Figure 21 - Employees' Opinion



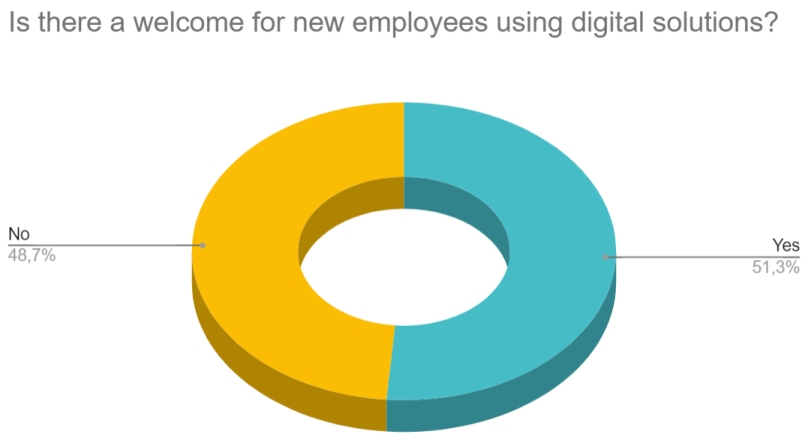
This question allowed us to understand whether the company provides the necessary helpdesk for its employees, since technical support is often needed to solve technical problems with certain work tools (applications). The majority of respondents (75% of replies - 57 people) answered that their Organization provides the technical helpdesk needed to solve these problems.

Figure 22 - Helpdesk



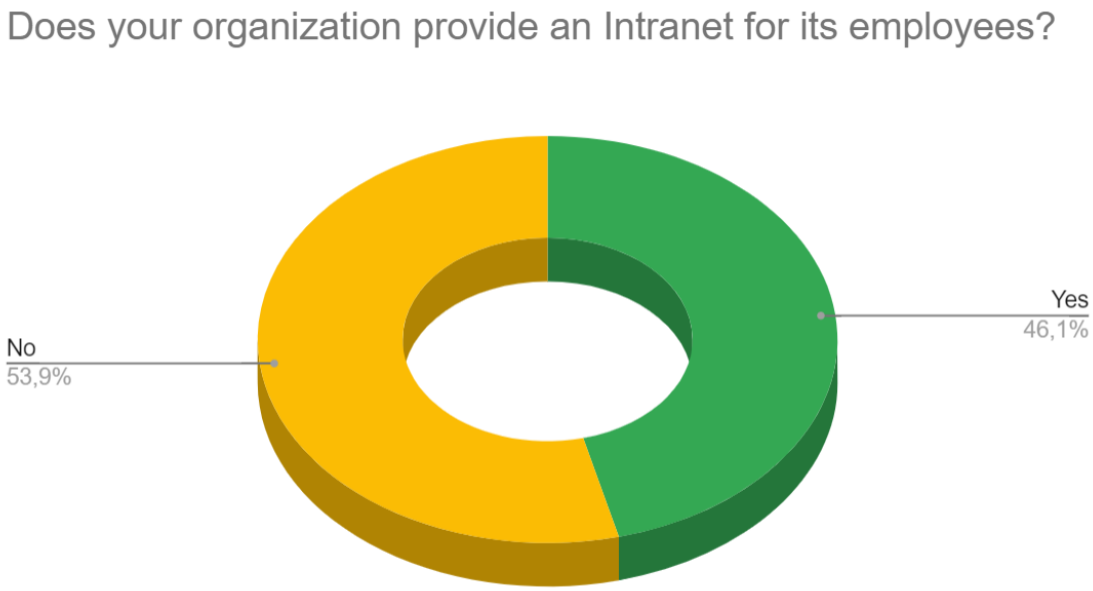
The answers to the question about welcoming new employees using digital solutions were divided, with no clear absolute majority. Around 51% of respondents said that their Organization welcomes new employees, while the rest (around 49%) said that their company does not welcome new employees.

Figure 23 - Welcome



The question below allowed us to validate whether or not companies make Intranet available to their employees to obtain daily performance benefits. As a result, most companies involved in this Questionnaire (around 54%) do not provide an Intranet for their employees, while the remaining companies (around 46%) do.

Figure 24 - Intranet

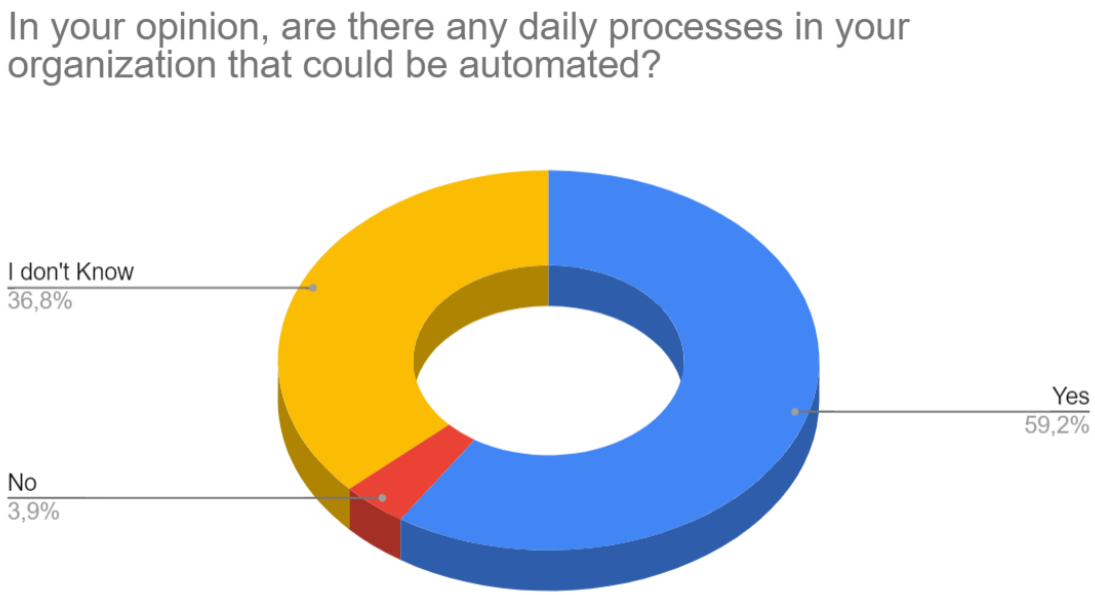


5.8. Dimension 6 - Artificial Intelligence and Automation

This dimension aims to assess the respondents' knowledge of Artificial Intelligence and Automation, the possible opportunities for their introduction into the Organization, and the processes in which it is possible to introduce these innovations.

Thus, the question below aims to confirm the existence of processes that could be automated within each Organization. The majority of participants in the Questionnaire (around 60% - 45 people) answered that there are daily processes that can be automated, with only 3 respondents answering that there are no processes in their Organization that can be automated. Twenty-eight (28) participants answered "*I don't know*" to this question.

Figure 25 - Process Automation



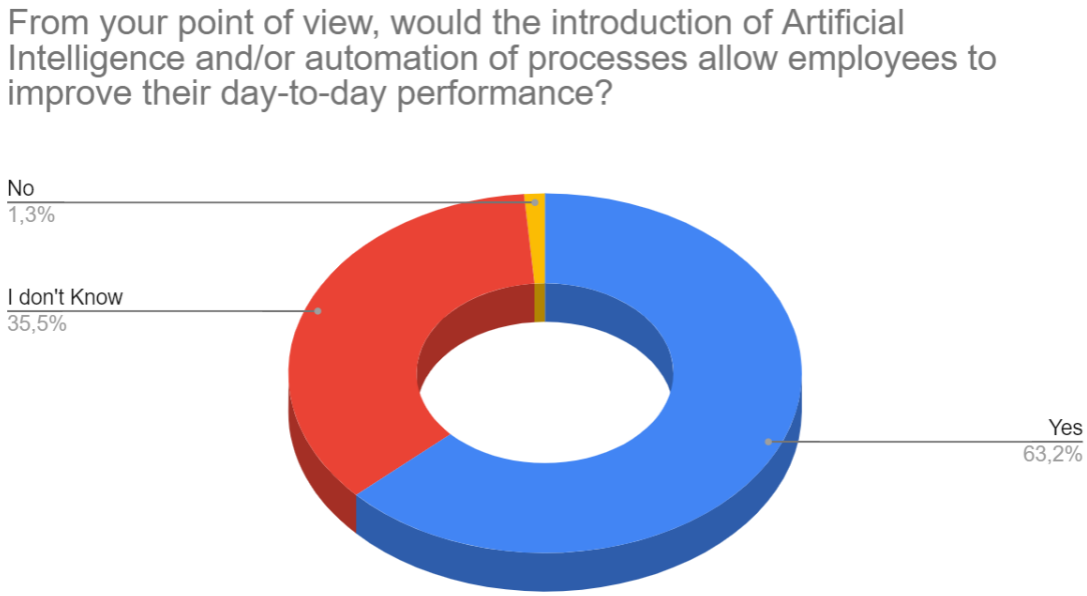
The question "*In which processes do you think it would make sense to introduce Automation/Artificial Intelligence?*", which is represented with the answers in the table below, was intended to validate the Organization's processes in which it is possible to introduce Artificial Intelligence or Automation, to obtain benefits both in terms of costs and performance.

Table 11 - Automated Processes

Processes	Answers
Vehicle Maintenance and Repair (e.g. Introduction of Robots, etc.)	41
Invoicing/Administrative Area (Worksheets, Customer Invoices, among others)	44
Material Procurement/Supplier Contact (Integration with the Supplier API, for example)	43
Logistics	42
Customer Support	43
Communication and Marketing	43
Human Resources and Training	41
I don't know	31
Cleaning the Workplace	1

More than half of the participants (around 63% - 48 respondents) believe that introducing Artificial Intelligence and/or Automation into their daily processes would benefit the Organization's productivity. Even so, there was 1 participant did not see the introduction of Artificial Intelligence as a benefit for their company. Around 35% of respondents (27 participants) are not sure that introducing AI will benefit the day-to-day running of their Organization.

Figure 26 - Performance



5.9. Global Analysis of Data Extraction

In order to answer this Questionnaire, respondents were selected based on their knowledge of technologies, knowledge of Digital Transformation and identification/familiarity with this research topic. In addition, one of the aims of this Questionnaire was to validate the proposed Research Questions.

The Digital Strategy section allowed Organizations' lack of planning concerning Digital Innovation and verifying human and financial resources or even Technology.

This Questionnaire also made it possible to assess the need for reference models/frameworks for implementing Digital Transformations in the automotive sector.

It can be concluded from this section that the lack of planning and the failure to check resources can result in the incorrect implementation of Digital Transformation activities, as these activities must be planned according to the size and processes of the Organization.

The Technology section showed that Technology is increasingly important for all sectors in the market and the automotive sector is no different. According to the answers to the Questionnaire, the companies in this study see the importance of using Technology in their day-to-day work.

However, it is essential that Technology is even more important and that companies can acquire even more technological equipment, tools and applications, such as the existence of an Intranet, Cloud solutions and a Website, or even CRM and ERP solutions.

The Processes section made it clear that although Technology is used in most Organizations' daily processes, it is possible to increase the use of Technology and thus benefit from daily performance gains by using new innovative equipment available on the market.

With the Customer section, it was possible to conclude that there is unanimity in how the company interacts with the customer (mostly via telephone, such as a phone call or SMS). Organizations should work to start using other, more automated interaction channels that communicate with the customer more easily and quickly, without hindering the employee's workflow.

In addition to these improvements, organizations should make their products/services available through other channels, such as social networks.

The Employees section showed a lack of investment in employees and their knowledge by organizations. In addition, it was possible to see that most organizations do not provide their employees with an Intranet, which can result in a loss of performance on the part of the Organization.

The Automation and Artificial Intelligence section led to the conclusion that Artificial Intelligence and Automation are fast-growing these days, and introducing these areas will bring numerous benefits to companies. According to the answers obtained in the Questionnaire, all or practically all companies have processes that can be automated.

Finally, this Questionnaire made it possible to verify and conclude that there are several gaps in the digitalization process of Organizations in the automotive sector, showing that there is a long process of Digital Transformation for most companies. Planning, the use of a Framework, the use of Technology in Daily Processes, the availability of the Organization's Products/Services in various channels/media, and investment in its employees (in their training and intranet availability, among others) are fundamental pillars for the Digital Transformation of an organization in the automotive sector.

Organizations should also consider the introduction of Artificial Intelligence and/or Automation.

The Framework presented in the next chapter, taking into account the results presented, aims to reduce the difficulties and shortcomings of companies in their Digital Transformation.

6. Framework Proposal

After extracting and analyzing the data from the Questionnaire, evaluating and validating the dimensions and maturity items, it was possible to conclude and present the Framework.

Therefore, this chapter presents the final Framework, and the dimensions and maturity items associated with each dimension. The dimensions (and their descriptions) are shown in Table 12, while the maturity items for each dimension are shown in Table 13.

The final Framework for assessing the digital maturity of organizations in the automotive sector is based on 21 Maturity Levels, grouped into 6 dimensions.

The aim is to help organizations implement digital transitions and transformations in a business context, whether the Organization is at an early stage (at a technological level) or at a more advanced stage.

Figure 27 illustrates the proposed Framework, where each dimension is represented by a colour and its maturity items and all the dimensions are interconnected with the Organization (central element).

Figure 27 - Framework

Table 12 gives a brief description of each dimension of the Framework. This description is based on the importance of each dimension for the Organization's Digital Transition/Transformation.

Table 12 - Description of Dimensions

Dimension	Description
Digital Strategy	The main element for implementing innovation in the Organization. It encompasses different elements that make it possible to assess the company's level of implementation of the digital transformation.
Technology	The use of Technology must become the focus of the Organization. Introducing innovative technologies and equipment/tools/applications into daily processes will enable the company to stand out in the market.
Processes	Throughout the digital transition, the Organization's day-to-day processes must use Technology.
Costumer	The customer is one of the beneficiaries of the Organization's transformation. It is hoped that the interaction between them and the company will be easier and that the service/product offered by the company will be better.
Employees	Fundamental elements for achieving the Organization's goals. The company must invest in their training and knowledge of new technologies.
Artificial Intelligence and Automation	An area of innovation that Organizations should consider, as it allows them to obtain performance and cost benefits.

Table 13 shows the maturity items that complement each dimension of the framework. As experience in implementing Digital Transformations increases, the dimensions and maturity items can be considered and possibly changed or added to.

Table 13 - Maturity Items

Dimension	Maturity Item
Digital Strategy	● Strategy ● Planning ● Changes to the Business Model ● Resources ● Investment
Technology	● Importance of Technology ● Equipment ● Tools and Applications
Processes	● Use of Technologies
Customer	● Availability of Services ● Communication Channels ● Adjudication/Sale ● Notifications
Employees	● Training ● Employee Feedback ● Internal Support ● Welcome ● Intranet
Artificial Intelligence/Automation	● Process Automation ● Automated Processes ● Performance

This Framework will segment companies into different levels of maturity based on the dimensions proposed by the Framework. Thus, an organization that meets all the maturity items in the Strategy and Technology dimension, for example, will be at a higher level of maturity compared to another company that does not meet the same items.

7. Conclusions

This section presents the summary of the study (together with the interpretation of the results), the limitations encountered during the research and suggestions for future work.

7.1. Summary of the Study

This research sought to scrutinize the benefits and requirements of implementing a Digital Transformation in an organization, as well as possible frameworks that can be used for this digitization and how these can be implemented in an organization in the automotive sector, using a systematic literature review.

Digital Transformation is a process of change in an Organization based on implementing new technologies in company processes. This change allows Organizations to obtain various benefits, such as increased productivity, reduced costs, and improved customer experience, giving them a competitive advantage.

This transformation can occur in all market sectors, including the automotive sector.

The automotive sector is constantly growing in terms of Technology.

The introduction of new innovative work tools (such as car diagnostic machines or vehicle elevators) allows Organizations to gain in performance compared to the past, when these work mechanisms did not exist.

Although most technologies are associated with high costs, introducing them into the Organization will increase revenue in the long term.

Improved product/service quality, reduced costs, an advantage over competitors and a better customer experience are all possible benefits of implementing Digital Transformation in an organization. However, for this digitization to take place, there are certain requirements to be met, such as the financial capacity that the company must have for the change, network capacity (Internet), and having qualified employees with knowledge of digital innovation, among other requirements mentioned in the systematic literature review.

Based on the SLR and the research, no specific reference models/frameworks exist for the automotive sector. The models analyzed are of a global context, and for this research, the need arose for a specific framework for implementing digital transformations in Organizations in this sector.

In order to find solutions to the problem identified in this research, three research questions were defined in the SLR: "*What reference models or frameworks exist for implementing a Digital Transformation in an organization*?", "*What are the requirements and benefits of adopting Digital Transformation in an organization*?" and "*How to implement Digital Transformation in an organization in the automotive sector?".*

Through SLR and the Questionnaire Survey methodology, it was possible to find answers to the research questions and present the solution to the problem identified in the research.

After analyzing the results of the Questionnaire, it was possible to finalize the Framework so that it could be presented as a solution to the problem identified in the research. The final Framework is made up of a set of dimensions, as well as a set of maturity items related to the dimensions. Six dimensions were defined: Digital Strategy, Technology, *Processes, Customers, Employees* and *Artificial Intelligence/Automation.* The dimensions and maturity items were drawn up based on the frameworks presented at SLR and then adjusted and validated with the Questionnaire and its results.

7.2. Limitations

Several limitations were identified during the the research. There was a certain difficulty in finding reference models or frameworks or implementing digital transformations in a general context using frameworks.

Even so, from the research, few practical implementation cases using frameworks were identified, mostly just theoretical cases.

Micro and small companies in the automotive sector are unlikely to use Frameworks to transform themselves digitally due to their structure, which does not allow them to dedicate part of their day-to-day to digital innovation activities. Otherwise, they will not be able to carry out their daily processes.

When preparing the Questionnaire, it was necessary to define the questions and validate them with an expert from the automotive sector. The questions had to meet the research objective, and it was also necessary to find potential respondents with sufficient skills and availability to answer the Questionnaire. All of this became a limitation, as some of those contacted were unavailable, which meant that the sample of participants was not as large as expected. With a larger number of participants, the Questionnaire could have had different results and conclusions.

Not being able to test the Framework in a real-world environment with the Organization limited this research, as it would have been practically impossible to complete this research in good time due to the delay in the process.

7.3. Future Work

This research has allowed us to see that there is still much work to be done in this area, and there is a lot of room for improvement and evolution in the digital transition and transformation process of Organization in the automotive sector.

With this in mind, and realizing that the future of Organization lies in their digital transformation, we believe that this research can be considered as a basis for future work.

This Framework can be improved using a larger and more diverse sample, thus reviewing the dimensions and their maturity items.

Considering the advantages that Digitalization gives companies, it would be relevant for them to create innovation departments where they can develop and test new solutions and evaluate new trends in the market.

Testing the Framework in a real environment in Organization could increase its effectiveness in implementing Digital Transformations in Organization.

In the future, it is hoped that a technological solution will be developed which, with the help of the Framework presented, allows companies to integrate their daily processes (such as creating invoices, worksheets and customer data management, for example) into the solution developed.

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Appendix

Appendix A - Email

Bom dia,

O presente questionário destina-se à recolha de dados como forma de base de análise, com vista à proposta de uma Framework de Maturidade Digital para uma organização do setor automóvel, no âmbito de uma Dissertação de Mestrado em Informação e Sistemas Empresariais (Universidade Aberta e Instituto Superior Técnico).

Todos os dados recolhidos neste questionário serão tratados especificamente para análise estatística em contexto de investigação, sendo que quaisquer dados pessoais serão mantidos em total sigilo e anonimato.

Este questionário foi concebido para uma duração de aproximadamente 15 minutos.

O Link do Questionário é o seguinte: https://forms.gle/zKAUvPFY9htduhYY7

Agradece-se o seu preenchimento até ao dia 30 de setembro de 2023.

Agradece-se desde já o tempo despendido.

Gonçalo Monteiro

Appendix B - Survey

Questionário - Dissertação de Mestrado em Informação e Sistemas Empresariais

O presente questionário destina-se à recolha de dados como forma de base de análise, com vista à proposta de uma Framework de Maturidade Digital para uma organização do setor Automóvel, no âmbito de uma Dissertação de Mestrado em Informação e Sistemas Empresariais (Universidade Aberta e Instituto Superior Técnico).
Todos os dados recolhidos serão tratados especificamente para análise estatística em contexto de investigação. Quaisquer dados pessoais serão mantidos em total sigilo e anonimato.
Este questionário foi concebido para uma duração de aproximadamente 15 minutos.

Agradece-se desde já o tempo despendido.

* Indica uma pergunta obrigatória

Parte I - Características Sociodemográficas

1. Idade *

2. Habilitações Literárias *

Marcar apenas uma oval.

- ◯ 1º Ciclo (1º a 4º Ano)
- ◯ 2º Ciclo (5º e 6º Ano)
- ◯ 3º Ciclo (7º a 9º Ano)
- ◯ Ensino Secundário (10º a 12º Ano)
- ◯ Licenciatura
- ◯ Pós-Graduação
- ◯ Mestrado
- ◯ Doutoramento

3. Nível de Conhecimento em Tecnologias *

Marcar apenas uma oval.

- ◯ Utilizador Básico
- ◯ Utilizador Independente
- ◯ Utilizador Avançado/Proficiente

Parte II - Características Sociodemográficas da Organização/Empresa

4. Quantos colaboradores tem a Organização/Empresa? *

Marcar apenas uma oval.

- ◯ 1 - 10 Colaboradores
- ◯ 11 - 50 Colaboradores
- ◯ 51 - 250 Colaboradores
- ◯ > 250 Colaboradores

5. Qual a sua função dentro da Organização? *

Marcar apenas uma oval.

- ◯ CEO
- ◯ Diretor Geral
- ◯ Diretor/Gestor Financeiro
- ◯ Diretor/Gestor de Operações
- ◯ Diretor/Gestor de Sistemas de Informação
- ◯ Diretor/Gestor de Marketing
- ◯ Diretor/Gestor de Formação
- ◯ Diretor/Gestor de RH
- ◯ Colaborador
- ◯ Outro: _____

Dimensão 1 - Estratégia Digital

6. *

Como avalia globalmente a estratégia digital de inovação da sua empresa?

Marcar apenas uma oval.

- ◯ Muito Pobre
- ◯ Pobre
- ◯ Aceitável
- ◯ Boa
- ◯ Muito Boa

7. A implementação das atividades de inovação digital na sua organização são previamente planeadas? *

Marcar apenas uma oval.

- ◯ Não
- ◯ Sim

8. A organização precisou de alterar o seu modelo de negócio e/ou os seus processos diários para efetuar algum tipo de inovação digital? *

Marcar apenas uma oval.

- ◯ Não alterou
- ◯ Sim alterou

9. Para a Transformação Digital, a organização verifica se os recursos humanos, financeiros e tecnológicos disponíveis são suficientes? *

Marcar apenas uma oval.

- ◯ Não verifica
- ◯ Sim verifica
- ◯ Não sei

10. A sua organização já investiu ou planeia investir nalguma das seguintes áreas de negócio? Selecione todas as opções aplicáveis: *

Marque todas que se aplicam.

- [ ] Plataformas de Trabalho (Intranet) - Registo de Horas, Horas Extra, etc.
- [ ] Software de Gestão dos Processos Diários (Escrita de Folhas de Obra, Registo de Dados de Clientes, Marcações, etc.)
- [ ] Sistema de Gestão de Stock
- [ ] Digitalização das Ferramentas de Trabalho (Máquinas de Diagnóstico Automóvel, Plataformas Elevatórias, etc.)
- [ ] Inteligência Artificial e Automatização
- [ ] Cibersegurança e Proteção dos dados dos Clientes (RGPD)
- [ ] Outro: _____

11. Quais Modelos de Referência e/ou Frameworks para a Implementação da Transformação Digital foram utilizados pela sua organização? *

Marque todas que se aplicam.

- [ ] APQC
- [ ] TOGAF
- [ ] IMPULS – 4.0 Readiness
- [ ] I4.0 Maturity Model
- [ ] Digital Maturity Model - Capgemini
- [ ] I4.0 Digital Operations Self-Assessment - PwC
- [ ] Não sei
- [ ] Nenhum
- [ ] Outro: _____

Dimensão 2 - Tecnologia

12. Qual a importância da Tecnologia para a sua Organização? *

Marcar apenas uma oval.

- ◯ Nada Importante
- ◯ Pouco Importante
- ◯ Moderado
- ◯ Importante
- ◯ Muito Importante

13. Quais os Equipamentos Tecnológicos utilizados pela sua empresa? Selecione todas as opções aplicáveis: *

Marque todas que se aplicam.

- [ ] Computadores
- [ ] Impressoras
- [ ] Dispositivos Móveis (Smartphones, Tablets, etc.)
- [ ] Máquinas de Diagnóstico Automóvel (Scanner)
- [ ] Elevador de Veículos
- [ ] Cabine de Pintura
- [ ] Alinhador de Direção
- [ ] Máquina Equilibradora de Pneus
- [ ] Máquina de Focagem de Faróis
- [ ] Máquina de Carregamento de Ar Condicionado
- [ ] Outro: _____

14. Quais as Ferramentas e Aplicações são utilizadas pela empresa? Selecione todas as opções aplicáveis: *

Marque todas que se aplicam.

- [ ] Website da Empresa
- [ ] Software de Faturação
- [ ] Plataforma de Trabalho (Intranet)
- [ ] Soluções de CRM e ERP
- [ ] Soluções de Análise de Dados/Apoio á Tomada de Decisão (Business, Intelligence, Tableau, etc.)
- [ ] Soluções de Marketing Digital (SEO, Email Marketing, etc.)
- [ ] Antivírus e Antimalware
- [ ] Soluções de Autenticação e Controlos de Acessos
- [ ] Encriptação de Dados
- [ ] Armazenamento em Cloud
- [ ] Outro: _____

Dimensão 3 - Processos

15. Quais os Processos da sua organização que utilizam Tecnologia? Selecione todas as opções aplicáveis: *

Marque todas que se aplicam.

- [ ] Serviço de Reparação/Manutenção do Veículo
- [ ] Serviço de Alinhamento de Direção do Veículo
- [ ] Serviço de Pintura do Veículo
- [ ] Serviço de Lavagem do Veículo
- [ ] Criação de Folhas de Obra (Com os Dados do Veículo, Cliente, etc.)
- [ ] Criação/Envio de Fatura para o Cliente
- [ ] Diagnóstico de Problemas no Veículo
- [ ] Processos Administrativos
- [ ] Pagamentos
- [ ] Contacto com Fornecedores
- [ ] Logística
- [ ] Não utiliza Tecnologia em nenhum Processo
- [ ] Outro: _____

Dimensão 4 - Cliente

16. Como é que o cliente sabe dos Produtos/Serviços oferecidos pela organização? Selecione todas as opções aplicáveis: *

Marque todas que se aplicam.

- [ ] Redes Sociais (Facebook, Instagram, Whatsapp, etc.)
- [ ] Publicidade (Flyers, Outdoors, etc.)
- [ ] Plataforma de CRM
- [ ] Anúncios na Televisão/Rádio
- [ ] Através do Website
- [ ] Através de outros Clientes
- [ ] Outro: _____

17. Quais são os canais pelos quais a empresa interage com o cliente? Selecione todas as opções aplicáveis: *

Marque todas que se aplicam.

- [ ] Telefone (Chamada Telefónica, SMS, etc.)
- [ ] Website da Organização
- [ ] Aplicação
- [ ] Redes Sociais (Facebook, Instagram, Whatsapp, etc.)
- [ ] Plataforma de CRM
- [ ] Outro: _____

18. Como se efetua o processo de Adjudicação/Venda dos Produtos/Serviços da Organização? Selecione todas as opções aplicáveis: *

Marque todas que se aplicam.

- [ ] Agendamento Online (via Website)
- [ ] Agendamento via Contacto Telefónico
- [ ] Através de Email
- [ ] Agendamento Presencial
- [ ] Plataforma de CRM
- [ ] Outro: _____

19. Quando o serviço efetuado pela sua organização a um veículo automóvel estiver terminado/completo, como é o cliente notificado? Selecione todas as opções aplicáveis: *

Marque todas que se aplicam.

- [ ] Através de Chamada Telefónica
- [ ] Através de SMS
- [ ] Através de Email
- [ ] Notificação via Aplicação/Website
- [ ] Plataforma de CRM
- [ ] Outro: _____

Dimensão 5 - Colaboradores

20. A sua organização investe na formação dos colaboradores? *

Marcar apenas uma oval.

- ◯ Sim
- ◯ Não

21. A sua organização é recetiva quanto às opiniões/ideias dos colaboradores sobre Inovação ou Transformação Digital? *

Marcar apenas uma oval.

- ◯ Sim
- ◯ Não

22. Existe apoio interno (Helpdesk Técnico) por parte da organização para os colaboradores? *

Marcar apenas uma oval.

- ◯ Sim
- ◯ Não

23. Existe acolhimento para os novos colaboradores com recurso a soluções digitais? *

Marcar apenas uma oval.

- ◯ Sim
- ◯ Não

24. A sua organização disponibiliza Intranet para os seus colaboradores? *

Marcar apenas uma oval.

- ◯ Sim
- ◯ Não

Dimensão 6 - Automação e Inteligência Artificial

25. Na sua opinião, existem processos diários da sua organização passíveis de serem automatizados? *

Marcar apenas uma oval.

- ◯ Sim
- ◯ Não
- ◯ Não sei

26. Em que processos acha que faria sentido introduzir Automação/Inteligência Artificial? Selecione todas as opções aplicáveis: *

Marque todas que se aplicam.

- ☐ Manutenção e Reparação de Veículos (Por Exemplo: Introdução de Robôs, etc.)
- ☐ Faturação/Área Administrativa (Folhas de Obra, Faturas dos Clientes, etc.)
- ☐ Aquisição de Materiais/Contacto com Fornecedores (Integração com a API dos Fornecedores, por exemplo)
- ☐ Logística
- ☐ Suporte ao Cliente
- ☐ Comunicação e Marketing
- ☐ Recursos Humanos e Formação
- ☐ Não sei
- ☐ Outro: _____

27. No seu ponto de vista, a introdução de Inteligência Artificial e/ou Automatização dos processos iria permitir um ganho de performance no dia-a-dia dos colaboradores? *

Marcar apenas uma oval.

- ◯ Sim
- ◯ Não
- ◯ Não sei

Opiniões e Sugestões

28. Escreva, caso considere pertinente, a sua opinião sobre a Transformação Digital no setor Automóvel e, possíveis melhorias que, na sua opinião, possam ser implementadas nas organizações deste setor

_____

_____

_____

_____

_____

Obrigado pela sua colaboração!