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Potential impact on workforce and labor market as a result of AI/automation:
A perspective of the Portuguese labor force

Dissertation presented as partial fulfilment requirement for the conferral of

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Abstract

The dissertation aims at exploring the impacts of automation and its branches (Artificial Intelligence, Internet of Things, Machine Learning, and others) in the workforce. As such, it intends to analyze predicted current jobs at risk of being automated and potential emerging professions due to the digital transformations humankind is subject to. It is intended to understand whether these transformations, also known as the Fourth Industrial Revolution, are likely to follow the same evolution as the previous Industrial Revolutions. The main target will be people working in Portugal, independent of their nationality, and I aspire to examine the level of awareness of the target about the potential technological impact on their labor activity and the extent to which they are preparing themselves for such continuous and exponential changes in the labor force.

A research on the previous Industrial Revolutions will be conducted. Also, a questionnaire will be performed to understand whether respondents believe their organization uses a technologically-oriented approach in their business and if the individual workers are preparing themselves towards a new working model that includes automation-related technologies.

The main findings of the conducted research were that most organizations include basic technological tools in their daily businesses yet are still way ahead in the integration of the most recent trends of this digital era. Also, respondents are not preparing themselves much as they believe the technological impacts on the labor force are still futuristic. Nevertheless, respondents are confident about a framework where humankind and automation work side-by-side.

Keywords: Industrial Revolution; Automation; Technological impacts; Portuguese workforce
JEL: J0; M0

Resumo

O desenvolvimento desta tese tem como principal foco explorar os impactos da automação e seus derivados (Inteligência Artificial, Internet das Coisas, *Machine Learning,* entre outros) no mercado laboral. Pretende-se analisar as previsões dos empregos que estão correntemente em risco de serem automatizados e aqueles com maior probabilidade de emergir, resultantes das transformações digitais. Requer-se começar por perceber se estas transformações, também conhecidas como Quarta Revolução Industrial, seguirão a mesma evolução que as passadas Revoluções Industriais. O *target* a analisar será a população activa em Portugal, independentemente da sua nacionalidade, começando por examinar o nível de *awareness* da população seleccionada relativamente ao impacto das novas tecnologias na sua actividade laboral bem como o seu nível de preparação para as mudanças que irão impactar o futuro dos trabalhos.

Será concretizado um estudo das Revoluções Industriais passadas. Em acréscimo, será realizado um questionário de forma a perceber até que ponto é que os respondentes percepcionam o nível de maturidade tecnológica das suas empresas e se os indivíduos consideram estar a preparar-se para um futuro onde se prevê um novo modelo de trabalho altamente aliado à automação.

As principais descobertas do estudo são que a maioria das empresas em questão utilizam ferramentas tecnológicas básicas relativamente às recentes *trends* digitais. Apurou-se, também, que os respondentes não se estão a preparar muito uma vez que acreditam que as implicações tecnológicas no trabalho são ainda futuristas. No entanto, a maioria aparenta estar confiante acerca de uma estrutura laboral onde a humanidade e a automação podem caminhar lado-a-lado.

Palavras-chave: Revolução Industrial; Automação; Impactos tecnológicos; Trabalhadores portugueses
JEL: J0; M0

Index

Index – Figures

Index – Tables

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Undergoing the completion of this master's thesis has undoubtedly contributed to fulfilling my academic and personal goals.

Executive Summary

Several recent studies claim that by 2020, around 85% of human interactions with product and service suppliers will happen through artificial intelligence (AI). The impact of automation and specifically AI or other technological branches in our daily lives has been growing exponentially and even though we cannot imagine what more is about to come, this is just the beginning.

Technology is a never-ending science and plays a crucial role in facilitating life, in general and at work, as it aids the increase of productivity leading to stronger economies and job creation. However, on the other hand, the continuous emerging of technological advances also causes many jobs to disappear. This is a result of the replacement of humans, essentially low-skilled jobs and tasks, for automated machines and programs.

It is not the first time in History that machines take over humans at several scopes. At this point, automation comes in several forms: artificial intelligence along with its subsets (machine learning, image and voice recognition, computer vision technologies, deep learning, etc.), together with other great technological trends such as Robotics, Virtual Reality (VR), Augmented Reality (AR), and Internet of Things (Iot). All these kinds of technologies are already in several contexts of the life of many people and businesses, and many do not even realize how intrinsic and dependent they are of these tools.

The world has always been in constant transformation. The replacement process is occurring gradually and repeating itself, but at a faster pace than ever before. In other words, this era is transforming at the speed of light and I dare to say that all enterprises should embrace this transformation – which is named among several denominations as the Fourth Industrial Revolution - in order to survive in the future.

Not only people themselves are changing with the technological evolution, but the enterprises and their workforce as well. Companies are now in a position where they have to reshape their strategies and structures at all scopes meaning that their labor force arrangement will also suffer alterations.

It is true that automation and artificial intelligence are older than we are aware of. However, the "boom" is just starting and no one sees an end to it, which is what enthusiasts me so much – digital transformations are present in the provision of services, all sorts of departments of a company, in people´s daily personal lives and their consumption, as well as in the labor activity.

In this study the aims are to understand the evolution and future prospects of these technologies, exploring at which point we are at in Portugal according to workers' perception (research on the level of technological maturity and prospects especially regarding my own generation and the ones that follow). Also, it is interesting to understand the way people are embracing and responding to the changes in the technologic age as well as the transformation of the workforce due to these changes (potential jobs that will disappear and emerge as a result of automation). This way, I intend to focus on the workforce in Portugal (Portuguese and foreign workers) and analyze whether or not they believe their current job is at risk of disappearing as a result of automation and the use of AI, or if they consider this as an opportunity in their career.

To conclude, I intend to open path for further discussions on whether we believe we will always be able to control the bots because we are humans with a brain and self-consciousness, responsible for creating and developing them, or if eventually they will take over us.

The workers and enterprises in Portugal of different sectors will be the main target of the study. However, an overall approach to several populations worldwide, included in different studies, will be considered in order to be able to compare and understand patterns. To conduct the study for my thesis I will do a thorough research, collect data based on gathered information through a literature review regarding several aspects, analyze results and interpret them. As such, a quantitative research will direct my study and therefore, this thesis will be written in a form of dissertation.

Questionnaires done to workers in Portugal over the age of 18 prove that enterprises in Portugal are suffering a technological delay in their businesses. This deferral may be one of the reasons for the following interpreted conclusions extracted from the questionnaire. These are that workers in Portugal are not much concerned about massive job losses to automation, essentially their own. Most believe that the technological transformations will only occur in a relatively distant time (considering more than 5 years). Nonetheless, they are confident about a future where humankind and automation are allied in the labor context.

I believe these are areas of extreme interest as they are at such a young stage in an undisputable growing and speeding path. They are present in my daily life and will certainly be part of my future.

Theme and research problem

The main subject of the dissertation is to me of great interest and of significant relevance since it is inevitably related and will certainly be part of everybody's future path in both personal and professional scopes, which is why I have decided to look through the perspective of two different extents: individuals and enterprises.

Around the 1760´s, the Industrial Revolution took over the civilizations. Now we are heading towards the 4th Industrial Revolution, or rather also known as coming in the form of "Digital Revolution" or "Digital Transformation". It is not a futuristic approach since the first industrial revolution people have been giving the power to machines to act like humans though automation and, most recently, to "think" like them, performing cognitive and logic reasoning. This simulated intelligence is known as artificial intelligence. Consequently, the use of these tools, among others, is to ease the performance of recurring tasks in the most various business sectors and daily life activities. This has been gaining such relevance that whoever is able to adapt to this evolving technologic era has higher chances of succeeding and accompanying the evolution of the world. Being the new technologies key drivers of success to many companies, the ones who are able to integrate the changes the present and the future holds, have higher chances of surviving over the ones who cannot or will not.

In addition, consumers are continuously changing their behavior regarding purchase decision-making. This way, companies must make the best use of automation to understand these changes in behavior in terms of their workforce structure and their strategy for the product or service delivery.

The aim of the research is to explore the impact of automation in workforce with special focus in Portugal: to understand how likely different jobs are to be replaced by machines; what are the skills predicted to be valued regarding the new technological era; to evaluate the level of technological maturity of companies in Portugal according to the opinion of the respondents in the different economic sectors; how the working population in Portugal is accompanying and potentially adapting to the evolution in the labor activity accounting for the new technological age based on automation and its derivatives; to understand if automation is perceived as an opportunity or a threat to workers; and overall if they are satisfied with their current job situation and whether they see the Fourth Industrial Revolution as a chaos through the replacement of human labor by automation or if technologies can walk side-by-side with humans in the labor activity.

I will begin by performing a thorough research on the mentioned field and others inevitably related by collecting and analyzing information in books, articles and newspapers/magazines (both digital and paper formats), internet, videos, interviews, and others that might be relevant.

1 Literature Review

The overall aim of this chapter is to analyze the past Industrial Revolutions and to contextualize the evolution of societies and how they have adapted to the different phases of industrialization. The intention is therefore to understand whether there is a pattern in the order of events as a means of understanding if societies nowadays are following the steps of the past occasions.

As previously mentioned, the main objective of the study is to probe how workers in Portugal perceive automation within their current jobs and future career path. This way, it is crucial to analyze different studies of how other countries are accompanying the process of automation in order to compare them with Portugal.

Furthermore, after describing numerical data and studies carried out regarding how other countries are integrating automation and how their own societies, specifically their labor force, are being affected by this and other related technologies, a more detailed description will be developed in order to provide a social, economic and political framework of how the current digital revolution will affect the human capital. To support this description, additional information regarding technological transformation and different perspectives of the waves of industrial revolutions will be portrayed as means to better understand the evolution of this matter - the industrialization.

Consequently, conclusions can be made about the current state of Portugal in such technological era and possible suggestions can be proposed in order to push Portugal forward into being more technologically developed and updated.

1.1 Evolution of four Industrial Revolutions

Industrialization has been shaping the world in the past three centuries. It has happened in three main landmarks and currently we are going through the fourth. The first industrial revolution started in Britain in the 1770s and rapidly expanded to Western Europe and to the United States of America. Later on, in the 1880s, a second wave of industrial revolution emerged and this time the main actors were Russia and Japan, as well as some parts of eastern and southern Europe, in addition to Canada and Australia. Moving onto the following era of industrialization – the third one – was when, around the 1960s, other countries such as Turkey, India, and countries from Latin America began to suffer the effects of mechanization which had been gradually taking over most of the world. No matter where, this meant clear

changes in the way how people interacted and how the economy was held. In other words, this global phenomenon reformed social and economic relationships worldwide.

Previously manufacturing and agriculture production was held essentially by people and animals that engaged tools and equipment specifically developed for manual use. Jobs often included planting and harvesting done by hand with the help of a few simple tools, equipment such as looms for weaving cloth was fueled by foot pedals, textile and fibers were handmade. Occasionally, waterwheels were also used but they were mainly limited to mill grain. The beginning of industrialization thus introduced power to the production process by means of the appearance of machines and automation, leading to a steady increase in the production as a lot more could be produced in less time per unit, needing only maybe just human assistance at times, but no human guidance in general (Stearns, 2013).

1.1.1 First Industrial Revolution

The first so-called Industrial Revolution dates between the sixteenth century and seventeenth century (1760-1830s). At this time dates the moment where production and consumption changed societies forever. Despite limitedly, machinery started to be used in fields, animation of toys and robots, predominantly in Europe. In addition, manual work – especially those of slaves – started to be replaced by machines, reaching both towns and villages (e.g. hydraulic and wheat mills, among others) (Ionescu, 2018, p. 183-186). Also known as Consumer Revolution, consumption habits led, until the end of the 18th century, to changes in the market homogeneity, the nature of goods on the market and the volume of sales essentially involving industries related to elementary goods such as food, clothes and housing, increasing diversification and resulting in increases of the annual growth rate (Flacher, 2007).

An article from the Strategic Design Research Journal (Duarte, *et al.* 2018) reinforces the mechanization of industries supporting the transition from the artisan knowledge of people at that time into a production of consumer goods marked by its intensity and speed, as a result of the introduction of steam engines. Also, new fuels began to emerge in substitution of coal, which is the case of wood, for instance.

The textile industry was the one which suffered the most severe changes during this epoch specifically due to the modifications in the use of yarn. Until then (1733), yarn was manually carried back and forth in the loom for which the width of the fabric was limited. However, in 1760 John Kay invented a new form of using yarn and it enabled its use in

different colors leading therefore to an increase in consumption of items produced in looms. Later in 1764, James Hargreaves innovated the means of yarn production which, until then, was manual, by inventing a spinning machine called Spinning Jenny. This kind of method continued to suffer changes and rapidly evolved with renovated methods. For example, in 1779 a mechanical spindle was introduced in the water frame leading to a higher quality of yarn and developing domestic production to mass production.

1.1.2 Second Industrial Revolution

In spite of the Great Depression, with the name of Revolution of Consumer Goods, resulted the second great phase of the Industrial Revolution with the emergence of the second industrialization goods (Flacher, 2007). Joel Mokyr stated that the solid changes leading to the second phase of the revolution dates between 1870-1914 (mid 19th century) and that this was a period in history where fruitful and dense innovations emerged, although a series of significant events can be dated since the 1850s. Technology improvements led to a drastic increase in productivity and product quality essentially as a result of meaningful inventions in energy, materials, chemicals, and medicine leading to strong mass productions. In addition, there were strong changes in the nature of production organization and rises in technological systems, growth in some industries of large economies of scale. Similarly to what can be said nowadays, back then the author already defended that "technology is knowledge" (Mokyr, 1998: 1).

Other sources (Duarte, *et al.* 2018) define the transition into a second phase of Industrial Revolution as occurring between 1840 and 1870 but agree on the fact that electricity was indeed the most influencing feature for such impact on productivity. The countries whom played strong roles at this time where the USA, Britain, France and Germany in addition to the technological development happening in Japan. Not only productivity increased brutally, but also the changes led to better quality of the line of the population and the introduction of new sources of energy, especially in the textile industry. By this time, innovations continued in the spinning method, but now innovations didn't occur solely in the spinning machine individually since John Torp (1828) created the possibility of spinning greater amounts of yarns simultaneously enabling various steps to be bundled up into one single process.

Overall, the second wave of the Industrial Revolution is characterized by the emergence of machines that were significantly more technologically developed leading to the rise of factory-line production, interchangeable parts, and mass consumption. Cities and the urban

life we live in today as well as the rise of business and corporations are a result of this era. Also, energy was revolutionized with the beginning of the usage of fossil fuels.

Globalization is not just a broad and current matter of the 21st century. Back then, this phenomenon was a consequence of all the growth and innovation the world was going through and at such an exponential pace. There are several components of the modern era that were made possible through certain inventions at that time, which is the case of cars, planes, telephones, and electricity, among others.

It is said that the keys to such evolution were electricity, petroleum and steel as these factors contributed to the urbanization and fulfilled transportation needs such as skyscrapers, telegraphs, trolleys and railroads. An example of the convergence of countries worldwide which was powered by urbanization and transportation was the emergence of refrigerated railcars as these permitted the transportation of goods to faraway cities. This means that from this time on, people become more connected, as well as ports and markets, building the path to economic growth and development. The government supported railroad companies by granting them land. This way, if these companies served and tracked the entire country rather than just particular regions, the government would invest capital in this kind of business (Flashes Magazine, 2017, p. 54-58).

Being a natural feature of humankind, people adapted to the new environment and characteristics of urbanization. As such, certain individuals blossomed many objects and processes that we still use these days only in probably larger dimensions and with innovated features. Certain names that must be highlighted when approaching this theme are, for instance, Henry Ford, who originated the process of assembly line. Orville and Wilbur Wright are other powerful names as successfully executed the first flight. Communication also suffered drastic transformations with the expansion of the telegraph and the invention of the telephone. This way, people were brought even closer and were able to become more connected. Before, certain places within each city fully depended on sunlight. However, "electricity brought power and light to ever increasing corners of the globe" (Flashes Magazine, 2017, p. 57).

Such changes led to the need for the government to make readjustments in the conditions of labor and investment. People who had the economic resources to invest in railroads were generally ruthless, extravagant, and corrupt. But on the other hand, they were by all means enabling the construction of these railroads. Much of the economic power that certain countries have nowadays was potentiated by this revolution, especially in the cases of Western Europe, the USA and Japan.

1.1.3 Third Industrial Revolution

Further on, between 1950-1980, after the World War II the Mass Consumption Revolution includes some of the major changes in consumption habits. This was essentially due to the significant increase in the purchasing power which led to a diversification of the spending patterns. Even though obviously not everyone could afford certain consumption habits, in general, there was an intensification of the use of commercial goods and services and an increase of consumption of non-commercial (collective) services such as administration, health, culture, education, leisure, and others. In addition, women paid work also raised, contributing to the changes in consumption phenomenon (e.g. replacement of self-production by actually purchasing the items) (Flacher, 2007, p. 7-8).

An article of the Strategic Design Research Journal (Duarte, *et al.* 2018) specifies this phase as being marked by the transition from analog to digital in addition to the beginning of a more substantial segmentation of consumer markets. In this era, the main changes were in the direction of computational capacity which came as means of largely decreasing production costs. Industries thus had to adapt and became more information technology-oriented (IT) and began to use significantly microprocessors, CAD (Computer-Aided Design), optical fiber, biogenetics and laser. The aggregation of these tools allied to other new apparatuses and strategies highly impacted the growth of economic performance. Hence, digital and communication technologies became part of factories' and industries' daily processing marking this way, the beginning of the information age.

From one kind of yarn used prior to the first industrial revolution to the information era, mass customization started to be more apparent and common meaning that large quantities of items are designed and specified according to individual needs and tastes rather than one type serving one need and infinite tastes.

In an era where digital contexts predominate, companies have been continuously adapting these new settings. In some cases, businesses that do not accompany digital changes may not even survive. An article published by the Journal of the Australian & New Zealand Institute of Insurance and Finance (Zhang, 2016) defines a digital platform as a network or a marketplace where entities (companies, individuals, institutions, and consumers) create combined services. Different courses of the value chain (product design, pricing, distribution, management, and others) are supported by IT systems that integrate and relate all sorts of devices, applications, data, products and services. The article describes the impact in the sectors within a company, within the Australian framework.

Distribution

Digital platforms enable distribution systems to operate more effectively, a lot faster and therefore reaching more consumers thus enabling companies to become even more powerful. The article suggests a few value propositions that can result from a good digital platform within a company: a frequent and clearer contact with customers can help lower costs of distribution; since digital platforms enable a closer interaction with customers, it is possible to collect more data. Accurate and rapid analysis of data allow therefore faster responses to consumers' fast-changing needs; strong capabilities in digital technology permit the delivery of products and services to be faster. Overall, strong technological skills of a company can help leverage the global existing infrastructure. However, an efficient distribution system powered by an eligible digital platform doesn't solely guarantee the success of a company.

Risk prevention and claims

There are several properties that can be secured by digital platforms and that can help preventing risk and claims. A few examples are wearable devices and gadgets that are worn in the human body (that collect and deliver information about the surroundings of the person wearing them), telematics, security systems, and others. On the other hand, claims management uses digital platforms to collect information about customers' purchase history, in order to detect frauds.

Product and pricing

As previously mentioned, digital platforms allow companies to gather information in more sophisticated ways (or not) and when correctly analyzed, features on customers' needs and desires can be identified. Such evidence permits the company to eventually tailor pricing and create new products according to the segmentation of the needs.

Only a few examples of the impact on the value chain were proposed, but digitalization is, almost inevitably, part of every company, whether it´s in a micro or a macro perspective or both. This is because technology is reshaping industries across the whole globe and companies are before an enormous opportunity to use technology's positive effects for their own benefit, whether digital platforms are simply a supporting tool of their business or the core activity. This way, in order to adapt, enterprises must take an agile approach by

rethinking their strategies, shifting their mindset and be proactive and reactive to such fast-changing environments.

1.1.4 Fourth Industrial Revolution

Moving on to the current revolution, there are several names do denominate the same concept which is mostly known as 4th Industrial Revolution, Digital Revolution or Digital Transformation. Even though many are aware it is related to the digital transformation, many are still unclear about what this means exactly and how it will and is impacting our daily lives. In comparison to other countries, Portugal is a few steps behind in preparing for the technological advances. Germany and China, for instance, are already developing a strategy to face the new industrialization trends and innovations.

<u>Made-in-China 2025 and Industry 4.0</u>

After analyzing the previous three main industrial revolutions the world has been through it is possible to conclude that all of them have "benefited mankind and moved society forward" (Li, 2017, page 2).

The first industrial revolution was powered by the introduction of the steam engine which enabled mechanization of products in factories thus providing millions of jobs and shifted many people from rural farms to urban areas. The second industrial revolution was marked by the mass production since it the advances in manufacturing systems and technologies permitted the production of large volumes of standardized products, resulting in low unit cost and in the division of labor which required the need for workers to develop specialized skills. This is because workers now worked in one specific task, thus the need to specialize in that single duty, rather than having to know how to develop every step of the production process. Such provided many well-paid manufacturing jobs which significantly enhanced low and middle-class' living standards. Later, the third industrial revolution emerged with the advances in digital technologies and allowed not only production and services to be automated but also the convergence of businesses and people across the world through globalization. Such event benefited many people worldwide and wealth was distributed across countries. Currently we are going through the fourth industrial revolution which is sustained by the technological advances, motivating both Germany and China, despite their disparity in economic power, to introduce "Industry 4.0" and "Made-in-China 2025", respectively.

In 2015 China started designing a plan accounting for time distance of ten years called "Made-in-China 2025". According to the author the main objectives of this program were to enhance China´s industrial capability through an innovative manufacturing approach, to optimize the country's industrial structure, increase the quality of the products rather than the quantity, attract skilled human resources, and achieve green manufacturing and environment. According to gathered data, countries like Vietnam, Cambodia, and Laos are now ahead of China, leading the market in terms of cost of labor.

As an emerging economy, implementing this program has a specific strategic goal which is to raise China´s place in the value chain and to shift itself into a world-class industrialized country. Currently, they are still in the first phase of a set of three stages.

It is true that the first industrial revolution began in Great Britain around the eighteenth century, but over the last decade, China has established itself as a global leader in manufacturing operations granting the place for the second largest economic power in the world. Such is supported by the fact that in 2014 China was responsible for 90% of the world total production of personal computers, 80% regarding air conditioners as well as energy-saving lamps, and 70% of the world's total production of mobile phones.

On the other hand, Germany is a world leading industrialized nation and likewise, the country´s government designed a strategic plan in 2013 called Industry 4.0 and intends to keep up with the latest industrial trends. The main objective is to emphasize its innovative strength in the industrial integration (smart factories, cyber-physical systems, and others), industrial information, manufacturing digitalization, and advanced technologies (automation, 3D printing, Internet of Things, among others).

The concept comes from a German initiative and translates the technological advances which include the digitalization and integration of these technologies in "manufacturing and logistics processes, and the use of internet and "smart" objects (machines and products) and merging the physical and the virtual worlds by the adoption of information and communication technology (ICT)" (Fonseca, 2018). In other words, the Industry 4.0 includes creating intelligent factories that integrate upgraded technologies such as cyber-physical systems (CPSs), Internet of Things (IoT), Big Data Analytics (BDA), Information and Communications Technology (ICT) and cloud computing. Intelligent manufacturing means that machines or devices respond to different situations based on past experiences and learning capacities, through Artificial Intelligence (Fonseca, 2018).

Processes within manufacturing systems embedded in the Industry 4.0 are monitored through "digital twin" or "cyber-twin" where humans and machines make real-time communication and smart decisions. This is possible through the combination of production system technologies with intelligent machines and processes leading to new forms of industry and production value chains, as well as new business models adapted to the new era ((Li, 2017).

1.2 Social, economic and political frameworks

The effects on society depend on society itself: culture, investment, openness, among others. Humanity has always been able to adapt itself, in spite of the many controversies caused by the several industrial revolutions. Technology has come as the primary cause of these series of events, and has had serious impacts of the workforce, both positive and negative: many were obliged to learn new skills, other were forced to relocate, many lost their job to machinery and/or technology while others have had their work enhanced by these. Technology has impacted the way, how long, and from where we work. Consequently, the difficulty in detaching from work has led to a redefinition of the settings between work and personal life (especially powered by the ability to be everywhere all the time and the need to respond to different time zones). It has also potentiated efficiency, thus impacting the global effects on the company, as well as the speed at which things happen in the market, the interaction between people, recruitment processes, directions/orders from top-level management. Working together has also changed and so has team coordination. Alterations in the workforce also impacts the company culture and influences health habits. Albeit the many drawbacks, technology's ultimate goal is to help and compliment humans increasing productivity and efficiency (Caruso, 2017).

1.2.1 How will the fourth industrial revolution influence human capital?

The use of ICT's (Information and Communications Technologies) is aimed at potentiating economic growth, promoting an ongoing progress and upgrading skills. But the fears of totalitarian control, alienation, job loss and insecurity among other worries, are a reality to every society worldwide. The German program Industry 4.0 supports that the applications of the new wave of technological innovations are expected to be mainly positive in terms of productivity, economic opportunities and the future of work, which is considered by the World Economic Forum as being highly advantageous for workers. However,

technologies are not exogenous to social structures and it is therefore very difficult to predict the effects on society since it depends on the way society itself is prepared, embraces and reacts to changes.

Labor force and organizational strategies and systems are suffering new organizational models as a result of the new technological trends which obviously has serious impacts, both positive and negative, in the company and its value chain, society and the environment as a whole.

Business models that are able to effectively integrate this kind of industry (4.0) can benefit by diminishing the times in operation cycles, delivery, market new products and services. Other aspects rely for instance on the improvement of the quality of these activities by receiving feedback from the clients more quickly and through several channels. This way, it is likely to improve product and service customization, therefore increasing customer loyalty and involvement. At this stage, companies that can integrate the new opportunities offered by digital transformation can benefit from a differentiation strategy regarding the ones that cannot adapt to these new tendencies. This is due to the fact that this era of transformation is still erupting, and many enterprises are still in the learning and adaptation process, which requires strong leadership, correctly identifying the needed human skills and developing them, in order to successfully implement the new technologically-centered business models at a whole new level of what we were at (Caruso, 2017).

On the one hand, many jobs will emerge as a result of the new labor market needs. But on the other hand, many jobs will disappear especially the ones that implicate lower levels of skills or involve constant repetition of tasks. It is possible to determine in table 1 several benefits and limitations of ICTs, of which:

Table 1: *Benefits and Limitations of ICTs*

Benefits	Limitations
• Smart assistance systems that support employees • Decentralized leadership, self-regulated autonomy • Free of the burden of hard manual work • Frees more time for creativity • Work is more based on knowledge rather than social classes or control of capital • Others	• Impact on work is still largely unpredictable • Analysis based on current scenario: ongoing trends and possible consequences of digital technologies on work • Others

Note. From "A: Digital innovation and the fourth industrial revolution: epochal social changes?", by L. Caruso, AI&Society, p. 379-392

Similarly to other authors, this article in the Strategic Design Research Journal sustains the importance of the fourth industrial revolution as a new change in the organizational structure of industries and societies at a global scale. More than a revolution, it´s an evolution of the past three.

The author states that the results of this revolution will be the Intelligent Factory where production goals are sustained by Cyber-Physical Systems (CPS), the Internet of Things (IoT) and Big data as key technologies, alongside to many others that have been continuously emerging and evolving (Duarte, *et al.* 2018).

Francis Griffiths and Melanie Ooi, December (2018) stated that it is crucial for the present society to advocate long-term solutions for certain issues, highlighting healthcare, environmental pollution, search for new and sustainable resources. The authors support that the hyper connected societies and revolutionized technologies can help pave the path to solve or moderate such concerns.

They agree with many other individuals on the fact that the fourth industrial revolution is progressing at an exponential rate and is definitely changing systems and processes worldwide due to mass digitalization and automation.

In order to adapt to such evolving developments, a few conditions must be taken in account regarding changes in work and workplaces of such:

Composition and skillsets of the workforce – it is not just the labor displacement that will be modified but there will also be a shift towards new and different jobs, thus requiring new skillsets;

Nature of work and workplaces – more work will become dislocated from and further away from designated workplaces and that involve more interaction with information and communication technologies;

Regulatory systems - old laws and frameworks no longer apply to the contemporary outlines of work, workplaces, taxation, and welfare (employment regulation, employers' identification, tax collecting, social protections). It is necessary to re-examine employment legislations. In this order, Stewart and Stanford suggest a set of guidelines as means to improve the regulation of technology-related or gig work: "1) confirm and enforce existing employment laws; 2) clarify the uncertainty and ambiguity around employment laws; 3) create a new category of independent worker; 4) establish rights for all workers rather than just employees; and 5) re-conceptualize the meaning of an employer" (Ruyter, *et al.,* 2018, p. 37)*.*

To resume, the first industrial revolution (1760-1830s) was marked by the beginning of the use of machinery as a means of replacing manual work leading to changes in the market homogeneity, nature of goods, volume of sales, increase in diversification, rising the annual growth. Technology improvements occurred during the second industrial revolution (mid 19th century) led to drastic increases in productivity and product quality, permitting strong mass productions. Such led to changes in society and landing (factories, globalization, transportation, urbanization, others). Despite the aversion to changes, eventually people adapted to the new environment and characteristics of urbanization. In addition, the governments were inevitably forced to make readjustments in the conditions of the labor and investments. In the third industrial revolution, changes in consumption habits were established, powered by features such as the transition from analog to digital, computational capacity (decreasing production costs). This way, industries had to adapt and become more technologically-oriented, which has impacted the growth of economic performance and the need for companies to be continuously adapting to the evolving new settings. The current revolution we are going through – among many denominations, the Digital Revolution – the urge to adapt and accept the inevitable future where technology will be embedded in all

sectors, is crucial. It has been difficult in the past, but humankind has been able to adapt and evolve despite all the struggles. As humans, we still have the power to use upcoming uses of technology as an opportunity, not as a threat.

To conclude, all industrial revolutions have had serious impact on the workforce and societies, both positive and negative which is why it is possible to predict that this 4th revolution will also influence the labor market, yet the ways and consequence are still unknown.

1.2.2 Technological transformation, waves and industrial revolutions

All along technology has been one of the main factors enhancing growth, revolutionizing production and economic activities, starting in the 18th century with the first Industrial Revolution that emerged from one of the most historic inventions – the steam engine. Peter Stearns (2013) defines the first Industrial Revolution as the "transformation of technology based on new sources of power, the revamping of economic and labor organization through the factory system, and the ascendancy of manufacturing in what had been predominantly agricultural economies (p. 4)". However, there was not just one revolution under this context. Different authors support different wave theories accounting for the course of events regarding Industrial Revolutions hence the thoughts of two specific economists will be presented - Nicolai Kondratiev and Joseph Schumpeter (Humbert, 2007):

Waves according to Kondratiev
1st Steam engine
2nd Railways and steel
3rd electrical engineering and chemistry
4th petrochemicals and automobiles

Just like Kondratiev, many authors like Clarke, Jevons, Marx, and Engels believed that all industrial waves went through struggles and peaks of ups and downs, economic instability, and social disorders. This way, Kondratiev supports that each wave is composed of 45-60 years, representing one economic cycle and divided in four periods: prosperity, recession, depression and improvement.

Waves according to Schumpeterian

1st Industrial Revolution (1771)

2nd Age of Steam and Railways (1829)

3rd Age of steel, electrical and heavy engineering (1875)

4th Age of oil, automobile and mass production (1908)

5th Age of information and telecommunications (1971)

Schumpeterian's theory supports the idea that growth is driven by innovation.

Other authors and historians prefer to divide the industrial epochs in three eras. However, this report focuses on an approach considering four waves of which:

1st Industrial Revolution powered by steam engine

2nd Revolution of Consumer Goods

3rd Mass Consumption Revolution

4th Fourth Industrial Revolution / Digital Revolution / Digital Transformation / Information Revolution

Throughout time, robotics and mechanization has been introduced in people's lives and work as it now possible to conclude from the short analysis of the collected data regarding the past Industrial Revolutions. Until the past years, robots could only perform crude, routine tasks. Nowadays, robots are not just closer to machines, but they are more and more alike to humans. They can see, hear and speak and even make motor movements. This evolution has led to the current (fourth) Revolution the world is going through (Eisen, 2018).

1.2.3 Social changes in the past industrial revolutions and potential social concerns in the future – technology and workforce

Back in the times of the first Industrial Revolution, institutions were overwhelmed by so many changes in the technological, social, and economic levels. The current situation happening as a result of the Information Revolution is no different from before since the world is suffering from disruptive disorders at the same levels. Due to the uncertainty about the future and the proportions technology can take, leader and political parties lack vision and ideas to solve the present and upcoming challenges and to potentiate the benefits of technological advances. This aversion to risk often unwelcomes the effects of such rapid

changes, yet some authors insist that this process of transformation is one of growth, not of decline and fall. However, the ability to cope with change and step outside the comfort zone is still one of the main challenges worldwide (Mean, 2018).

The current transformations named, among many other designations, as Information Revolution, are considered by many authors to be as socially and economically disruptive to the countries as the previous industrial revolutions, if not even more. The aim of this chapter is to discuss the social implications that the previous industrial revolutions have had throughout time alongside with the concerns and repercussions in the different eras, as well as how they were overcome. A series of predicted challenges will be discussed as a result of the technological innovations with special attention to the consequences in the labor market and societies worldwide.

1.2.4 Positive and negative changes and challenges throughout the several industrial revolutions

There are several visions regarding the benefits, disadvantages, challenges and opportunities of advanced technologies like artificial intelligence, machine learning, robotics, 3D printing, IoT, and others. What is consensually known is that it will have serious impacts on the workforce, just like the past technological advances boosted the previous industrial revolutions. Statistics vary, but several studies predict that recent technologies can be responsible for extinguishing around 50% of the existing jobs in the U.S. being the ones most at risk those that are routine and repetitive regardless of being physical or mental work. What is highly uncertain is whether there will emerge better jobs to replace the ones that will eventually disappear. According to what happened in the past, new jobs did indeed cover the ones that vanished due to industrialization processes. Optimists believe that this time will be the same while pessimists consider this time to be different from the past (Eisen, 2018).

A positive consequence of this event was that the growth in productivity enabled a dramatic increase in production capacities. Optimist approaches support gig work[1] can positively impact living conditions, create and displace jobs and consequently increase savings, productivity, and flexibility. In addition, gig work enables businesses to encompass a fluid workforce that is highly adaptive to change, cost-saving and with high levels of productivity. Workers are able to enjoy a flexible employment, they can work from wherever

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[1] Gig work – "involves personal services delivered through a web-based platform" (Ruyter, *et al.* 2018, p. 37)

they want, they are very autonomous, and they can decide their workload. However, even though there are many reasons to believe in a prosperous future, there are also several reasons to be concerned about the challenges and uncertainties ahead.

Pessimistic scenarios handhold job losses, increased insecurity in employment, de-skilling and even more inequalities (Ruyter, *et al.* 2018). In the past it is true that old jobs were replaced by new ones, but it was a long process especially aggregated to the fact that, especially in the first industrial revolution, mass poverty and misery was severe in the first decades and it took quite a long time for the economic and political struggles to be overcome. Inevitably the changes resulting from the industrial revolutions led to trade unions, struggles in the working class, and more significance of the current dominant class. Unemployment rose, and, at the beginning, the level of wages was even lower. Such led to gradually increasing labor movements causing strikes and destabilizing social cohesion. Surely there was a part of society which benefitted from the improvements, but there was also deep exploitation, severe insecurity, and increasing human misery. In addition, workers' movements were continuously repressed and rejected. On the other hand, the constant and insistent riots were actually the roots of the political and economic improvements since until then there were no parties to defend the workers' interests and rights. Nowadays, it is even more predictable that the current revolution causes several disruptive disorders essentially due to the speed at which technology impacts every sector.

Similarly to the steam engine consequences in the end of the 1970's, the current Fourth Industrial Revolution is also changing as a result of the Information and Communications Technology (ICT), modifying the way societies and the economies are organized. Before, machines replaced human manufacturing, physical efforts and muscle power. Nowadays, machinery is directed to function as "thinking machines" and has been "increasingly capable of performing conceptual, managerial, and administrative functions and of coordinating the flow of production, from extraction of raw materials to the marketing and distribution of the final goods and services" (Scammel, 2000, p. 21). Machine learning is consuming and invading humans' most important and distinctive asset – brain power. At times, essentially the manufacturing industries suffered from technological advances. The industrial revolutions had serious consequences on the production of goods since productivity increased exponentially leading to augmented wealth. Currently, not only manufacturing but also service industries have been exponentially suffering from the impacts caused by the Information Revolution severely diminishing the global force. Thinking and intelligent computers will likely outperform workers in terms of the ability to think, solve problems and learn if humans make

that path possible. The author proposed a bright example of this case, which was once said by Martin Ford "You can compare it to horses. Horses got displaced because they couldn't adapt in the way that people do, but now you've got these thinking, learning computers that are going to begin competing with people in that primary capability that so far has allowed us to stay ahead of all this. That´s why I think this could be the biggest disruption we´ve seen yet in terms of what it all means for jobs, the economy and society".

A new social order is therefore considered to be one of the major challenges of the moment, attending that knowledge is becoming the dominant key economic input among societies, rather than capital. Around the 1970s the world entered a new era – the Age of Information were Information and Communications Technology (ICT) were predominantly changing the ways of life, leisure and the way people communicate and interrelate, essentially due to the Internet. This period has brought many blossoming and prospering outcomes worldwide and in the various existing contexts. It is marked by the transition of mass production into mass customization. Previously, workers were served and aided by machines yet now technology serves workers. However, on the other hand, such events are also negatively affecting the way the world is organized and significantly impacting the workforce.

Economic and social issues, among others, are some of the most problematic subjects resulting from the information boom. The Information Age is leading to serious employment and social class issues since re-engineering, automation, outsourcing and offshoring is leading to several negative consequences. A few examples are unemployment, underemployment and temporary work, thus threatening low-skilled, blue-collar, and even middle-class and white-collar workers. Such has also caused an increase in various precarious forms of work which is contributing to employment uncertainty. For instance, 36% of the Americans worked in a farm in 1900. This rate dropped to 34% in 1960 due to the manufacturing absorption of the majority of farmers. The number continued to decrease reaching 16% in 1997 and it is predicted to go down to only 5% in 2020. The increasing job insecurity can easily take larger proportions compromising the cohesion of societies, incrementing violence and crime especially when the rate of permanent joblessness increases.

A pessimist view of the standards of living during the several industrialization processes is that they tend to lead to misery, enhancing inequality and disparity between classes as it widens the gap between the rich and the poor or proletariat and the bourgeoisie as so for the skilled and less skilled workers. It also suggests that during those periods, working men even had to work for longer hours than the peasants before industrialization. Some people defend

that sectors based on knowledge seem to be the only ones that will provide new jobs, requiring high-skilled employees and threaten jobs like sales clerks, managers, stock personnel, security guards. All of the changes in employment inevitably impact consumer demand and economic growth since workers who have low income or have become unemployed have thus less power purchase to continue consuming.

An optimistic approach suggests that technological advances can stimulate consumption since productivity can be increased thus producing goods at a cheaper cost per unit, accelerating the cycle of production and consumption. With goods at lower prices, more products can be purchased and consumed impacting the level of employment (Humber, 2007).

Another factor that is contributing to the uncertainty about the future and is therefore a challenge that every country must face individually and as a whole is the organization of society and the economy themselves. Technology is not just reshaping jobs. It is also reforming the way the labor market functions as a result of online platforms which are revolutionizing the way individuals, workers and employers, and businesses relate and interconnect with each other. It is a hard task to employ laws to every single emerging platform, thus disabling workers of that kind to benefit from the rights and duties of traditional employees and are not entitled to unemployment benefits when they are dismissed. Another factor that is transforming the way society is shaped is that online platforms enable one to be connected 24/7 almost anywhere in the world, which influences other life paradigms such as health, relationships, family, rest, and many others (Eisen, 2018).

All in all, the previous industrialization epochs were hard times for everybody, especially workers. However, the modern conditions and living standards have improved brutally when comparing to the 19th century that even makes it no longer comparable. Industrialization processes brought many hard times to a great part of societies, but the economic growth is undeniable and so are the long-term effects. Nowadays, a larger part of the world's society has much better conditions as a result of the evolution of technology and industrial progressions. However, it is crucial that a process of re-engineering is carried out and that the world goes through a process of reorganization of the society and production structures, especially in the labor market, including new information technologies.

1.2.5 What has to be done

The need to adapt and accept the inevitable future where technology will be embedded in the all sectors, production processes, daily lives, workforce, and the way the world works in general, is crucial and urgent. It has been difficult in the past, but humankind has been able to adapt and to evolve despite all the struggles. Walter Russel Mead suggests that during the beginning of the 20th century, the process of adjustment to industrialization in America came in three stages (Eisen, 2018):

1st Americans began to learn from their failures and sought to understand the new conditions. For instance, economists made strong efforts to make deep analysis about problems and statistics, the quality of the personnel in the civil service improved, new methods and ideas were developed by many individuals and institutions

2nd Following generations started to grow more confident in the effects of industrialization

3rd The Americans were able to design a template for organizing the society, due to World War II

This process did not solve problems, nor did it happen from night to day, but it surely was a good start to gradually defining a prosperous intellectual, social, and political structure.

One of the major dilemmas at the moment is how to organize the workforce accounting for the recent demands of the market and advances in technologies since more and more require less workers in manufacturing production and services.

Predictions on how new technologies will affect work depend on several conditions of which the industrial structure of the economies, employment policies, investment, research, and infrastructures available to support new technologies. This way, predictions are directed based on the characteristics of new technologies meaning that there are hardly the same for developing countries (Ruyter, *et al.* 2018).

The labor structure has changed, and it is time to update the outlines that guide the workforce configurations. It is predicted that, in time, the knowledge sector will be the only one requiring human intelligence, at least until intelligent machines don't take over human knowledge workers as well. This way, it is vital that people are educated according to the new era and the future ahead, which is already happening.

Furthermore, since the structure of the workforce is being molded by the technological impact on work and careers, it is necessary to assess the relationship between education, employment, credentials, and careers. This seems obvious having in account that young

people highly invest in their education which is currently based on past outlines, so that when they are released into the labor market, jobs are different from the ones they were prepared for to such a degree that there are unable to find a job or become underemployed, meaning that resources are therefore being wasted, investment is lost, impacting income and welfare.

So far, humans still have the power to decide how they want production gains of the Information Revolution to be managed and distributed (Humbert, 2007). New technologies are inevitably significantly reducing the amount of people required obviously impacting the labor market. The way technologies are engaged as means to potentiate the benefits leading towards a better world and to ease the downside effects or the fear of possible increasing poverty and inequality depend on how we manage these technologies. Changes must occur in order to achieve positive outcomes with the use of new and advanced technologies such as new legislations, new mechanisms to redistribute income for the benefit of society, encouragement actions, environmentally sustainable efforts, among many others. However, there is no list of settings that is suitable for all societies. It is each country, city, and community´s responsibility and of those who lead them to work on their own vision of the future. It will not be an easy process, and everybody will surely suffer collateral damages at some point, but ultimately, everyone will have to adapt (Eisen, 2018).

Despite many social, economic, and political disorders that resulted from industrialization, Walter Russel Mead describes a pattern for each industrial phase: eventually societies, specifically the Americans, learn how to make use of the benefits from the industrialization and address its problems; the workforce adapts to the new circumstances and new professions and occupations emerge and replace the ones that disappear also providing stable jobs and with wages and benefits which gradually increased, and eventually the regulatory system also adapts to the changes. Also, international life becomes more stable with the development of globalization (e.g.: international employment; exportation and importation, others). All in all, lives ultimately end up becoming more regular after the stressful periods that result from the industrial developments. Is this what´s going to happen this time?

The previous experiences were the fundament for designing a set of useful lessons to face and embrace the current revolution. First, is that no matter how hard times are and will be in the future as a result of technological advances, what is happening now is an opportunity, not a disaster. Second, the contemporary approach involving policies in which ever institution must be changed and adapted according to the new frameworks (schooling, healthcare, regulations, social benefits, government, among others). Last but not least,

information and knowledge are a state of power and must be used as means to grow. Even though the challenge is immense, a human's distinguishing characteristic is its strive for solving problems and now is just another opportunity to evolve (Mead, 2018). The author describes this situation as "The good and the bad news are perhaps the same: the American people, in common with others around the world, have the opportunity to reach unimaginable levels of affluence and freedom, but to realize that opportunity, they must overcome some of the hardest challenges humanity has ever known. The treasure in the mounting is priceless, but the dragon who guards it is fierce." (Mead, 2018, p. 19).

After reviewing literature on the subjects of the evolution of industrialization, and the impact it has had at different levels - social, economic, geographic, political, and others - I can conclude that societies suffered continuous, and sometimes severe, changes. However, despite the struggles, eventually humankind adapted and evolved. This generic framework solidified my interest in understanding a more specific moment in time, being this the fourth industrial revolution – the one which we are currently facing. As presented in chapter 2, I aim at understanding whether or not the Digital Revolution will follow the same pattern as the previous revolutions and how well is the population currently working in Portugal aware and prepared for the foreseeable future. Since my own future is at stake, it eagers me to contribute to increasing the awareness and helping prevent potential struggles that the technological era may incur essentially in the labor market.

2 Aim of thesis

The aim of this thesis is to investigate the potential impact of automation on the labor force working in Portugal, in the era of the Fourth Industrial Revolution. This urge was consolidated after deepening my knowledge about the evolution of the industrial revolutions, their main remarks and how societies reacted and adapted to the changing settings regarding their daily lives and, specifically, the labor force. As such, my interest in understanding whether there is a pattern of events was solidified.

Despite presenting highlights on the several definitions regarding the technologic trends of the era of the digital transformations, I will focus specifically on automation since this is the IT tool that directly impacts the labor force the most. While all the technologic trends complement human work, automation, in addition, can substitute it.

However, in order to attain the main objective, it is necessary to consider a set of topics, namely:

1. People's and companies' level of technologic maturity
2. To analyze whether or not workers in Portugal believe their current job is at risk and will potentially disappear as a result of automation and the use of AI, or if they consider this as an opportunity in their career
3. To explore the extent to which workers and their companies are embracing and responding to the changes in the technologic age as well as the transformation of the workforce due to these changes

In the end, I intend to open path for further discussions on whether we believe we will always be able to control the bots because we are humans with a brain and self-consciousness, responsible for creating and developing them, or if eventually they will take over us.

3 Technology breakdown: definitions and trends, with special focus on automation and its implications in the labor market

Before being able to fulfill the aim of the thesis, it is important to consolidate a few concepts related to the technologic trends of the 4th Industrial Revolution. This is an important step as to guarantee that definitions are well clarified, especially regarding the concept of automation. As presented in the aim of the thesis, the intention is thus to explore and present brief considerations on how will and how is this technology currently influencing and affecting the labor market in Portugal, and how is it predicted to do so in the future.

As previously presented in the literature review, all industrial revolutions share a common event: the labor force has always suffered changes resulting from the inherent consequences of technologic systems, especially due to automation. In other words, from the research data, it was possible to infer that, from a series of technologic trends that affect work, automation is continuously the most highlighted tool. This is the reason why my approach will focus on this type of technology.

Technology has always been the motor of change enabling societies to evolve at all levels. Alongside, organizations also run the same path and are guided by technology as well and are inherent in every single business in any kind of way. This way, this chapter intends to provide some highlights on how technology has been in our lives for the past centuries and it has come to stay and it is in constant evolution.

3.1 Technology has come to stay

Undoubtedly, and especially nowadays, societies are technology-centered. Not all populations have access to or even know about technology, but it certainly is taking over the world and probably people are not aware of what it already enables at all levels. To provide just a glance of the future of technology, Future Timeline.net (2000-2009 timeline contents, 2018) designed a timeline showing the most revolutionizing events starting in the 21st and 22nd century to what they believe will happen up until the far future and beyond (2200 onwards).

Not only societies are technologically-oriented but so are organizations and towards this technological era we are living in, according to Nelson Kunkel "it is important to place humans at the center of our problem-solving and let technology enable that process, not define it" (2017). Technology is practically limitless in both personal and business scenarios.

Enterprises are challenged with the use of the power of technology as means of meeting human needs. Leaders must be able to adapt to the increasing automated processes when it comes to turning irrational human behavior into rational machine processes.

This process of adaptation must be held by every business sector (primary, secondary, tertiary, and quaternary) and types of industries (healthcare, agriculture, education, energy, etc.) or will otherwise inevitably fall behind. Implementing automation technologies help improve productivity and develop long-term economic growth. This way, technology must be combined with human capabilities at its best in order to enable competitive advantage and therefore guarantee that companies (Manyika and Bughin, 2018):

- Optimize their own operations (cost reduction);
- Innovate and develop new business models.

This same study - Executive Briefing - conducted by McKinsey Global Institute (Manyika and Bughin, 2018) concludes that policy makers and leaders must take action and pay special attention regarding the disruptive transition of new processes that have been replacing or complementing people or jobs for (intelligent) machines, whereas a smooth shift is required. Humanity has been through this progression before in several Industrial Revolutions – as previously mentioned, this era is now known as Digital Revolution or Transformation.

3.2 Technological trends and respective definitions

Like all previous revolutions, machines have been taking over humans in several ways, leading to changes in business models, operations, workforce structures, products, and client experience and technology is the main factor for boosting these continuous transformations in both societies and organizations. It has always been this way, and it is no different this time.

This section aims at defining which front-line trends are ruling the way people are living, and companies are running their businesses, as well as changing humans' involvement in several kinds of activities. This way, it is important to refer the major trends around the automation topic in order to clarify the characteristics of each trend. An explanation will be presented in order to clarify the differences in the terms. Even though at times they may all seem alike, though related, the specifications of each are different (Gershgorn, 2017).

3.2.1 Robotic Process Automation (RPA), White Collar Automation, or Automation

Back in 2014, RPA wasn´t necessarily perceived as one single term (Handel, 2004). defined the concept in two subsets, of which: *robotics* – robots are programmed under a certain kind of language defined by combinations of algorithms, enabling the repetition of the programmed tasks and *automation* – the term emerged after World War II in the industry and defined the use of automatic equipment and controls on production lines based on mechanical and computerized processes, monitored or not by humans and providing real-time information.

More recently, RPA can be seen as one term. Similarly to the previous definition, it is defined as software used to automate business processes of which personal digital assistance, web analytics, data interpretation, processing transactions, among many other functions. Like others, the objective of RPA is to substitute repetitive tasks that were previously done by humans, through automation. Contrary to what one may think, "repetitive" doesn't regard solely to basic tasks.

3.2.2 Artificial Intelligence (AI)

It is the science and engineering that creates intelligent machines that simulate human tasks. The word "intelligence" refers to the different mechanisms and therefore it is not uniquely definable, yet it can be described as "*computational part of the ability to achieve goals in the world*". Identically to humans and animals, machines also have different kinds and levels of intelligence. AI is able to define patterns of information, creating procedures, just like a human brain does. Nevertheless, AI does not solely study human intelligence in order to perform it. It also studies animals and worldwide issues. It is presented in all sorts of industrial sectors, products, systems, operations, and so forth (McCarthy, 1998).

3.2.3 Augmented Reality (AR)

Technological tools used to enhance the environment or a certain context and providing as if an immersive experience. Organizations can highly benefit from using AR especially in industrial fields like construction or automotive maintenance. It works through presenting a 3-D version of information within an environment and its specific targeted objects. However, the use of AR tools in organizations is still at an early stage and therefore rarely used for the purpose of a daily basis usage (Jetter *et al.* 2018)

3.2.4 5th Generation (5G)

It is the next generation of connectivity intended to replace or augment the previous ones and it is 100 times faster than the current latest generation. It has been being developed over the last 10 years and is still not fully completed but the means for its use extend far more than just mobile purposes, as such for autonomous vehicles (providing real time road and performance information by communicating among vehicles and to drivers), public safety and infrastructure (enabling cities to operate more efficiently by instantaneously and remotely tracking usage, using sensors to alert for possible events), healthcare (especially in areas such as telemedicine, remote recovery, physical therapy through augmented reality, and others), IoT (communication becomes a lot faster and using a less resources), and many others. The emergence or at least a more regular use of the 5G is still uncertain but it is certainly about to come (Looper, 2019).

3.2.5 Virtual Reality (VR)

It is simulation software where the user becomes part of a certain environment through the use of virtual glasses. The primary objective of VR was for gamers to be involved and to immerse the games. Nowadays, both AR and VR are used in several other activities and branches such as marketing (e.g. tourism), training (e.g. doctors; marine), education, entertainment and others. The percentage of job demand for candidates with high VR knowledge and skills have been increasing exponentially but the range of potential employees is still scarce (Duggal, 2018).

3.2.6 Internet-of-Things (IoT)

Much of what is being developed nowadays includes a connectivity feature through Wi-Fi or, in other words, the internet. In this case, objects incorporate features like electronic sensors, actuators, or other digital devices that, connected to the internet, collect and exchange data. There are several kinds of objects, systems, services and devices that are being created with this functionality enabling object-to-object communication and data sharing (including home applications, for examples, turning on the washing machine at home while one is at work through the mobile phone; un/lock doors remotely; preheat the oven while arriving the house; tracking our daily sleep and physical exercise) (Zhong *et al.* 2017). Nikita Duggal states in a published article (2017) referring that in 2017 there were 8.4 billion devices that were IoT based and the number is expected to increase up to 30 billion by 2020, which is

comprehensible in a context where many traditional areas are being affected by IoT and in the most various fields (industry, retail, transportation, medical care among others) and it is embedded in several moments of the quotidian life. Businesses are also benefiting from this creation as it helps increasing efficiency, decrease time consumption, and others. However, despite the popularity IoT has gained, there is still a lack of experts on the subject being this a hindrance to growth.

3.2.7 Cyber Security

In spite of being in the market for a long time already, this kind of technology is also evolving as security threats are always emerging due to hackers whom constantly try to illegally access data.

3.2.8 Cloud computing

It is a network model that enables the access to a shared platform made up of configurable computing resources (e.g. networks, servers, storage, applications, and services) (Mell and Grance, 2011).

3.2.9 Big Data Analytics (BDA)

Advanced analytic techniques operate on big data and can be defined through three "Vs" of which Volume (terabytes, records, transactions, tables, files), Velocity (batch, near time, real time, streams), and Variety (structured, unstructured, semi-structured, all the previous) (Russom, 2011).

3.3 Automation and its branches

From the previous section it is possible to understand how technology is constantly present in our daily professional and personal lives, and even though only a few of the current main technological trends were referred, the list of possibilities is endless. Nevertheless, two of the mentioned concepts are the most relevant for this report and, consequently, this chapter, of which automation and AI.

Even though the two concepts have already been described, they will be explained in more detail, individually. However, automation and artificial intelligence follow a converging line which is why they will be constantly highlighted as a pair rather than one-to-one. In spite of being part of people's regular day-to-day life, the chapter will focus on describing both

terms in an internal business-related manner in order to later analyze the influence on the workforce structure, as means to mitigate the impact on the human resources within the companies. The reason why it is pertinent to take a look at the two concepts is because AI is an expansion of automation. In other words, AI can also be called Automation 2.0, as it is characterized for adding to automation, a cognitive topography (optical character recognition (OCR), voice recognition, and other features). "There is a drive toward automation and the application of artificial intelligence, the skills are consistently changing, and there is very little communication from the creators of this innovation and the way we are training workforce", said Oakley in a panel on employment pipeline – how companies are finding or developing the workers they need (Press, 2018).

3.3.1 Robotic Process Automation (RPA)

RPA combines hardware and software and pairs networking and automation as means to simply computer science, electronic and communications, mechanical engineering and information technology. This technology facilitates daily procedures in companies such as processing employee payrolls and status changes, selection and recruitment, accounting, invoice administering, managing inventory, reporting and software installations. In addition to its countless applications, RPA is used in all sorts of sectors within the industries. Examples are "healthcare and services, financial services, outsourcing, retail, telecom, energy and utilities, real estate and FMCG and many more sectors" (Madakam, *et al.* 2019). RPA uses several other sub-technologies which were previously explained and are combined in the business operations-level, including "artificial intelligence, machine learning, deep learning, data analytics, HR analytics, virtual reality, home automation, block chain technology, 4D printing, etc." (Madakam, *et al.* 2019).

The use of technology is intended to support human skills as well as to enhance and accelerate human expertise. RPA, being one of the major sectors of modern technologies, has become compulsory in daily business activities and even in personal use. Not having this kind of tool in the company may lead to a fallback comparing to direct competitors. In other words, more and more enterprises are allying software robots or AI workers to human employees, potentially leading to some threats or tension to the human workforce. Nonetheless, RPA is certainly in most businesses and daily lives in any form and conditions the way strategies are defined, how people do their work, how people live. The term "RPA" comprises two different units of such "Robots" and "Automation" and the article defines each one, separately.

Robot – it is a machine which is mechanically operated and programmed by a computer enabling it to develop certain actions automatically through the use of engineering and science. The system by which they function can be enabled through artificial intelligence if the robot is to be intelligently connected in order to perform certain actions.

An example of an intelligent robot is Sophia and is characterized as being a chat box with a face, comprising over fifty facial expressions and is officially the first humanoid robot citizen. Sophia, likewise robots in general, functions through the use of wireless networks, big data, cloud computing, statistical machine learning, open-source, and other resources that enable performing certain actions in several different areas such as assembly, inspection, driving, warehouse, logistics, package delivery and many others.

Automation – it is the procedure or a system that makes something work automatically. It is not a simple process to combine automated systems and human features, particularly cognitive characteristics. Nowadays, more and more things can and are being automated and relying on smart devices is becoming more frequent to people on a daily basis as they help people increase the quality of life, releasing time and energy since automated processes enables certain things and tasks to function more easily, faster, and better.

Robotic Process Automation is therefore becoming the most relevant wave of innovation and is being extended to all aspects of life and industries and one of the main significant goals is to transfer work previously done by humans to preconfigured software boosting the value of core business processes (Madakam, *et al.* 2019).

3.3.2 Artificial Intelligence (AI)

AI is a concept that describes machines that work, react and perform activities just like humans, or in other words, it is the process involved in intelligent machines. Even though it seems like a recent hot topic of the past few years, the term "intelligent" was popularized at a conference at Dartmouth College (United States) back in 1956, but it was only in the 1990's that this field of study started gaining exponential hype, especially due to the technological blast of that time.

As stated in an article from Negócios (Lourenço, 2017), also advocated by many other sources, artificial intelligence (AI) was one of the most popular buzzwords in 2017, not due to the concept itself and its potential - which are not that recent - but rather due to the effective concretization in the businesses and the way each one of us comes across with several sorts of

AI in our daily routines. Additionally, it supports the idea that this will achieve an exponential scale in the next few years.

AI is manifested through machine learning algorithms and its range of utility has been growing exponentially meaning that it is not destined to be applied in one single objective, but it has instead been gaining territory in all sorts of platforms, applications, or devices and it will only accelerate even more with time (DeMers, 2017).

Gartner Study (Elliot and Andrews, 2018) denominated the acronym "AI" as "Amazing Innovations". With its evolution, they now denominate it as "smart machines" with several branches of more advanced technologies such as deep learning, machine learning, mental ability, among others which will be explained further on.

Nikita Duggal, a content writer of Simplilearn (2019) reinforces the idea that artificial intelligence is for sure a buzz topic of the moment and, like many others, supports that it will continue to have a highlighted trend in the world for its impacts and effects at all scopes such as the way we work, the way we organize our personal life, leisure, relationships, and others. All in all, AI is a set of computer systems that intend to simulate human intelligence and equal the performance of human tasks for instance image and voice recognition, patterns, and decision-making.

3.3.3 Intelligent automation

RPA has been proving how productivity can be enhanced by these new technologies without having to recur to massive systems reengineering. In the case of business organizations, RPA can boost progress and add value whether it´s used as the company´s core business or simply to aid the process models, products, services or business operations.

Intelligent automation is a further expansion and one of the many branches of automation. It is an advanced step of digital transformation, where business activities can increase their value by accompanying the current innovations, wholly or partially, and can also be referred as cognitive RPA, or CRPA (Beardmore, 2018).

With the blossoming era of automation, many jobs have emerged across various industries causing shifts in the standing living of societies all around the world, changes in product design and manufacturing, modifications in business models (as repetitive work has been increasingly being replaced by automation as means to optimize routine operations, improving efficiency and reducing costs). At the same time, internal business processes are

also being altered due to automation namely the workforce market. Until now, machines have been substituting humans essentially in manual and repetitive tasks. However, even though robots are not new, AI has been giving these robots and other machines the capacity to think, simulating a human brain. The implications of these changes have been having serious impacts, especially on white-collar workers similarly to those brought to the manufacturing sector (blue collar workers) all along, as previously shown.

This way, it is important to understand that AI, as a subset of automation, also has its subdivisions that result from the integration of cognitive capabilities into robotic process automation. CRPA platforms can perform different tasks using technologies like natural language processing, machine learning, speech recognition, among others. These will be briefly explained further on (Partner Content, 2018). However, "(…) some of the branches are surely missing, because no-one has identified them yet." (McCarthy, 1998, p. 7)

3.3.4 Chatbots

Computer programs that impersonate a conversation with people through a series of previously programmed answers. This feature in websites is enabled through artificial intelligence.

3.3.5 Machine Learning (ML)

Algorithms that are programmed to extract patterns from a set of historical data. The machines then use the gathered knowledge for the performance of certain tasks previously executed by humans. As the name indicates, these machines are programmed to perform certain tasks and to be able actually learn from patterns of information. It enables to access and organize large sets of data and therefore make more decisions more efficiently and results-driven. Within ML are several other subdivisions such as (Elliot and Andrews, 2017; Hale, 2018):

- **Deep Learning (DL) –** focuses the knowledge of specific observations within a larger amount of data. This way, it is possible to tackle more complex issues
- **Natural-Language Process (NLP) –** a subset of AI, NLP is a tool that enables machines to understand and analyze the human language (words, body movements, contextual patters) in order to apply in the business market and its respective departments (marketing, management, etc.). Experts use algorithms that

include statistical machines learning to decode grammar rules and this way determine the context of what has been said (Mills 2010).

- **Neural networks** – described as a tool that is able to extract complicated or imprecise information and turn into something more simple and interpretable. It does so by extracting patterns and detecting trends that are too difficult for humans to attain. Through its learning capacities, this technology enables the modification of behavior depending on the environmental conditions it is exposed to, thus adjusting itself to the context. This happens through the process of pattern recognition (Eluyode and Akomolafe, 2013).

3.3.6 Computer Vision Technologies (CVTs)

By observing and processing digital images it uses methods that enable to analyze and understand the images' meaning and settings (Elliot and Andrews, 2017; Hale, 2018).

3.3.7 Speech recognition

One of the most difficult technologies that is still being developed and needs a lot of innovative thinking is speech recognition. When machines are able to translate verbal words and sentences into a format that can be read and comprehended by machines (e.g.: Google Voice, Amazon Alexa, Apple Siri, Microsoft Cortana) (Elliot and Andrews, 2017; Hale, 2018).

3.4 Do computer programs with AI settings have IQs?

One of the many fears of AI is related to the possibility that robots may substitute cognitive work currently done by humans, rather than just the repetitive tasks. Such cognitive competences may lead to wondering whether intelligent machines may have IQs or not. John McCarthy, father of AI, stated that machines do not have IQs even though they are "intelligent".

IQ tests are performed in order to measure problem-solving and reasoning abilities in comparison to other people in the same age group. In other words, it is the ratio at which a child answers certain questions higher or lower than those in his/her average group age, meaning higher, standard or lower IQ. McCarthy supports that machines do not have IQ as "computer programs have abilities that correspond to the intellectual mechanisms that program designers understand well enough to put in programs". In addition, he also stated the

platforms and products that work under AI settings correspond solely to the intellectual abilities and mechanisms of those program designers (McCarthy, 1998).

3.5   Examples of different approaches to automation

To finalize, parallel approaches with be shown as examples of both optimistic and pessimistic views of the undeniable though uncertain future that will, as it has always been, ruled by technology namely, automation.

According to authors from the Harvard Business Review (Jesuthasan and Boudreau, 2018), when debating prospects about how will advances in automation affect the labor market, generally predictions fall into one of two options. One of the sides there are the optimists, which support that automation and the new technological trends will enable human workers to increase the value of their work and will open path for more creativity. Contrarily, pessimists preview massive unemployment or, in a more dramatic scenario, that robots will take over humans' jobs.

There are several approaches regarding the automation and artificial intelligence era. As mentioned, some are optimistic, others pessimistic, and others do not have an opinion yet. The question is, **are people even really aware of what this era really means and what implications will it have in our daily personal and professional lives?** Let´s take a look at some perspectives.

3.5.1   Optimistic approach

"*Cybernation   revolution*", "*Digital   transformation*", "*Industrial   Revolution*", "*Industry 4.0*" or even "*Automation apocalypse*", as described in the online magazine Quartz (Kessler, 2017) are some of the names that describe the new epoch we are living in. It states that in spite of the fear of robots or machines stealing our jobs, this is not a new trend and it has been happening ever since the Middle Age. In fact, the article even defends that "automating a job can result in *more* of these jobs" (Kessler, 2017). Taking factories as an example, its workforce can benefit from automation in terms of decrease in product prices, making them more attractive to demanders, leading to the need of more workers. Also, if profit increases, the workers that remain may be paid higher wages and have more capital to invest, leading to more production, and therefore, increased need of labor force.

Amazon is a great example of the replacement of human workers for robots. This situation has generated a buzz due to the increase in the numbers in such a short period: from 1,400 robotic workers in the warehouses in 2014, the amount increased up to 45,000 in 2017. However, the rate at which the ecommerce company hires workers hasn´t changed, and can be seen in the following graph (figure 1):
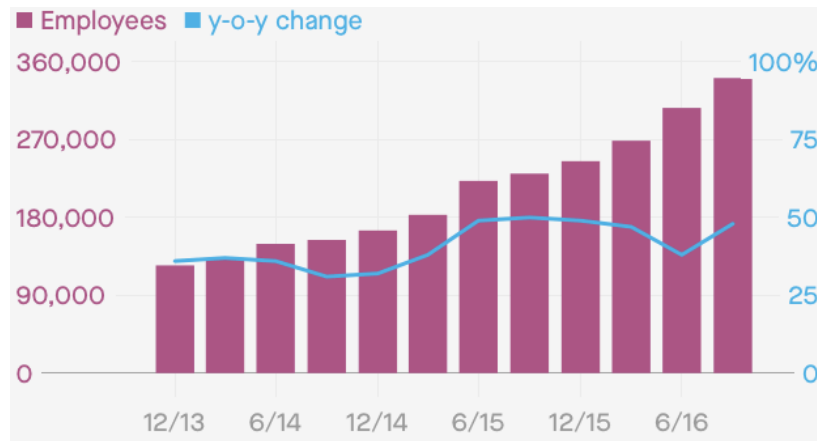
Figure 1: Amazon's quarterly headcount (full and part-time employees)

Source: Sarah Kessler, Quartz. Amazon. Excludes contractors and temporary personnel https://qz.com/673247/amazons-workforce-grew-by-50-last-year-alone/

It is possible to conclude from the graph that even though the year-over-year rate [2] varies both positive and negatively, the number of employees working in Amazon has raised between 2013 and 2016.

The idea of using automation to lower prices, mentioned above, is what happens in this company. This enables people to buy more products within the company, which requires more people to manage the warehouses and the robots, and thus, lower the need of human hours of labor per package. Other optimists agree that automation may either replace human labor or reduce time spent performing certain tasks, meaning that in both cases, automation comes as a way to supplement labor and not necessarily lead to the extinguishing of a job. Again, it is stated that more productivity may lower the level of prices which demands more production, and therefore more labor is needed. In addition, using automation in certain tasks enables the worker to be better or to simply shift into other occupations. The author states that

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[2] Year-over-year rate: enable to evaluate growth by comparing statistics of a specific period to the same period the previous year (a period can be a month, a quarter, a semester, and so on), removing effects of season. This way, it is possible to see if the event in a certain period is recurrent to the last year, or if the changes are unexpected or actually due to unknown causes (Amadeo, 2018).

in both cases, automated occupations may lead to an increase of employment rather than a decrease (Bessen, 2016).

However, what is not possible to tell from the graph is not only the jobs that were extinguished - meaning that people had to be dismissed or shifted to other functions – but also the way automation, in general, impacts jobs.

It is no lie that the latest technologies will come to replace many jobs, but it is also said and known that new jobs will emerge likewise for instance, AI supervision, repairing and maintenance of new systems, reshaping infrastructures. However, when predicting which jobs will emerge and disappear, it is important to take in account whether it refers to the whole job itself, or just tasks of a certain job (Kessler, 2017).

Nonetheless, History gives strong chances to trust the strength of human and economic adaptability, thus facing the challenges and consequences of technological unemployment. The article "Should we fear robotic revolution?" suggests a series of opportunities that can rise from this specter such as "income growth raises the demand for labor in sectors that produce non-automatable goods and for workers that perform manual-intensive tasks; higher productivity stimulates investment throughout the economy in cooperating capital inputs" (Berg *et al.* 2018). In addition, the article suggests that despite the fact that automation may lead to the obsolesce of some jobs, not only it can complement others as well as it can lead the emergence of new ones, especially those highly related to creativity, flexibility, and abstract reasoning. In response to the pessimistic view of many people, the author believes many people do not look at the global outlook of the situation thus supporting that "journalists and even expert commentators tend to overstate the extent of machine substitution for human labor and ignore the strong complementarities between automation and labor that increase productivity, raise earnings, and augment the demand for labor . . . Focusing only on what is lost misses a central economic mechanism by which automation affects the demand for labor: raising the value of the tasks that workers supply uniquely." (Berg *et al.* 2018).

3.5.2 Pessimistic approach

Opinions diverge when it comes to the consequences of automation in humankind, especially regarding artificial intelligence, being this technology the one that is most identical to human features. The Journal of Monetary Economics presented an article where the authors gathered variants within models defining different views on the transformations automation

can bring to the labor market. They concluded that "automation is good for growth and bad for equality".

Previously, robots started by substituting human labor only by performing routine, physical and analytical tasks. With the evolution of different technologies, robots are now able to perform cognitive work, among other kinds, that no longer require human labor or human supervision. This has been and will continue resulting in the elimination of countless jobs in many different sectors and departments affecting, among other variants, the growth and the distribution of income.

Whilst optimists believe that despite the undeniable fact that automation will cause disruptions in the labor market in the short term, they state that periods in History where rapid technology transformations occurred have created more jobs than they have destroyed and that wages and the income per capita has, consequently, increased.

On the other hand, a pessimist view supports that we are heading towards a scenario of inequality and class conflicts, and where humans will be taken over by the commands of robots. The article proposes models stating that the robot implications for output are quite positive. However, in the short-term (typically meaning 20 to 50+ years) wages will decrease negatively therefore impacting distribution. Unskilled workers will be the ones that will suffer a larger negative impact due to automation meaning that strong investments in education must be held in order to convert "unskilled" into "skilled" workers. Capital taxation must be carefully reviewed and will certainly impact people in all social classes. Also, in a pessimist perspective, inequality will be intensified not only regarding social status within a country but will also increase the disparity between developed countries with capital to invest in technology, education, and others, and underdeveloped countries with low or no solid and controlled labor structures and policies (Berg *et al.* 2018).

It is possible to conclude that there are several technologies emerging and evolving all the time and everywhere, but the concepts presented are the main domains and are known to have a strong potential of boosting organizations in terms of the way there are managed and how they perform their activities. However, what at this stage, most of them have in common, is the lack of skilled workers that have these recent technological-related capabilities. This way, now is the right moment for both organizations and workforce to start acting upon this era by adapting their knowledge to the current and future demands of the market.

3.6 Automation and the labor market

3.6.1 Impact of automation in companies

As previously mentioned, there are several digital technologies that are revolutionizing the world and have been doing so for many centuries - the way companies process their daily business models, products and services, and strategies. However, the main focus with remain directed to automation and, consequently, artificial intelligence or, in other words, automation 2.0. This way, an executive perspective regarding how companies should and can achieve mature automation capabilities will be presented according to different authors. In addition, a combination of several opportunities and constraints will be considered in order to later discuss the impact of automation in an internal framework of companies, specifically regarding the impact on the labor force.

3.6.1.1 Steps to achieve mature automation capabilities

Everything that has been discussed about how technologies have been influencing societies, in general, is reproduced in organizations. The digital technologies previously mentioned are influencing business models, structures within companies – their management and functions' strategies – products and services, and operation models, namely automation.

Digital transformation is a continuous process and more and more, people begin to believe it will also have a never-ending development. According to the International Data Corporation (IDC), by 2020 40% of digital transformation projects will incorporate a certain type of artificial intelligence (Lourenço, 2017). However, according to Gartner's research about AI (Elliot and Andrews, 2017) it is currently a two-sided coin: on the one hand, the study supports that AI will help accelerate innovation, influence the emerging and producing of new insights, affect the way decisions are made by individuals and business strategies, and possibly lead to improvements in business outcomes. On the other hand, many employees and head of departments and enterprises agree that they are still not quite sure about how AI can help companies and are unsure of how and where to begin using AI-based solutions. This supports the fact that a thorough study must be held by each company in order to understand how this range of technologies can be applied in their own enterprise and the definition of best ways and places to deploy.

Despite the resistance and uncertainty about the future, everyone knows it is going to come at a constant steady speed. Garter's research proposes that companies that are not yet so

familiar with AI should start investing in a process to increase their automation competences. Several studies present a series of steps to achieve mature automation capabilities. Gartner's study suggests that companies should start by:

- Learning how the organization can gain practical experience from AI pilots;

- Experimenting / testing / early production systems;

- Using results to revise plans and set realistic objectives based on AI benefits, accounting its disadvantages.

Also, about this matter, Bruno Horta Soares, IT Executive Senior Adviser of IDC Portugal, despite believing that each organization should design their own, suggests several common practices that should be held by any company to effectively trace their digital transformation path before investing in AI, of which (Lourenço, 2017):

- Understand current stage of the enterprise (timeline, positioning, market);

- Define the company's current level of maturity regarding the process of digital transformation (research of this consulting group showed that most of the organizations consider themselves as being in a level of maturity 3 of 5);

- Map which innovation accelerators would be useful to invest on (AI, Internet of Things, 3D printing, among others);

- Assess risk.

These steps should be taken in consideration with regards to the different individual projects of a company in order to understand the impact on the "big picture" of overall strategy, human resources, decision-making, safety and privacy, reputation, and other aspects.

Another journal article performed in London School of Economics (Lacity and Willcocks, 2016) proposed several other advantages accomplished by companies who were able to build mature service automation capabilities, thus leading them to significantly benefit from the use of this broader business strategy. Hence the gains are the following:

- Producing repetitive content in reports (e.g.: journalists – enables workers to focus on producing creative work and accelerates delivery time to clients);

- When strategic service automation support (meaning that automation is used in strategies and not just in daily work) comes from top management rather than just from the divisional or IT level, the usage influence is deeper and helps connecting the different levels within a company;

- Increases sourcing options:

1. *Outsourcing:* Company A may sub-contract a specialized service automation tool provider - B - which is cost saving when this is not a core business to company A;

2. *Insourcing:* Buying software licenses;

3. *Cloud sourcing:* buying service automation as a cloud service.

Companies that captured the full benefits of service automation had a long-term view. Whereas some users approach service automation as a way to achieve quick wins for the business, the same journal found that companies that undertake it as part of a broader and more integrated business strategy were able to achieve more substantial gains.

3.6.2 Impact of automation in industries and the labor market

Like everything in the world, this subject carries inherent challenges and opportunities in several areas, especially regarding to human resources within the labor market worldwide. This way, the following chapter presents a framework about how automation is predicted to affect industries in the following years. Jobs can be partially or completely automated, which is why three kinds of waves were developed as automation is predicted to have effects at different periods, and therefore differing the tasks and/or jobs impacted. This way, some industries are predicted to highly suffer the consequences of the Revolution 4.0.

Consequently, companies themselves are suffering transformations in their various segments: client experience, internal business model, and operations system (product or service, structure, others). Later, this topic will be discussed with more detail focusing on the operations of companies since despite having the objective of optimizing operations' strategies, the use of automated systems will inevitably alter the structure of the labor force within the companies.

3.6.3 Estimated automation rates across waves

Table 2: Estimated automation rates across waves

Phase	Description	Tasks impacted	Industries impacted
Algorithm wave	Automation of simple computational tasks and analysis of structured data, affecting data-driven sectors such as financial services	Manually conducting mathematical calculations or using basic software packages and internet searches. Despite increasingly sophisticated machine learning algorithms being available and increasingly commoditized, it is these more fundamental computational job tasks that will be most impacted first	Data driven sectors like financial and insurance, information and communication, and professional, scientific and technical services
Augmentation wave	Dynamic interaction with technology for clerical support and decision making. Also includes robotic tasks and semi-controlled environments such as moving objects in warehouses	Routine tasks (e.g.: filling in forms or exchanging information, which includes the physical transfer of information). It is also likely to see a decreased need for many programming languages as repeatable programmable tasks are increasingly automated, and through machines themselves building and redesigning learning algorithms	The financial and insurance sector will continue to be highly impacted, along with other sectors with a higher proportion of clerical support, including public administration, manufacturing, and transport and storage
Autonomy wave	Automation of physical labor and manual dexterity, and problem solving in dynamic real-world situations that require responsive actions, such as in transport and manufacturing	AI and robotics will further automate routine tasks but also those tasks that involve physical labor or manual dexterity. This will include the simulation of adaptive behavior by autonomous agents.	Sectors like construction, water, sewage and waste management, and transportation and storage with the advent of fully autonomous vehicles and robots

Note. "Will robots really steal out jobs?, PwC Analysis 2018. Adapted from https://www.pwc.com/hu/hu/kiadvanyok/assets/pdf/impact_of_automation_on_jobs.pdf

A study carried out by PwC (Will robots really steal our jobs? 2018) with regards to robots replacing human-performed jobs identified three types of waves of the automation process accounting the impact in different tasks and industries, of which:

At a time where automation and the increasing use of artificial intelligence, business leaders must be able to effectively integrate the new technologies in their companies and, specially, within their labor force. It is possible to verify that many tasks will be undertaken by technology - in this case specifically – *smart automation* (combination of AI, robotics, and other digital technologies), which is no different from what has been happening continuously over time. And, similarly to other cases, individuals must take responsibility and must act upon what is happening by seeking to increase their own intellectual property and developing skills related to the rapid pace of the increasing use of automation. This way, companies as a whole must attempt to maximize the benefits of AI and robotics while minimizing the impact on their human resources and other potentially negative effects.

3.6.3.1 Estimated automation rates across industry sectors

Industries are going through huge transformations with the rise of automation. In some industries, this technology can intensify the potential value and on the other hand, others are not predicted to suffer strong transformations as a result of these automated innovations. Many studies are being carried out as means of predicting the future ahead. This way, a macro approach of the impact automation and AI will have on industries will be discussed.

But not only will the industries as a whole suffer transformations. Inevitably the structure of the labor market is also suffering severe impacts, both positive and negative. As a result, certain jobs and tasks are at risk of being partially or completely substituted by machines or algorithms, and humans are the main target regarding these fluctuations. This way, graphs will be presented showing the potential incremental value that AI can bring to the different sectors. However, and because automation doesn´t include solely AI technologies, a graph showing the overall percentage of automation potential in the different job sectors will also be presented. This enables taking conclusions about the potential risk of jobs within those industries.

As stated in the Executive Briefing performed by McKinsey Global Institute (Manyika and Bughin, 2018) performance can be improved with the use of artificial intelligence in more than two-thirds of the cases. The following graph (figure 2) represents the referred statement above:
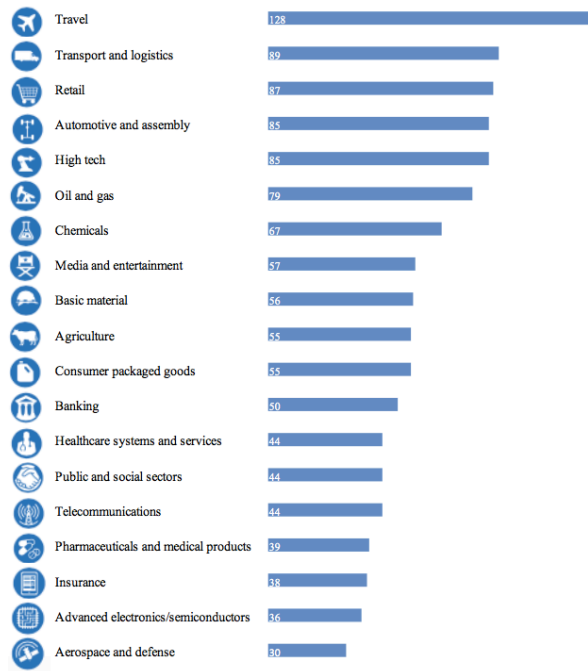
Figure 2: Potential incremental value from AI over other analytics techniques, %

Source: McKinsey Global Institute Analysis

The graph above (figure 2) shows that more than half of the sectors presented may have a potential increment of their value due to artificial intelligence. This translates the fact that many jobs will be modified or replaced by this phenomenon. This leads to a series of debates on the subject itself, where the human factor and the labor field are inevitably correlated.

On another perspective, and because new technologies do not solely involve artificial intelligence, the following graph (figure 3) shows the potential that automation has over fully or partially replacing jobs in the different sectors.
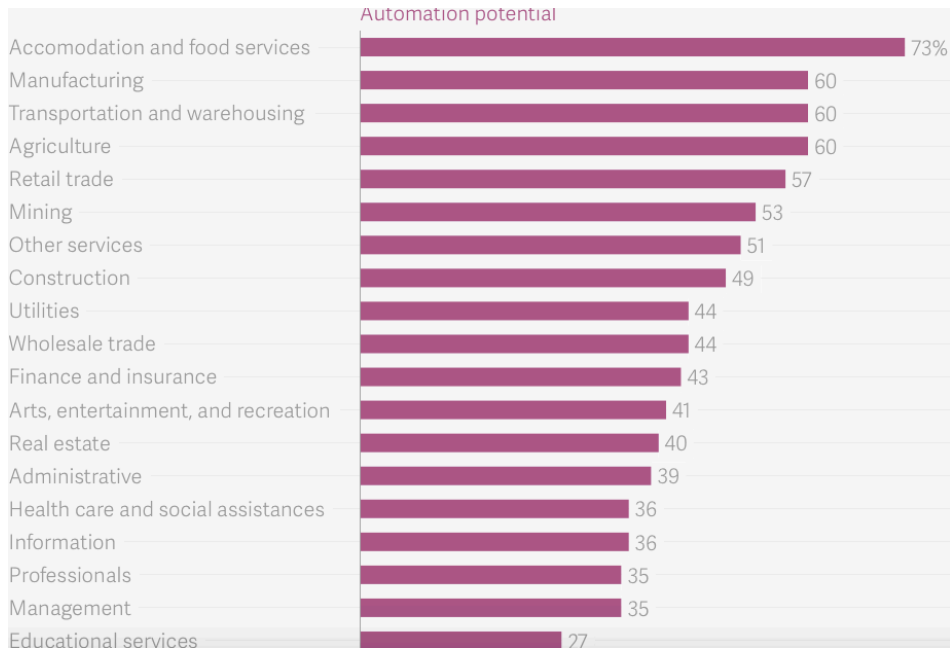
Figure 3: Automation potential across industries

Source: US Bureau of Labor Statistics; McKinsey Global Institute analysis

As expected, similarly to the graph regarding artificial intelligence, sectors like leisure (travelling, accommodation, and food services), manufacturing, transports, logistics, and warehousing have high potential of being somehow affected by the new technologies.

Consequently, jobs in those industries are at high risk of being partially or completely substituted by automation. In contrast, sectors that involve creativity, social relationships, strategic thinking or some sort of specific and continuous knowledge, are predicted to not be so affected by automation systems.

3.6.3.2 Estimated impact of automation across industry sectors over time
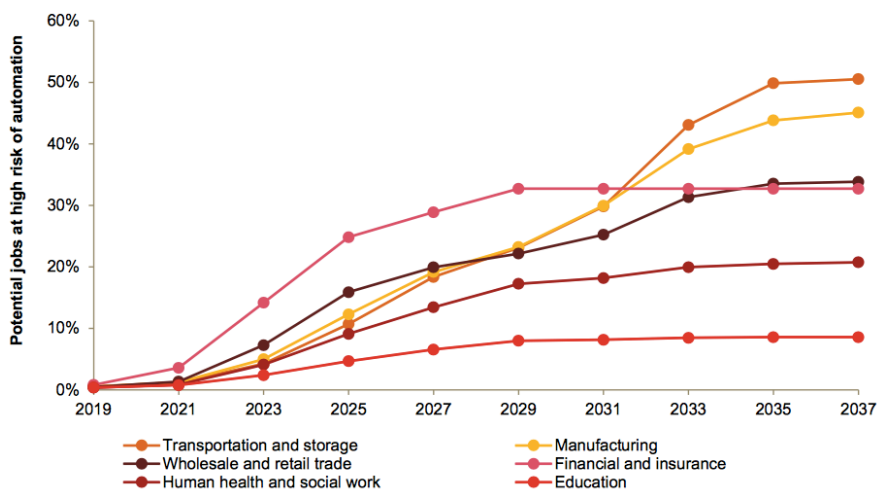
Figure 4: Potential impact of job automation over time across industry sectors

Source: PIAAC data, PwC analysis

Even though the automation process will affect all industries eventually, this will happen at a different pace for each type of automation wave. Being part of the Algorithm wave (where mathematical and computational-related jobs are highly likely to be taken over by softwares), the financial and insurance sectors are the ones that will suffer a larger share of jobs at risk in between 2019-2030, which will then stabilize. Then comes the Autonomy wave including routine tasks regarding information, manufacturing, transportation and storage, which until 2030s will haven´t have suffered too much risk but will then reach a considerable rate due to the emerging of driverless vehicles ("Will robots really steal out jobs? PwC Analysis, 2018)

3.6.4 Employment framework accounting to the Fourth Revolution

At first, to better understand a few of some existing terms, an explanation of concepts like *white-collar, blue-collar, pink-collar* will be defined as well as the difference between partial and complete automation.

The main objectives at this stage are to mitigate the impact on the human resources and the way they are and will be managed, and the job uncertainty in the different industry sectors caused by white-collar automation era, including AI. Also, to understand which are the potential jobs at risk of declining as well as those who of potentially emerging. And last, to understand and identify the demanded skills that are both diminishing and growing as a result of this technological trend, followed by a research on the potential evolution of division of hours of work between humans, algorithms and machines.

3.6.4.1 Blue collar vs. pink collar vs. white collar automation

With the evolution of the industrial eras, *blue collar automation* emerged and resulted in the machine substitution of jobs that required relatively low skills, low wages, repetitive tasks, essentially several kinds of manufacturing, mining, sanitation, commercial fishing, food processing, recycling, construction and others. *Pink collar automation* regards jobs related to customer interactions, entertainment, sales and others. Nowadays, machines are coming to substitute (partially or completely) another type of professions, known as the *white-collar automation* which include jobs performed in offices or other administrative settings.

With respect to this topic it is crucial that young students start directing their academic choices into the direction of the future as well as organizations start taking action into adapting their business models, strategies and structures into a more digital transformation-

oriented path. Jim Wilson, manager and director at Accenture Plc, defined four human core competencies that must be strongly developed and paid attention to in order to achieve success in such an era, of such: complex reasoning, social and emotional intelligence, creativity and certain forms of sensory perception (Torres, 2018). Note that other competencies are vital to be well managed and well mastered to achieve the maximum success.

3.6.4.2 Partial automation vs. Complete automation

Many times, the fear of potential disappearance of certain jobs currently performed by humans as a result of automation is confused with potentially being partially substituted. In other words, automation can partially replace tasks or totally replace an occupation, and here is the difference:

Partial automation – does not imply a net loss of jobs. Automation can appear as means to substitute certain tasks within a job rather than fully substituting human labor in a certain occupation. When partial automation actually leads to decreasing employment in a profession, it may be due to one of two options: first is when there is an inelastic demand for an occupation (need for specialized labor, meaning that the job cannot be easily filled due to the specific knowledge it requires to perform). Secondly, a job can be substituted by another (need for more people in some jobs, less for others).

Complete automation – implies a net loss of jobs. Frey and Osborne (2013), together with a group of machine learning researchers, were responsible for determining which jobs can be completely automatable by analyzing and evaluating 70 occupations. Of the 70 researched jobs, they determined that only 37 of several types were potentially fully automatable in the near future. However, so far, none of the 37 has been completely automated.

Professions aren´t necessarily just affected by automation but also by other means of technology. For instance, the appearance of the automobile eliminated horse-related jobs such as carriage and body makers. However, new jobs emerged and the need for workers who designed and manufactured car parts, maintenance, and others, also appeared. In addition, it's not just the job as a whole that can be affected by technology as it may also change the way work is organized, shifting of work between occupations and industries. For instance, self-service machines in supermarkets may have not led to the dismissal of employers as the need for assistants was required, and those may have been shifted to performing other tasks in the store.

In any case, the conclusion of the study with regards to this topic is that technological changes can be disruptive and can indeed eliminate certain jobs, but it is not expected that these changes will lead to major job losses overall. But on the other hand, automation may and in many situations will, lead to reducing the labor needed to perform certain tasks (Bessen, 2016).

3.6.4.3 Impact of white-collar automation in the labor force

The impact of technology in the labor market has been gaining expression due to its potential. However, this subject is a concern to workers regarding the potential replacement of robots in certain jobs. Sophia, the first citizen-robot, confirmed during the Web Summit in Portugal (2018) that technology, and especially robots, will indeed take over jobs and tasks currently performed by humans. Yet, she added that this will be something good.

After this event, PwC, a consulting firm, carried out a study on the impact of technology in the labor market where it was stated that Portugal, being a country predominantly held by services, will suffer a smaller and/or slower increase of the job automation rate when comparing to other European countries.

The following graph (figure 5) presents an overall framework of the risk that different occupations recur of being or not overcome by automation.
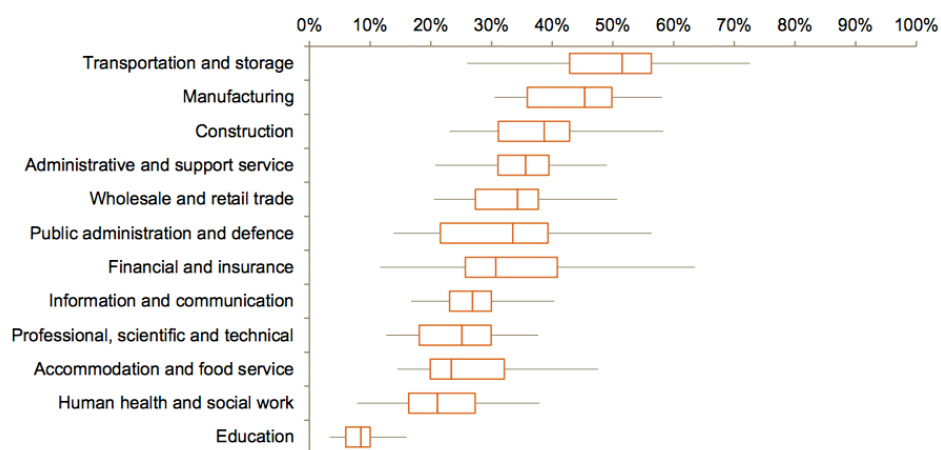
Figure 5: Potential jobs at high risk of automation

Source: PIAAC data, PwC analysis

The risk of a job being overtaken by automation varies across industry due to the specificities of each sector. This graph shows that transportation and storage (with 52%) as well manufacturing (with 45%) are sectors which include jobs that are highly likely to be substituted by automation by the 2030s. On the other hand, education and human health and social work are the ones scoring the lowest rates of automation with a risk of less than 30%.

This means that industry sectors that constitute social and literacy-based tasks are predominantly less automatable sectors for their inter-relational and continuous knowledge-based and life experiences´ features. Contrarily, sectors that involve more repetitive tasks are likely to suffer more alterations and substitutions as a result of technology.

3.6.4.4 Predictions regarding the employment framework

Figure 6: The jobs landscape 2022

Source: Future of Jobs Report 2018, World Economic Forum

The report Future of Jobs 2018 from World Economic Forum (2018) states that the professions related to the employee base of big firms across the world emerging nowadays are going to rise from currently being 16% up to 27% by the year of 2022. Also, job roles that suffer from technological obsolescence are predicted to decrease from 31% to 21%. In other words, and quantitatively speaking, it is said that 75 million current job roles will be shifted and range from human labor, machines and algorithms, and 133 million new job roles will appear.

As shown in the graph above (figure 6), occupations that have higher potential of growing and emerging are technology-related such as data analysts and scientists, AI and machine learning specialists (software designers, applications' developers, social media and

e-commerce specialists). In addition, jobs that are related to human traits are also expected to be enhanced due to automation such as customer service, sales and marketing, training and development, people and culture, organizational development specialists, and innovation managers.

3.6.4.5 Demand for new skills to perform future jobs

With the shift of (future) occupations, new kinds or differently developed skills are required to be mastered while others are losing significance. Competencies that are growing more important are the ones that include analytical thinking, active learning, technology design and other technological aptitudes. On the other hand, and probably more difficultly attainable, human skills are gaining more and more substance. Automation, more specifically AI has cognitive reasoning, but it still needs certain patterns to create outlines. Humans, alongside with continuous learning, life experience, and other conditions, must develop as much as possible skills such as creativity, originality and initiative, critical thinking, persuasion and negotiation, in order to increase one's value. Other abilities also rely on attention to detail, leadership and social influence, as well as service orientation (Ratcheva and Leopold, 2018).

Skills that are losing credit are the ones related to repentance, data analytics and processing, manual dexterity, among others. The following table (number 3) presents the prospects of the skills that are likely to grow and decline in the next few years, according to the Future Jobs Report 2018 of the World Economic Forum.

Table 3: 2022 Skills Outlook

Growing	Declining
• Analytical thinking and innovation	• Manual dexterity, endurance and precision
• Active learning and learning strategies	• Memory, verbal, auditory and spatial abilities
• Creativity, originality and initiative	• Management of financial, material resources
• Technology design and programming	• Technology installation and maintenance
• Critical thinking and analysis	• Reading, writing, math and active listening
• Complex problem-solving	• Management of personnel
• Leadership and social-influence	• Quality control and safety awareness
• Emotional intelligence	• Coordination and time management
• Reasoning, problem-solving and ideation	• Visual, auditory and speech abilities
• System analysis and evaluation	• Technology use, monitoring and control

Note. Adapted from the Future of Jobs Report 2018, World Economic Forum (2018)

3.6.4.6 Division of labor between humans, machines and algorithms

Nowadays, the total task hours across the industries performed by humans are of 71%, whilst the average for machines or algorithms is 29%. The report states that these numbers are predicted to shift down to 58% regarding human-performed task hours against 42% for machines and algorithms, by 2022. Currently, in terms of total working hours, no work task is done mostly by machines or algorithms in comparison to humans but, by 2022, the scenario is going to suffer drastic changes especially in organization fields that include communication, data processing and information search and transmission. The report also predicts the numbers of human-performed working hours to decrease to 48% in contrast to an increase of machine-performed tasks to rise up to 52% in 2025. Nonetheless, many researchers and others defend that it is probably more likely that we enter in "no collar automation", rather than necessarily a "blue or white-collar automation" where robots and machines work together with humans, rather than automation substituting a job as a whole. Figure 7 shows the described percentages regarding the share of hours spent by humans and machines or algorithms in a certain task (Ratcheva and Leopold, 2018; World Economic Forum, 2018).
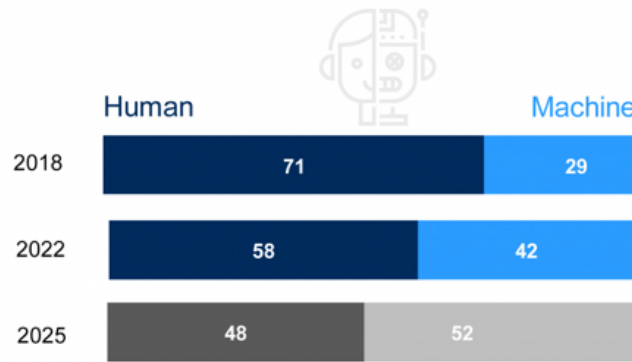
Figure 7: Rate of automation: division of labor as a share of hours spent (%)

Source: Future of Jobs Report 2018. World Economic Forum

Technology has evolved as means of potentiating growth, promoting ongoing progress and upgrading skills, which has continuously led to the evolution of society throughout time. Several studies prove that technology helps increase productivity, economic growth, diminishes time in operation cycles and delivery, decreases all sorts of costs and provides an improvement of quality in the products and services. However, these technological transformations inherently bring fear due to risk and aversion to change, insecurity and potential job loss (especially the ones that implicate lower levels of skills or implicate constant repetition of tasks).

This way, it is possible to conclude that technology has been part of the world's evolution all along. Societies have survived and adapted to all industrial revolutions. Technology is known for being the engine of change throughout the past centuries and will continue to be so. The same way it guides societies, it is the main guideline for organizations to transform and evolve as well. However, the main factor that makes people fear this white-collar era so much, is the possibility that robots come to substitute humans in several areas, leaving no space for humans to work. However, even though automation is predicted to lead to severe job losses, it is also creating new ones, especially in the fields of AI. In addition, researches show that it is more likely existing "no collar automation" where robots and humans work together, rather than machines and algorithms completely substituting the jobs that are currently performed by people.

The main issue relies then on the ability of humans to adapt to these new circumstances just like we have been doing so all along. With regards to organizations, leaders must be able to adapt their business models as well as their inherent operation models, paying special attention to the workforce (Duggal, 2018).

Overall, it can be understood that many jobs related to technology are more likely to emerge and be enhanced, whilst the ones that require repetitive tasks are declining. This way, people should start adapting their knowledge and skills towards the market demands and invest (time, money and interest) in the labor force capabilities that are potentially required.

3.6.5 Portuguese employment framework

The goal of this section is to analyze the current situation of the population in Portugal (level of education, active population, distribution of workers by economic sectors, and others) moving on to a thorough analysis of a study conducted by McKinsey and Company containing the subject about automation and the future of work in Portugal.

3.6.5.1 Demographic data in Portugal

The level of education in Portugal has been improving over the past few years especially in the higher education and technical and professional studies. The bachelor's degree level slightly decreased between the years of 2015-2017 but seriously improved in the year of 2018. The levels of integrated masters, masters and PhD have also come across slight variations but in the numbers of 2018 where more favorable than those of 2017. Overall, it means that the Portuguese population is becoming more educated and instructed, with a global increase at all levels of education.

Year	Level of Education (individuals)					
	Higher Education	Technical and Professional Studies	Bachelor Degree	Integrated Masters	Masters	PhD
2015	84 781	395	212 275	59 941	53 582	19 465
2016	89 650	6 430	211 619	60 852	54 433	19 214
2017	96 366	11 048	210 963	60 684	55 684	11 048
2018	400 901	12 780	216 471	60 993	58 643	12 780

Figure 8: Level of education in Portugal

Source:https://www.pordata.pt/Portugal/Alunos+matriculados+no+ensino+superior+total+e+p or+n%C3%ADvel+de+formação-1023

From 2016 to 2018 there are more active people in Portugal. Research by Eurostat (Pordata, 2019) provides evidence on the decrease rates of unemployment in Portugal in the mentioned years. In January 2016, the rate was 12%, going down to 10% in the same month of the following year. In January 2018 the rate was of 7.8%.

All age groups present small variations from year to year. However, ages groups 25-34 and 35-44 present a decrease throughout the three mentioned years.

Year	Age Group (individuals - thousands)						
	<25	25-34	35-44	45-54	55-64	≥65	Total
2016	364	1 055	1 429	1 296	796	239	5 178
2017	371	1 033	1 408	1 314	846	247	5 219
2018	372	1 016	1 384	1 323	881	256	5 233

Figure 9: Active population in Portugal

Source: https://www.pordata.pt/Portugal/População+activa+total+e+por+grupo+etário+-29

It is possible to conclude from the graph (figure 10) that almost all economic activity sectors except for agriculture, animal production, forestry and fishing present an increase of the distribution of workers throughout the years of 2015 to 2018. Also, the sectors of energy, gas and water, and retail have suffered a large decrease of the number of workers in the year of 2018. On the other hand, the sectors of process industry, financial and insurance services, educations and healthcare and social support have had a significant increase of workers in the same year.

Year	Level of Education (individuals - thousands)													
	Agriculture, animal production, forestry and fishing	Mining	Process industry (combustible, fuels and waste material)	Energy, gas, water	Construction	Retail	Transportation and storage	Accomodation and food services	Financial insurance services	Real estate	Education	Healthcare and social support	Other sectors	Total
2015	343	12	769	48	278	702	172	259	108	28	380	404	1 046	4 549
2016	318	12	777	49	290	702	189	279	112	33	381	424	1 038	4 605
2017	304	12	803	54	308	704	204	323	108	43	391	440	1 063	4 757
2018	294	14	834	54	307	698	207	329	113	48	234	452	1 093	4 867

Figure 10: Distribution of workers regarding economic activity sectors in Portugal

Source: https://www.pordata.pt/Portugal/População+empregada+total+e+por+sector+de+actividade+económica-3384

According to Pordata (2019) the average monthly income has increased since 2015, being little more than 900€ a month.

Year	Average monthly income
2015	913,9
2016	924,9
2017	943

Figure 11: Average monthly income in Portugal (€)

Source:https://www.pordata.pt/Portugal/Salário+médio+mensal+dos+trabalhadores+por+conta+de+outrem+remuneração+base+e+ganho-857

3.6.5.2 Study about automation and the future of the jobs in Portugal (McKinsey)

Automation has been affecting almost every population worldwide at different levels. A study conducted by McKinsey & Company (Automação e o futuro do emprego em Portugal, 2019) deliberates about the relevance of automation, the importance of the growth in productivity as means to sustain the increase of the GDP (Gross Domestic Product) in parallel with the increase in the number of jobs and of the population itself, the way automation can sustain and boost productivity and economic growth and also the impact of automation in the Portuguese labor market.

The study reveals that digital transformation leads to changes in the way that customers, employers and businesses run their procedures and experiences. These transformations enable lower costs, faster processes and flexibility. In addition, automation supported by its several branches guarantee better quality, better customer experience and support knowledge, deepening it to levels impossible to reach just through human capacities.

Automation has different potential levels across the countries and across industries and, consequently, different impacts. The presented study shows several matters that are influenced by the evolution of Portugal including namely the evolution of the national GDP, time spent in labor occupations, and others.

The following graph (figure 12) reveals the acceleration of the increase in productivity (1.5) and growth as a result of automation technologies. This study accounts for the use of automation in a medium-term period of time assuming that the workers displaced from their current jobs as a result of having their tasks substituted by technologies, integrate new professions.
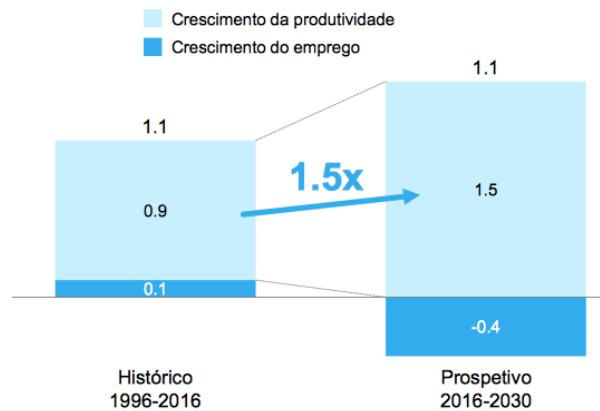
Figure 12: Evolution of GDP in Portugal (historic vs prospective)

Source: Automação e o futuro do emprego em Portugal, 2019. Retrieved from: https://www.isq.pt/wp-content/uploads/sites/78/2019/01/190116_1700_Jobs-Automation-short-version-final-version-PORTUGUES-FINAL.pdf

The same study also reveals that 52% of the working time in Portugal is spent performing repetitive tasks that have 70% of chances of being automated. These numbers are translated in the graph below, which also proves that the economic sectors that consume more working time are those that require repetitive tasks and procedures (predictable and physical and data processing and collecting), thus being the ones that have higher probabilities of being automated. These account for more than half (52%) of the total working time in Portugal which can be substituted by automation. This percentage is foreseen to increase up to 67% by 2030.
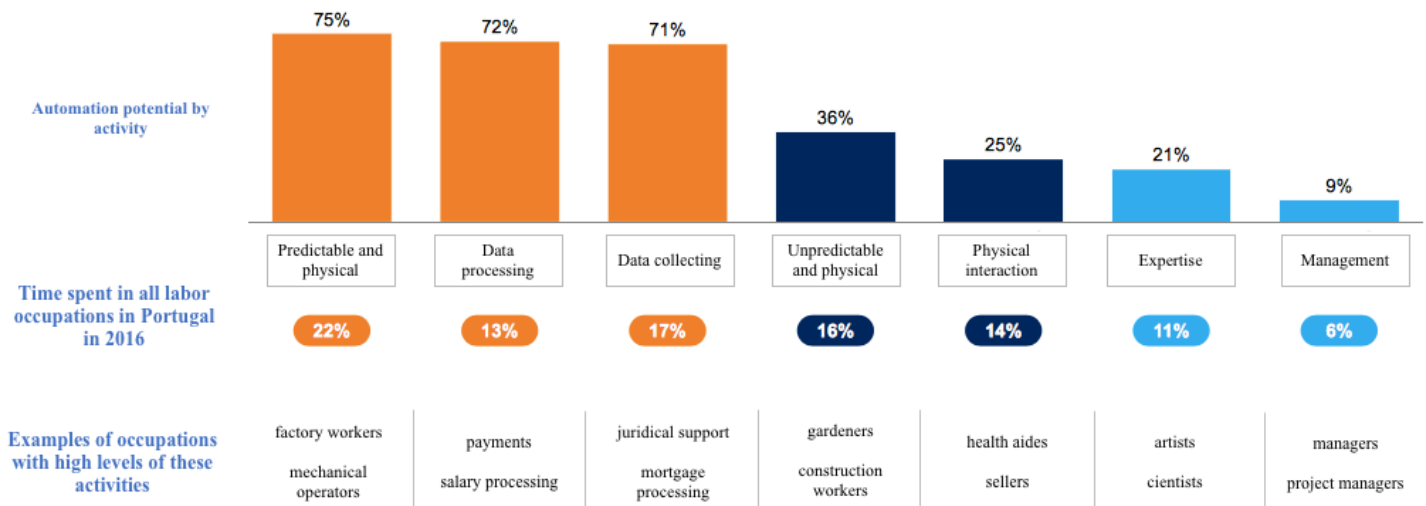
Figure 13: Automation potential by activity and time spent in labor occupations (Portugal)

Source: Automação e o futuro do emprego em Portugal, 2019. Retrieved from: https://www.isq.pt/wp-content/uploads/sites/78/2019/01/190116_1700_Jobs-Automation-short-version-final-version-PORTUGUES-FINAL.pdf

The graph below (figure 14) suggests that, in Portugal, the activities with highest automation capacity are the ones related to construction and financial services and insurance, each representing 49% of automation potential. However, they do not represent a significant percentage of the total employment rate (being construction 6% and financial services and insurance 2%), therefore not many people will be affected.

However, the activities that constitute the majority of workers present an automation capacity and potential of more than 49%, affecting a vast number of workers – these also represent the three industrial groups that consume more working time, presented above.

Even though it is predicted that 67% of the total amount of working time can potentially be automatized in Portugal, due to fallbacks it is expected that only 26% will follow the automation path. This is a consequence of technical feasibility and the slow rhythm at which technological developments runs as well as its implementation costs, adding to the cost of work and progress of demand and supply, advantages that may result from the replacement of workers, and also social and regulatory barriers.
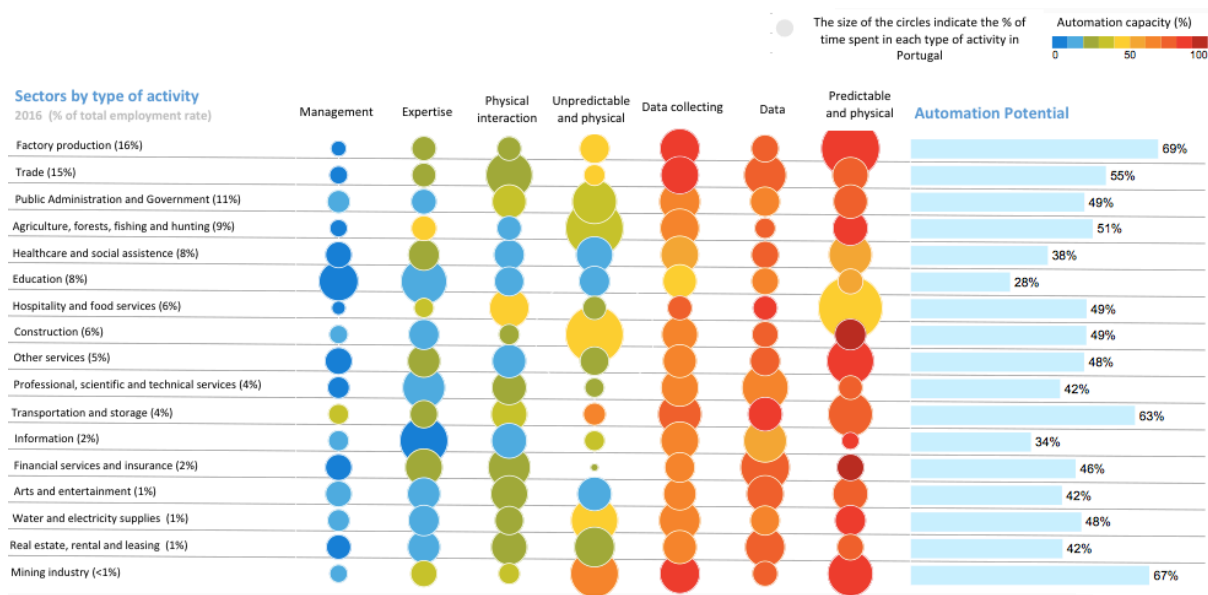
Figure 14: Level of automation potential according to industry sector and combination of activities (Portugal)

Source: Automação e o futuro do emprego em Portugal, 2019. Retrieved from: https://www.isq.pt/wp-content/uploads/sites/78/2019/01/190116_1700_Jobs-Automation-short-version-final-version-PORTUGUES-FINAL.pdf

The graph below (figure 15) represents the predictions of the effects on workers in Portugal in a situation where 67% (intermediate scenario) of the working time is automated by 2030. Overall, it translates a scenario in which 1,1 million jobs become redundant. Activities related to factory production, trading, public administration and government are foreseen to be at higher risk of vanishing, opening path for automation to substitute these jobs. This case would possibly affect around 556 thousand full-time workers in Portugal. On the other hand, the activities that present lower numbers regarding job losses are the ones related to professional, scientific and technical services, financial services and insurance, and arts and entertainment, encompassing around 79 thousand full-time workers in Portugal.
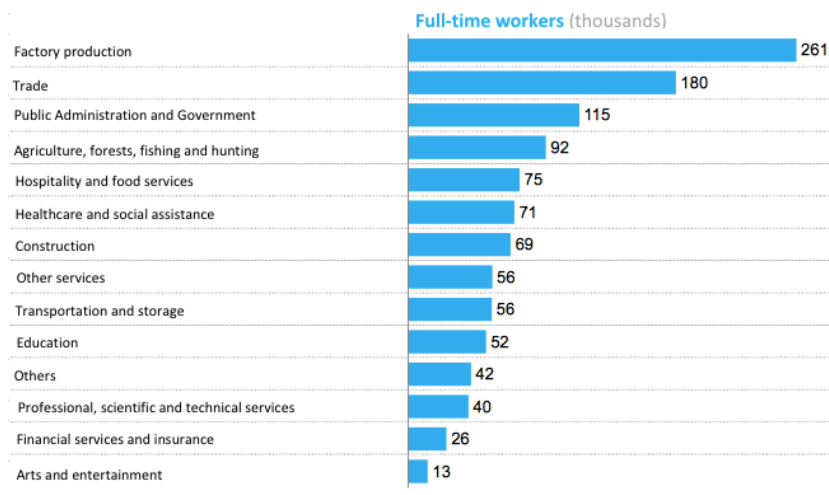
Figure 15: Level of automation potential according to industry sector and combination of activities (Portugal)

The same study (Automação e o futuro do emprego em Portugal, 2019) predicts that even though 1,1 million jobs can become redundant, the same number can be created within three stages of growth of the employment demand, by 2030.

1st stage – base scenario: emergence of 600,000 jobs resulting from the trends of the current economy (income growth, aging and better healthcare services, education, technology spending, investment in real estate and infrastructures, adoption of new sources of energy);

2nd stage – step-up: emergence of 200,000 jobs resulting from social and political choices (investments on real estate, construction, infrastructures, and new sources of energy, promotion of non-paid work);

3rd stage – job creation: emergence of 300,000 jobs and occupations that currently do not exist yet.

This means that approximately 700.000 people of the working population will have to change their occupations in order to remain employed. These might possibly result in people having to shift to sectors related to services, construction and creative activities, as presented in the graph below.

Sector	Employment shift (intermediate automation/step-up growth scenario) (2016-2030, thousands)	% of total number oj jobs	
		2016	2030
Healthcare and social assistance	51	4%	6%
Professional, scientific and technical services	41	8%	11%
Construction	29	6%	8%
Arts and entertainment	0	1%	1%
Financial services and insurance	-12	2%	2%
Education	-39	8%	8%
Others	-42	4%	4%
Hospitality and food services	-47	6%	6%
Other services	-50	5%	4%
Transportation and storage	-54	4%	3%
Agriculture, forests, fishing and hunting	-59	9%	8%
Trade	-70	15%	15%
Public Administration and Government	-113	11%	9%
Factory production	-162	16%	15%

Figure 16: Employment shift (Portugal)

Source: Automação e o futuro do emprego em Portugal, 2019. Retrieved from: https://www.isq.pt/wp-content/uploads/sites/78/2019/01/190116_1700_Jobs-Automation-short-version-final-version-PORTUGUES-FINAL.pdf

All in all, the study suggests that Portugal designs a labor requalification plan that aims at: enhancing demand (by promoting investment, entrepreneurship and economic growth); investing in human capital (through education and academic training, endorsing domestic talent, guaranteeing primary and secondary education as well as much as continuous development throughout life, and betting on talent acquisition and retention); revitalizing the labor market and reshaping transition by supporting the changes and all workers. However, it is suggested that all economic actors play an active role in defining this plan namely the Government, employers, employees, and educators.

To conclude, the study advocates that automation is seen as a key-solution to improve GDP, which will then lead to increases in productivity. Also, even though automation is predicted to cause a job loss or job redundancy of 1,1 million workers, around 0,6 – 1,1 M jobs can simultaneously be replaced in the long-run. Even though the path to the state of equilibrium will inevitably face challenges in the short-term, it is crucial that automation opportunities are spotted and confronts are both foreseen and tackled in addition to designing an execution plan that aims primarily at the well-being of the workforce.

4 Methodology

4.1 Research by survey

The research carried out has shown that technology has indeed replaced the human factor in several cases, yet it is undeniable that overall it has supported people's daily lives and all sorts of businesses worldwide. Weather it is in the administrative, management, or operational level, automation and related technologies have been transforming and sustaining corporate processes and essentially the people who comprise these businesses.

Many civilizations have become tech-centered and even the less developed countries have been evolving with time alongside with several kinds of technologies. Societies have been through many revolutions, labor markets have adapted, transformed and, in the end, they have survived. The studies presented throughout this dissertation prove that, despite the struggles and rough processes of adaptation, challenges were overcome, and welfares extolled. Currently there are technologies that are leading the digital revolution and that are already gradually having significant impact in organizations´ operations and actions namely accounting for the workforce level. This will lead to an inevitable transformation in business structures.

The research in this thesis was held in a deductive approach. In other words, after analyzing existing research as a means to develop and support the research (including articles, reports, papers, other thesis, books, theories, and other documents), questions were proposed.

The aims of the research and, consequently, the questionnaire, are to understand how workers in Portugal identify automation within their own company and also, how this population perceives the way that this technologic era is and will impact the marketplace and their own jobs (including data regarding level of education, level of technological maturity, consciousness of how technology will impact their current job, technology as a threat or an opportunity).

As previously mentioned in chapter 2, accounting that my own future is at stake, I would like to deepen my knowledge on what is predicted to be the future of the labor market and the labor force. In addition, I intend to enlighten my understanding on how Portugal is adapting to the future ahead considering the technologic impacts on the working systems during this era of the Fourth Revolution, hopefully guiding my future labor decisions.

A quantitative research was engaged in form of questionnaire with 38 questions (open and closed answers). Some derived from my own creation and others were used from research and case studies such as Nordic HR Survey, the State of Artificial Intelligence in HR, and others. The questionnaire was directed to a Portuguese target where the age range goes from18 to 65 years old. The tool used for the development of the questionnaire was *Googleforms* and it was released via *Facebook, Instagram, e-mail,* private messages and word of mouth. This method enabled the analysis of statistical data where conclusions can be taken. This process was appropriate in this context which had the objective of reaching as many people as possible attending to the limitations (timing, resources and range of contacts).

The survey is divided in four parts being the first related to categorical questions with closed answers - demographic variables were considered such as age, gender, nationality, income, among others. This enables to evaluate disparities, if existent, in people that were born in the digital era and people that have seen it blossom and grow. On the other hand, the second part includes open answers enabling the individual research on the degree to which the respondents believe technologies like automation and artificial intelligence will influence their own job in the near future. The third part, also comprising open answers, is more related to one's workplace, enabling a deeper vision of each individual inquired, namely regarding his/her perception of automation and artificial intelligence within the company. At last, the fourth part refers to more general questions related to the future of automation within the labor force. In other words, this part intended to explore the consequences of the changes that may occur in the marketplace and the workforce due to such evolving technologies.

After combining these results with those of the literature review, it will be possible to analyze data and interpret using statistical methods (pivot tables of own elaboration in MS Excel which can be found in the annexes) in order to compare different variables among the questions thus enabling the final conclusions to answer the previously outlined objectives.

4.2   Sample characterization

The present investigation was developed aimed at researching the Portuguese active population, in any economic activity sector during the course of the questionnaire. The sample number of respondents was of 70 individuals, of which only those who are currently employed and working in Portugal were considered - being these, 44 people in total. All companies were accepted, whether they are national or foreign, since the main objective is to understand the workforce working under Portuguese regulations, customs, and culture.

Before opening the questionnaire to all individuals, a previous test was carried along to 6 people in order to figure out any possible gaps and irregularities within the script of the questions. After making the due corrections and suggestions, the survey was then released to friends, family, and colleagues through the previously mentioned sources.

The online survey was available from 8/07/2019 to 6/08/2019, totalizing 70 respondents. From these answers, it was able to gather some data regarding the characterization of the sample. Because the method used was broad, there were some results that did not correspond to the characteristics I intended to study. This way, as previously mentioned, the first approach to the data processing was to assess which respondents were eligible or not in the context of this research. By means, I then concluded that those who would not be inserted in the data analysis would be the ones who were not currently employed and the ones who didn't work in Portugal. The following graph therefore presents the distribution of the respondents by country and by employment status, still considering the full number of respondents.
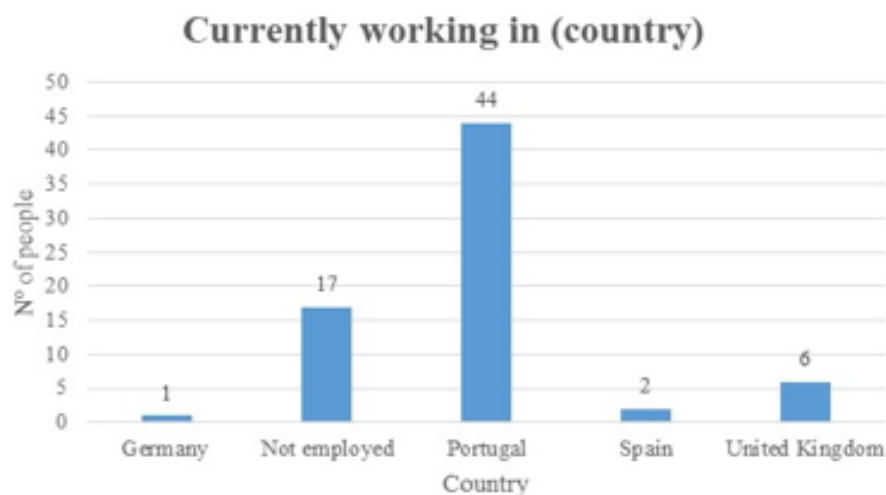
Figure 17: Distribution of respondents according to country currently working in Portugal
Source: Own elaboration
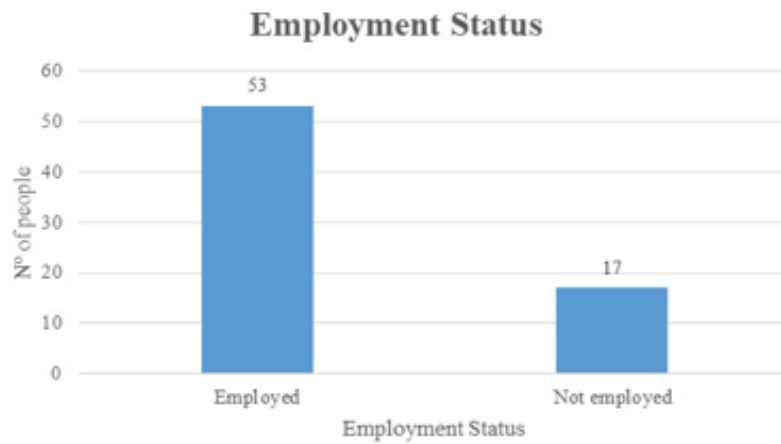
Figure 18: Distribution of respondents by employment status
Source: Own elaboration

After stabilizing the sample, it is now possible to analyze the remaining data which is why the graphs ahead will be shown considering the premises presented above. This way, the sample simply comprises 44 respondents, which are the ones who respect the conditions defined. The data will be scrutinized considering the four-part division of the questionnaire itself. In order to categorize the sample, the first part will comprise categorical variables. As means of discussing relationships between the questions, the following chapter of discussion of results will include parts two, three and four of the questionnaire relating to all four segments.

The age groups that contain the largest numbers of respondents are 26-33 (48%) and 18-25 (36%) years old. In addition, there were more male respondents (57%) than female (43%).
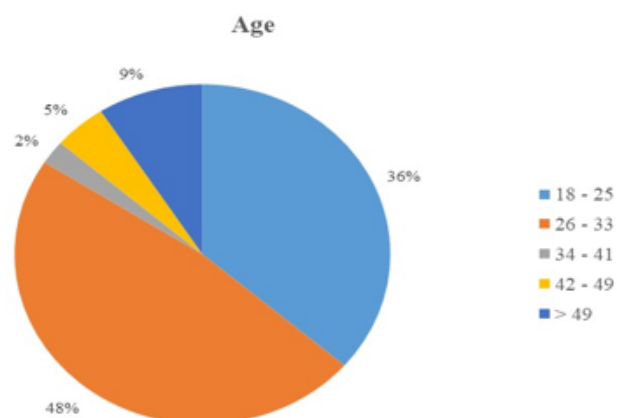
Figure 19: Distribution of respondents according to age
Source: Own elaboration
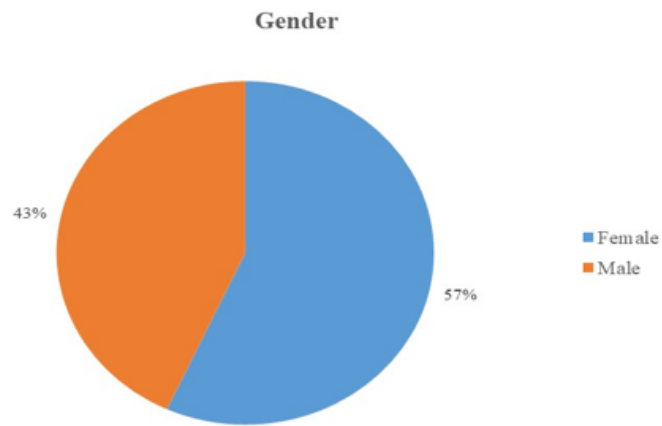
Figure 20: Distribution of respondents by gender

Source: Own elaboration

Most respondents were Portuguese, adding up to 41 people (93%). The other respondents were: 2 Brazilian (5%), and 1 German (2%).
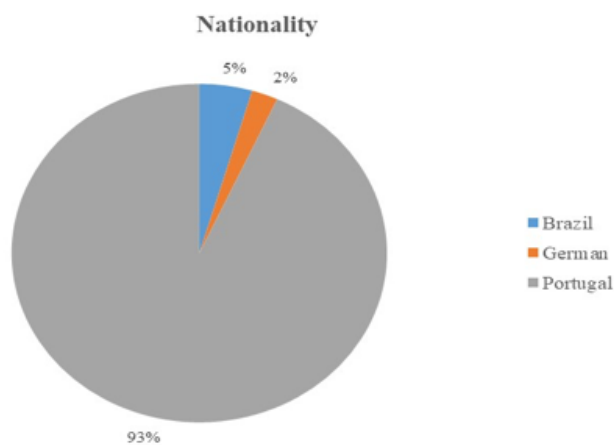
Figure 21: Distribution of respondents by nationality

Source: Own elaboration

Naturally, in parallel with the distribution of the age range of the respondents, more than half have completed or are currently undergoing their master's degree (64%), followed by the bachelor completion with 20%.
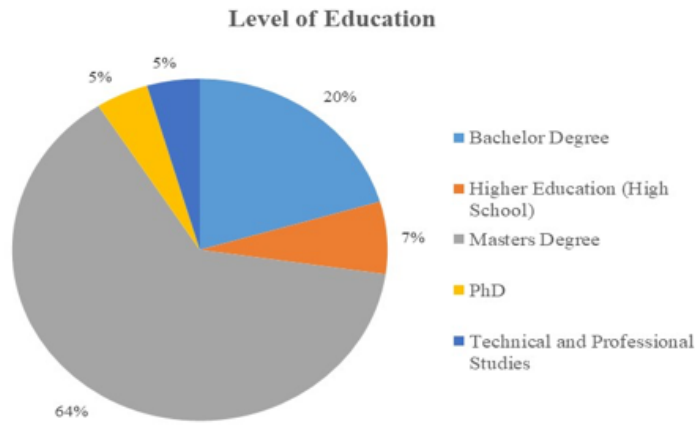
Level of Education

Figure 22: Distribution of respondents by level of education (completed or undergoing)
Source: Own elaboration

As previously mentioned, only the people who are currently employed were considered of which 86% work in a full-time regime (at least 35 weekly hours according to the Portuguese system), whilst the remaining works in a part-time regime employment regime (in which the time labor depends on the individuals' contract).

Schedule Employment Regime
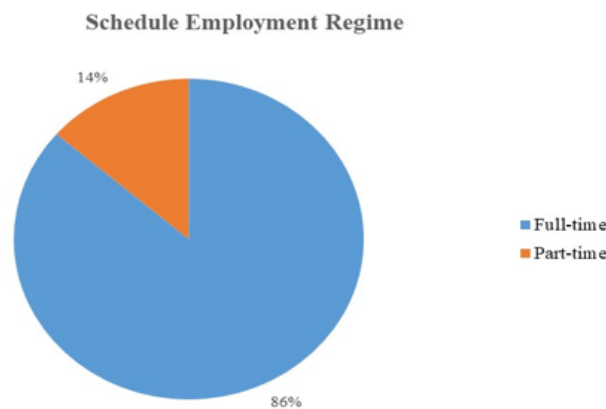
Figure 23: Distribution of respondents according to schedule employment regime
Source: Own elaboration

As seen in the following chart (figure 24), most respondents work in management (five people) followed by accommodation and food services, banking and healthcare, with four people each.

Figure 24: Distribution of respondents by area of work
Source: Own elaboration

More than half the respondents earn between 700€ - 1500€ a month comprising 59% of the inquired considered population, followed by 23% whom earns between 1501€ - 3000€.
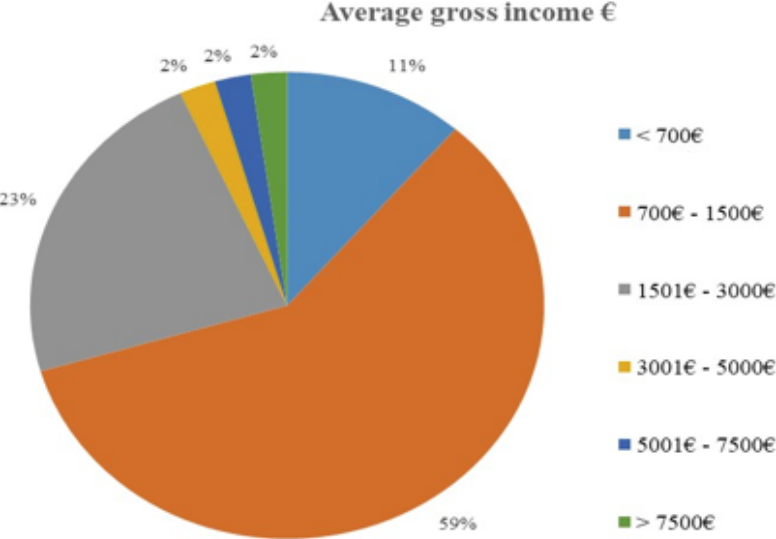
Figure 25: Distribution of respondents according to average monthly income (€)
Source: Own elaboration

Results and discussion of results

As previously mentioned, the primary goal of this questionnaire was to explore how workers in Portugal perceive automation in their own company and how will the new technologic trends impact the labor force and their own jobs.

In the first set of questions it was possible to conclude that most respondents are inserted in the age group between 18-33 years old, with slightly more females than males (in this specific age range) but still rather balanced, being the majority Portuguese respondents. Most have a master's degree, and most are working full-time. The predominant areas of work are those related to services. To finalize, the major levels of monthly income sit between 700€ - 3000€.

The second set of questions was carried out as a means of investigating different scenarios regarding automation and artificial intelligence in the respondents' own companies. The subsequent set of graphs includes information about this matter.

The following graph (figure 26) shows the individuals' opinions regarding the relationship between artificial intelligence and human capital. The majority (61%) considers to be acquainted and interested in the impacts of artificial intelligence on human capital yet they do not seek to know more about it than what appears on the news, TV, and other communication sources. On the other hand, 36% consider to be acquainted with the subject and actually try to understand and seek further research of their various dimensions, on a regular basis and also believe they understand the advantages/disadvantages. This question shows that none of the respondents are neither interested nor afraid of the potential consequences, being these the apparent reasons why they do not seek any further research.

People of all ages consider themselves to be acquainted with the subject of artificial intelligence in relationship to human capital. In all age ranges, more than half of the people within 18 – 33 years old and 100% of the respondents from 34 - 49 consider being knowledgeable, yet do not seek to know more than what appears on the news, TV, and other communication sources. Considering the gender of the distribution of the answers, most people who answered that they are acquainted yet do not seek information are female. On the other hand, most people who are acquainted to the subjects and try to understand and seek further information about the various dimensions, are male.

In addition, the majority of people answering that they are familiar yet do not seek further research mostly hold a master's degree, have completed high school or held technical

and professional studies. On the other hand, most people whom have a bachelor's degree are interested about the consequences and advantages/disadvantages about the impacts of artificial intelligence on human capital. Of those who have a PhD, the distribution is equal.

Regarding the area of work, 100% of the people who answered that they were acquainted yet not interesting in deepening their knowledge about the presented matter are those who work in areas related to architecture, audit and assurance, automotive and assembly, CSR (corporate social responsibility) consultancy, educational services, life sciences, media and entertainment, marketing, research and development engineering, retail, tourism, transportation and logistics. Contrarily, 100% of the people who answered that they were acquainted and were interested in finding out more about the implications of AI work in areas such as automotive and assembly, biotechnology, and information technologies. The opinions are equally distributed when it comes to healthcare, public and social sectors, services and services. Regarding banking, management, accounting and marketing, more people are not interested in knowing more about the future consequences while most people working in accommodation and food services believe they understand the impacts and intend to know even more about them.

All respondents who earn more than 5001€ believe to be acquainted but do not seek further information about the impact of AI on human capital. In addition, most people who earn less than 1500€ have the same opinion. On the other hand, 100% of the people who earn between 3001-5000€, as well as the majority earning between 1501-3000€ intend to understand more about this matter.
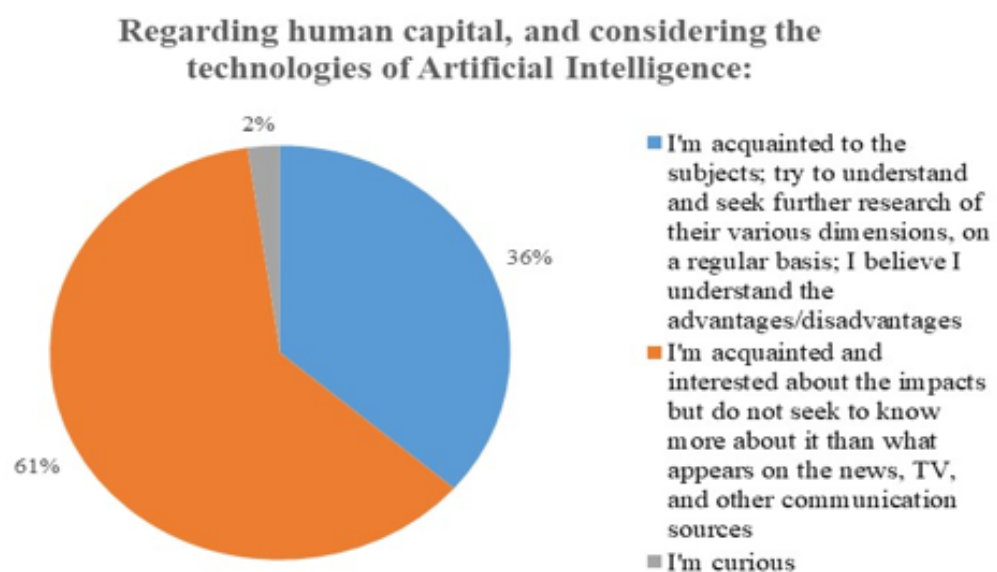
Figure 26: Distribution of respondents according to the opinion regarding human capital and technologies of artificial intelligence

Source: Own elaboration

The answers for the following question were quite distributed. In other words, 43% of the workers in Portugal whom answered the survey under the premises presented, moderately agree that over the next 5 years, employees will increasingly take directions/orders from AI management and will be in charge of assigning and allocating tasks to workers. In contrast, 25% moderately disagrees with this statement.

Accounting for the statement above, from the people who moderately agree, most of them are 26-33 or between 42-49 years old. The ones who strongly disagree are mostly 18-25 years old or over 49. Comparing the gender variable to the responses, in both female and male respondents, most of them moderately agree (32% and 57.89%, respectively) while 8% of the females and 5,36% of the males strongly disagree.

The levels of education of those who moderately agree are predominantly bachelor's degree (44%), high school (100%), master's degree (42,86%). Aside from the ones who undertook technical and professional studies and strongly disagree with the statement (50%), most people with this opinion currently have their master's (10,71%).

Between 60% and 100% of people in the areas of work related to accommodation and food services, accounting, automotive and assembly, information, management, public and social sectors believe employees will increasingly take directions from AI management, over the course of 5 years.

In contrast, the majority of people (>60%) inserted in work departments related to architecture, audit and assurance, CSR consultancy, information technologies, life sciences, and research and development engineering moderately disagree with the statement above.
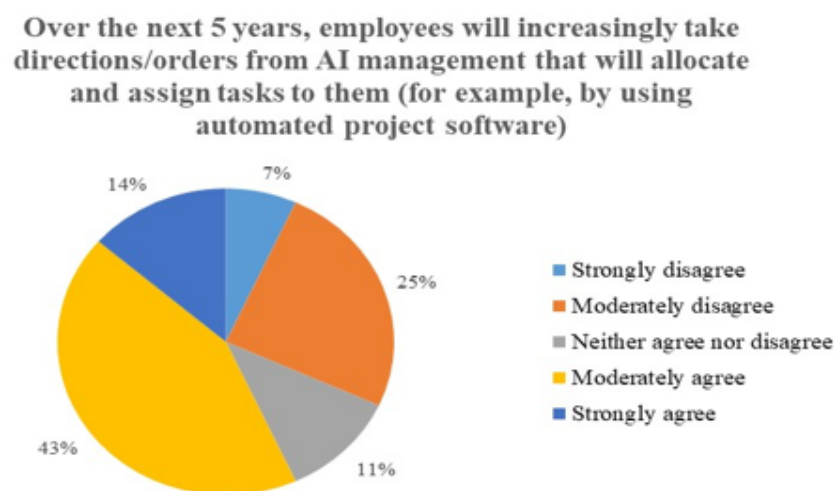
Figure 27: Distribution of respondents according to the opinion regarding AI management in the next 5 years
Source: Own elaboration

The graph below (figure 28) shows that the answers are somewhat contradicting regarding the workers' current preparation to handle the individual consequences of AI and/or automation in their own jobs. The two larger proportions represent 27% of the sample population, which moderately agrees with the statement while other 27% moderately disagrees.

A significant part of the respondents who answered that they moderately agree with the statement saying they are currently preparing themselves for the future AI and automation consequences, are 42-49 years old (100%) and more than 49 (50%). In contrast, the majority of people who moderately disagree are between 26-33 years old (42,86%). All people who are between 34-41 years old moderately disagree with the statement.

From the total female respondents, most of them moderately disagree. On the other hand, most male people, moderately agree. Accounting for the area of work, people who moderately agree with becoming prepared for the technological labor future are mainly dedicated to departments such as accounting, healthcare, information technologies, public and social sectors, and transportation and logistics (admitting a significance of over 50%). People who are not preparing themselves much, thus moderately disagree with the statement, are mainly involved in activities related to banking, information, public and social sectors, retail and tourism (significance over 50%).
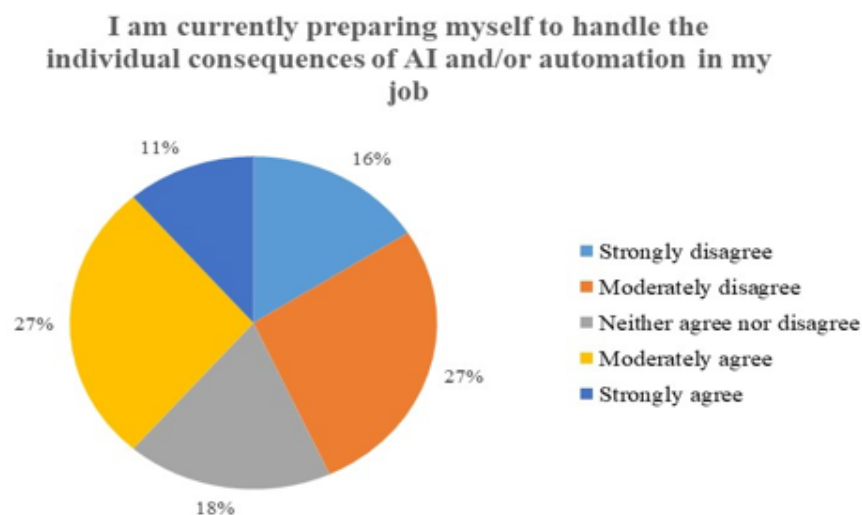
Figure 28: Distribution of respondents according to level of individual preparation towards consequences of AI and/or automation in one's current job

Source: Own elaboration

Regarding the workers' current functions/department, more than half of the respondents (57%) believe that their organization is low at making use of AI/automation. The next greatest values are of 20% each, representing very low extent in contrast to a high extent. These numbers suggest that Portugal is quite behind at involving the latest technologies in the businesses.

In most areas of work, the individuals' opinion considering the level of extent to which their organization is currently making use of AI/automation in their own functions/department tends to be quite low, in general. 100% of the respondents in the areas of accommodation and food services, architecture, audit and assurance, biotechnology, CSR consultancy, educational services, law, life sciences, management, media and entertainment, research and development engineering, retail, services, tourism and transportation. People who work in areas like automotive and assembly and healthcare believe their organization makes use of AI and automation. This proves that most organizations in Portugal lack in including automation-related technologies in their daily businesses.

In your current functions/department, to what extent is your organization making use of AI/automation today?
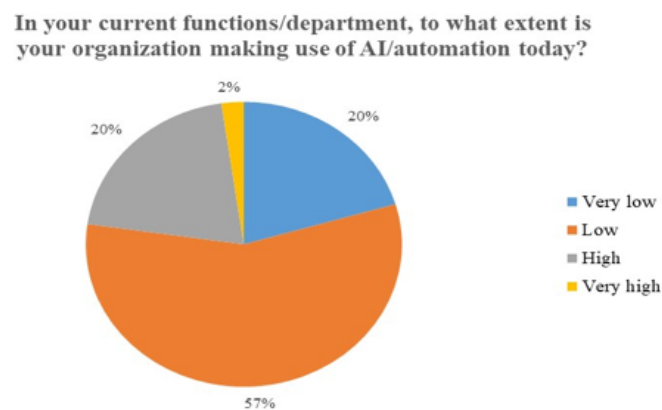
Figure 29: Distribution of respondents according to extent to which the respondents believe their organization is making use of AI/automation today
Source: Own elaboration

39% of the respondent workers in Portugal forecast that in five years, their companies will be making a low use of automation/AI in contrast to 30% who defend that their organization will be doing so to a high extent. This translates the framework towards the integration of the new technologies in the businesses held in Portugal, according to the inquired workers.

Regarding the extent to which individuals believe their own company will be making use AI/automation in their own functions/department in 5 years, are quite disperse. The areas

of work where all respondents answered there was a low probability for this to happen were architecture, CSR consultancy, educational services, life sciences, research and development engineering, retail, services and tourism. 100% of respondents working in automotive and assembly, information, and law believe in the event that their company will integrate automated technologies. There is still a significant part of respondents who are unsure, which is the case of all respondents working in the areas of audit and assurance, biotechnology, media and entertainment, and transports and logistics. Companies should start changing their business framework soon in order to accompany the inherent changes of technology. If they do not do so soon, workers will have more difficulty in adapting to the new technologic settings in the labor market. Not only companies are currently not making use of AI and automation in their business and several work departments, but also according to the responses, they are not yet planning to do so in the near future, which will most likely put Portugal way behind in the value-added competences.

For your own functions/department, to what extent do you believe your organization will be making use of AI/automation in 5 years?

- Very low — 7%
- Low — 39%
- I don´t know — 18%
- High — 30%
- Very high — 7%
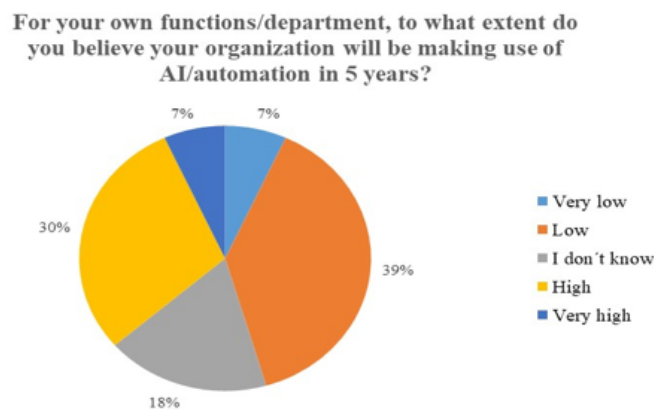
Figure 30: Distribution of respondents according to level of extent to which individuals believe their organization will be making use of AI/automation in 5 years
Source: Own elaboration

Most respondents are in favor of the use of machines being limited to doing dangerous or unhealthy jobs currently done by humans.

Regarding the involvement of the Portuguese government in guaranteeing an income that meets people's needs, the answers towards the substitution of human jobs for machines are quite variable. Most people (17) are in favor of this statement. On the other hand, the second highest number of people moderately or strongly opposes (11).
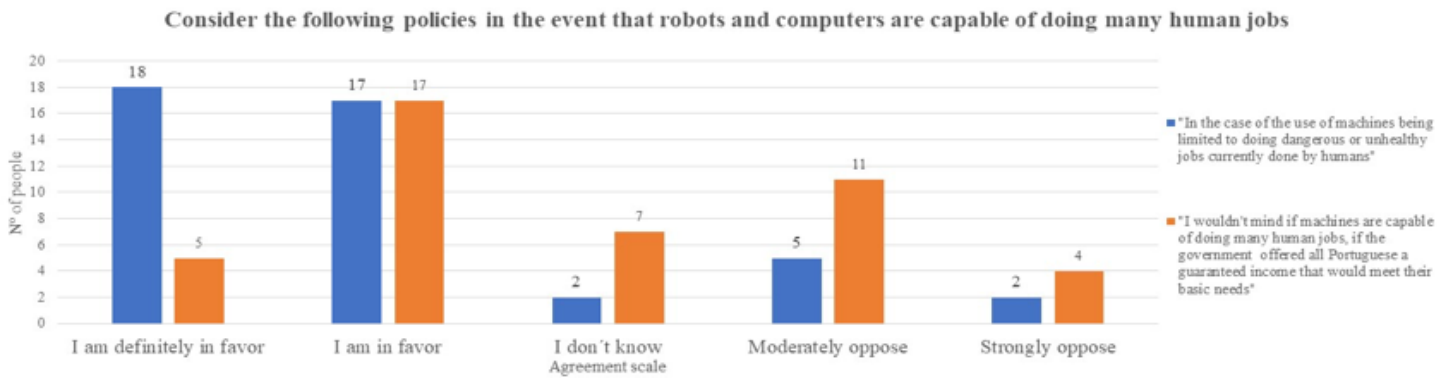
Figure 31: Distribution of respondents according to level of agreement with the statements
Source: Own elaboration

The top three individual features that the workers consider to be the most relevant regarding an AI-powered application in one's own functions are the ability to predict (21), followed by the ability to analyze (19), and the ability to organize (17).

Regarding the use of AI-powered application in one's daily functions, below is presented the preference of features according to the area of work:

Table 4: Preference of features according to area of work

Area of work / Features	Skills augmentation	Automation cognitive tasks	Automation physical tasks	Diagnosis	Gauge emotions	Organization	Personalization	Simulation	Analysis	Prediction
Accomodation/food services		✓	✓			✓		✓	✓	✓
Accounting	✓	✓	✓	✓	✓	✓				✓
Architecture						✓	✓	✓		
Audit and assurance			✓			✓			✓	
Automotive and assembly		✓							✓	✓
Banking	✓	✓	✓	✓			✓	✓	✓	✓
Biotechnology					✓			✓		✓
CSR consultancy								✓		
Educational services	✓			✓						✓
Healthcare	✓	✓		✓		✓		✓	✓	✓
IT		✓	✓	✓		✓				✓
Law						✓		✓	✓	
Life Sciences		✓								
Management	✓	✓	✓	✓		✓	✓	✓	✓	✓
Marketing	✓	✓		✓		✓	✓		✓	✓
Media/entertainment				✓			✓		✓	✓
Public/social sectors		✓		✓		✓			✓	
R&D	✓							✓		✓
Retail		✓				✓	✓	✓		✓
Services		✓	✓			✓	✓		✓	✓
Tourism	✓			✓			✓			
Transportation /logistics						✓		✓	✓	
Total	8	12	7	10	2	13	8	11	12	14

Note. Own elaboration

It is possible to withdraw from the table above (table 4) that despite the kind of job performed, the main preferred features powered by AI in individual work are those related to prediction, organization and analysis.
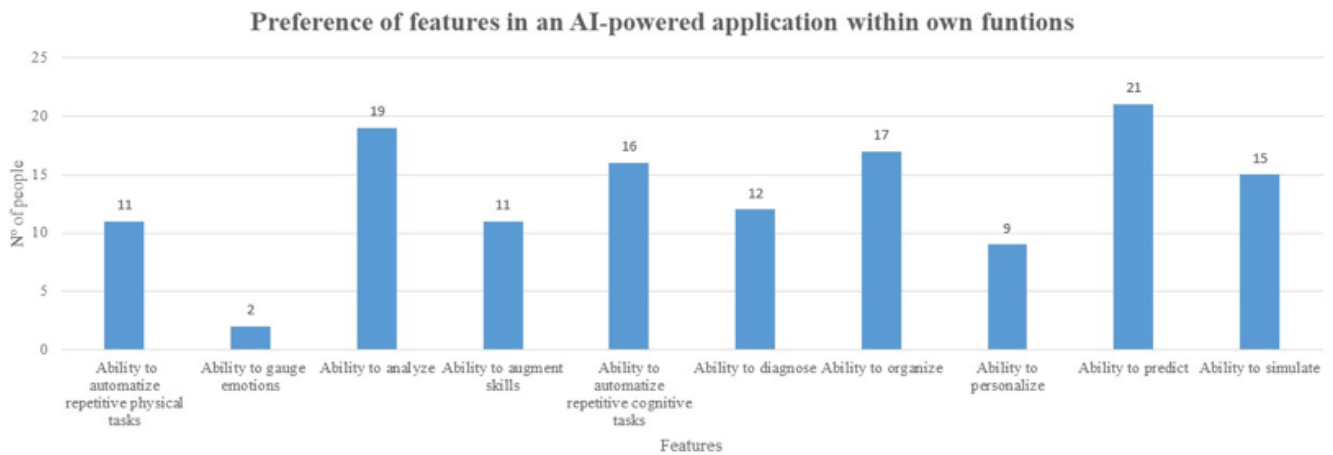
Figure 32: Distribution of respondents according to preference of features powered by AI in own job/functions
Source: Own elaboration

Most respondents believe that skills such as creativity, originality and initiative (40), followed by technology use, monitoring and control (38) are the human competences demanded in the near future. In third place, with the same number of opinions each (36), comes skills related to critical thinking and analysis as well as emotional intelligence. In contrast, abilities such as manual dexterity endurance and precision (30), reading, writing, math and active listening (28), followed by memory, verbal, auditory and spatial abilities are the top three skills' categories which respondents consider to be declining during the next few years.

In comparison to the 2022 Skills Outlook (World Economic Forum, 2018) study performed by "The Future of Jobs Report 2018", it is possible to verify that the respondents are in fact aware of the trending and declining skills demanded in the near future and therefore meet at least this requirement of preparation for the upcoming job automation-related events.

In your opinion, select one of the options (trending or declining) regarding the human skills demanded in 2022
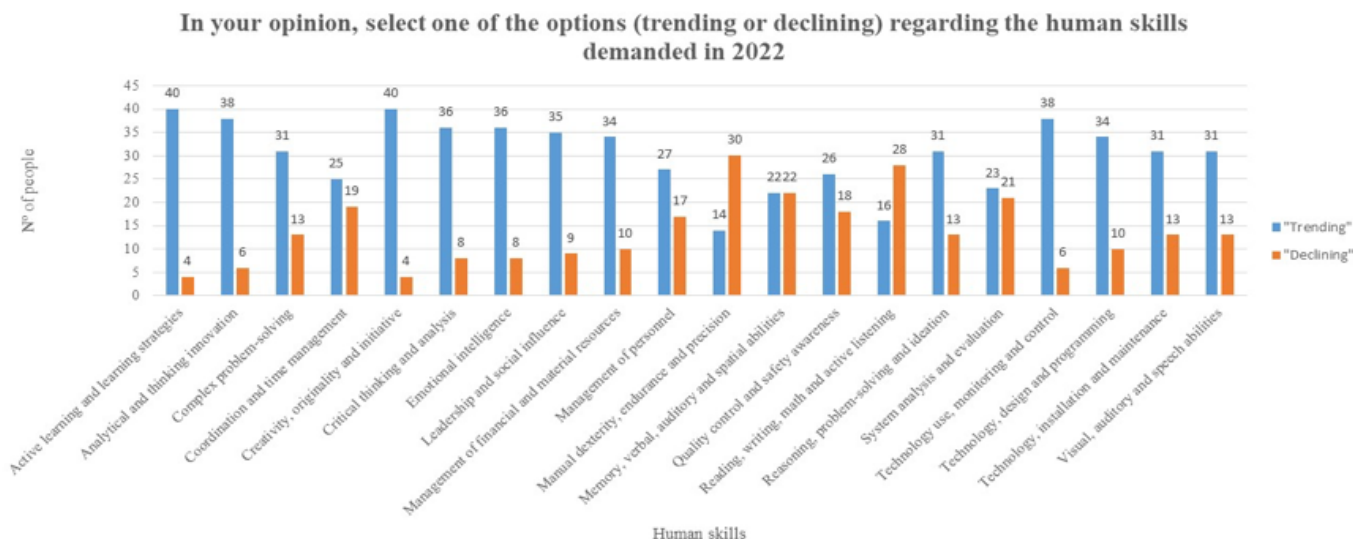
Figure 33: Distribution of opinions regarding the replacement of jobs by robots/computers during the respondents' lifetime

Source: Own elaboration

More than half of the respondents believe that within the next 20 years robots/computers will probably do much of the work done by humans. On the other hand, 30% believe such will probably not happen. The majority (60%) support that these technologies will probably or definitely not perform their own type of work.

After comparing the age groups with this question, it is possible to conclude that people between the ages of 18-41 are more aware of the implication of automation in the work currently done by humans as the majority is keen in thinking this will probably or definitely happen in the next 20 years. Contrarily, older people, namely between the ages of 42-49, do not believe this will happen.

In addition, there were both more males and females believing that automation-related technologies will take over many human jobs, yet still an approximate percentage of both genders (being 12% of females and 15% of males) are still not sure about this potential future event.

From the people who answered that robots/computers will do much of the work done by humans, 100% think their own type of work will be replaced by automated technologies. From the people who believe this will probably happen, probably not happen, or don't know, the majority is confident that this will not affect their own job. This way, it can be observed

that many people believe automation will indeed affect the labor force, yet not their own type of work.

Oddly, people who strongly believe they are currently preparing themselves for newly automated jobs don't think their own type of work will be automated in the next 20 years. The majority of those who are moderately preparing themselves also believe the same. In addition, a greatest portion of respondents who neither agree nor disagree, moderately disagree, or strongly disagree with their own preparation for the consequences of AI/automation in their own job (meaning they are not significantly preparing themselves for the effects ahead), considers that computers/robots will probably or definitely not affect their own job. This may be the reason why they are currently not taking any actions toward the exponential technological era in the labor market.
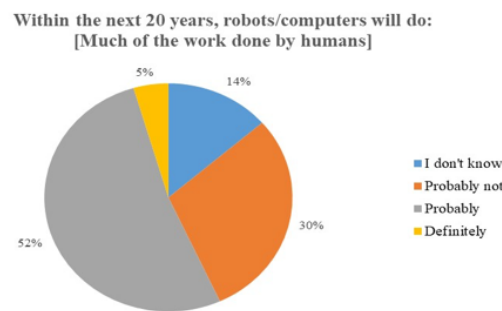
Figure 34: Distribution of opinions regarding the work robots/computers will do in the next 20 years

Source: Own elaboration
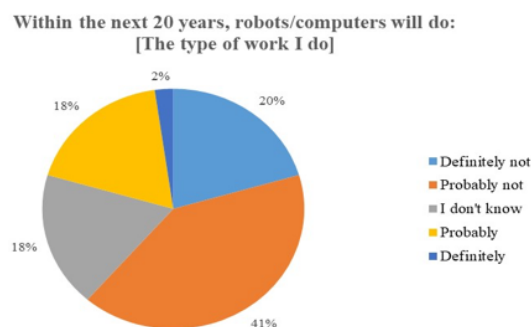
Figure 35: Distribution of opinions regarding the work robots/computers will do in their own work

Source: Own elaboration

Up until the present time, 95% of the respondents still haven't been affected by a machine, robot or computer program. In other words, these people have not yet lost their job or had pay hours reduced due to the replacement of these technologies for their human work. However, 5% have already had this experience at some time in their career. Consequently, the ones who were affected by technologies like artificial intelligence, robots, automation, were either prompted (2%) or were transferred to another job (2%). Figure 37 shows that from the ones who were affected by the change-over, actually liked the transition (5%).

Respondents working in accounting and banking went through the loss a job or had pay hours reduced as a result of job/task replacement for automation. In all cases, the level of income was between 700-1500€ and are currently 42-49 years old. Fortunately, they were transferred to another job rather than losing it completely.

This data supports the low level of automation practiced by organizations in Portugal. Many jobs haven't yet been affected but sooner or later it will happen, and it is crucial that companies start adapting their labor force in order to minimize the negative consequences this event may incur.
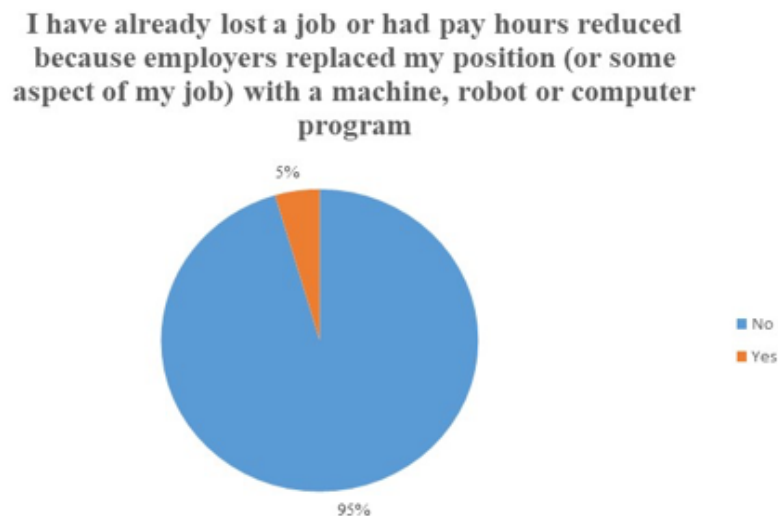
Figure 36: Distribution of respondents that have lost a job or had reduced pay hours due to the substitution of his/her job by a machines, robot or computer program
Source: Own elaboration

To whom answered "yes": What effect did the change-over technologies (AI, automation, robotization, others) have on your job?

2% 2%

- I answered "No"
- I was prompted
- I was transferred to another job

95%
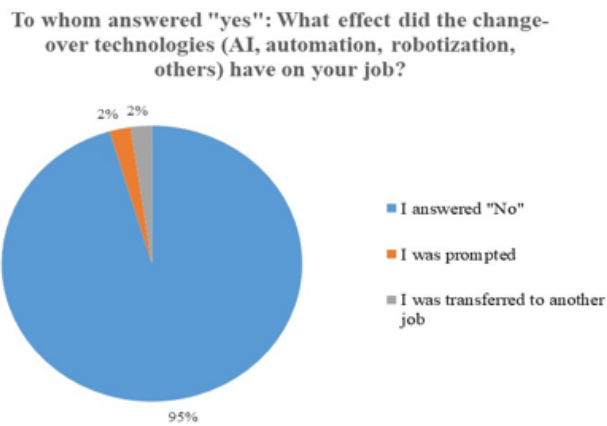
Figure 37: Distribution of the effects of the change-over that the technologies (AI, automation, robotics, others) had on respondents' job
Source: Own elaboration

How did I feel about this?

5%

- I liked it
- Non-applicable

95%
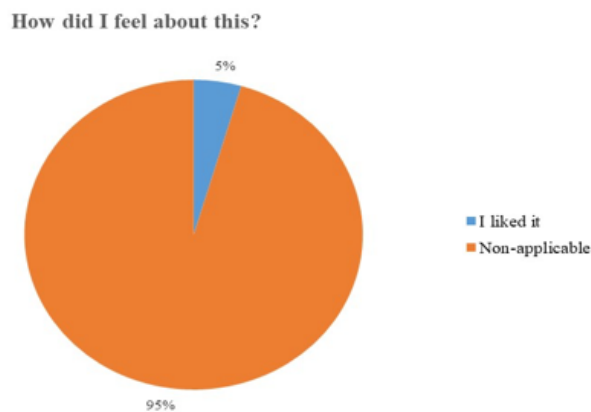
Figure 38: Distribution of respondents regarding their feelings respective to the effects of the change-over caused by technologies (AI, automation, robots, others)
Source: Own elaboration

The following graph (figure 39) shows that people working in Portugal are not very concerned or not concerned at all about losing their own job to automated technologies (77%). Most respondents believe the consequences of the new technologic trends (AI, automation, robotics, others) will only affect their job in a span of 6 years (43%) while others believe such will never happen (20%). Having this in account, the majority feels this to make no difference (43%) to them or like it (27%).

In spite of being a small percentage, youngsters between the ages of 18-33 are, in general, not concerned about losing their jobs. On the other hand, people between the ages of

34-49 are somehow concerned while people over the age of 49 are not. 80% of females do not demonstrate a big concern with job loss. Similarly, males who are somewhat not concerned with losing their job represent 70% of the total male population. People who are either a little or very worried with the possibility of losing their job currently work in accommodation and food services, accounting, banking, healthcare, management, and public and social sectors.

Despite the low level of concern of losing the own job to technologic trends (AI, automation, robotics, and others) almost everyone believes their job will be affected regardless of the age. Most people between the ages of 18-33 believe this will not happen until more than six years ahead. Just very few believe this will happen in the next year or two and around ¼ of each of the two age groups – 18 to 25 and 26 to 33 years old – even think it will never happen. People in between 34-41 consider a timeline of 5 to 6 years. People who are between 42-49 believe automation will affect their jobs in the next few years while most people over 49 years old believe it might happen in more than six years.

60% to 100% of the respondents belonging to the following areas of work believe their work will be affected by technological trends in more than six years: architecture, healthcare, marketing, retail, services, tourism, and transportation and logistics. In contrast, 100% of respondents who work in corporate social responsibility consultancy, information, and life sciences believe their work will never be affected.

Statistics show the majority (> 60%) of people who are a little concerned or very concerned about losing their job consider that their work will only be affected in over 6 years and most are not comfortable with the concern (dislike it or dislike it very much). This is contradicting because if workers believe their work won't be affected in the near future (1-3 years) they have time to start adjusting to the demands of the technologic era and start preparing themselves further ahead, thus minimizing their concern of losing their job.

This can be translated in means that workers in Portugal are conscious about the technologic delay Portugal sustains, due to several different reasons. On the other hand, at the velocity that technology is affecting all kinds of strands, it can mean that employees and employers are not accompanying the natural technologic evolution. This low level of future casting and current preparation can be one of the causes that Portugal is not so highly technologically advanced.
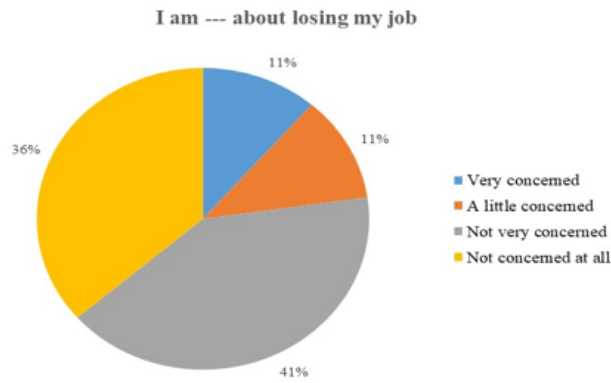
Figure 39: Distribution of respondents' opinion regarding their concern about losing their own job

Source: Own elaboration
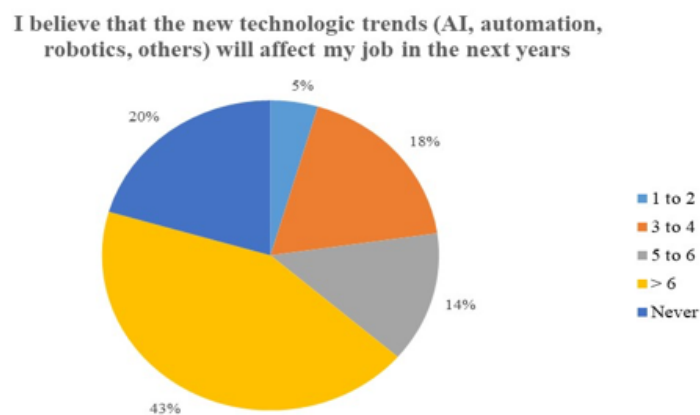
Figure 40: Distribution of respondents' perception whether automation-related technologies regarding effects on jobs in next years

Source: Own elaboration
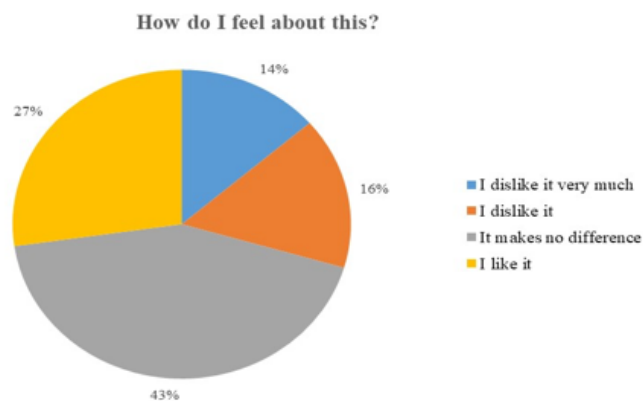
Figure 41: Distribution of respondents regarding their feelings respective to the effects on jobs in the next years

Source: Own elaboration

The features that have suffered most changes in the individuals' jobs are the amount of variety, amount of work required, and degree of accuracy. Contrarily, aspects such as the amount of security felt, amount of pay, and amount of supervision, variety, and chance of promotion to a better job have remained the same or with no significant changes throughout time.
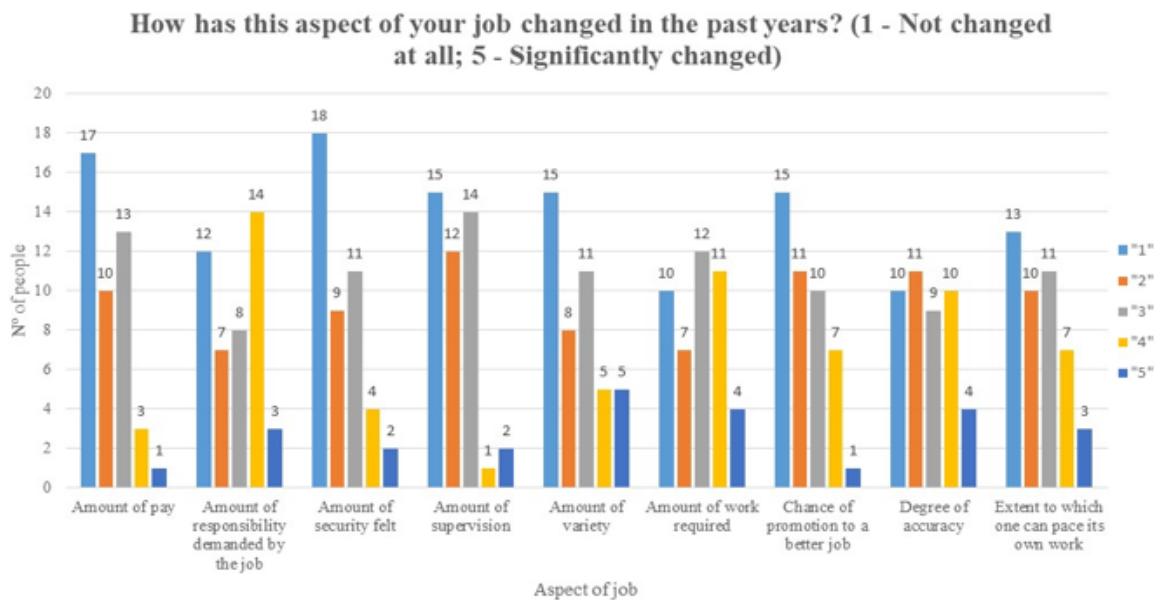
Figure 42: Distribution of level of changes in features within jobs
Source: Own elaboration

The following graph (figure 43) provides information about the level of satisfaction of workers in Portugal regarding their current job, having everything in account. Most of them are either satisfied (39%) or neutral (27%). Most people who are satisfied with their job are between 18-25 years old (56,25%) or between 26-33 years old (33,33%). The majority of the total satisfied respondents are male. 100% of the people who are between 34-49 and most females are neutral.

The areas of work where more people (>70%) are either satisfied or very satisfied are audit and assurance, biotechnology, CSR consultancy, educational services, healthcare, information technologies, law, life sciences, management, marketing, research and development, and tourism. Jobs related to services, architecture, and media and entertainment have large percentages of 100 neutral respondents. Also, the majority of people whom are neutral to the satisfaction of their job earn less than 700€ a month. 100% of the people earning more than 3000, are very satisfied. According to the low statistics in the relationship between level of income and level of satisfaction, one doesn't seem to affect the other much.

Taking everything into account, how satisfied are you with your current job?

11%

23%

27%

39%

- Unsatisfied
- Neutral
- Satisfied
- Very satisfied
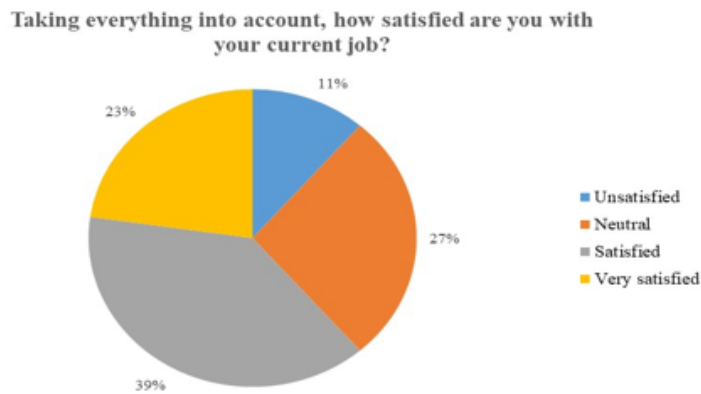
Figure 43: Distribution respondents' level of satisfaction with current job
Source: Own elaboration

In a scale that goes from being 1 – to a very limited extent to 5 – to a very large extent, from the graph below, it is possible to conclude that the majority (14) believes the organization they work for stands in a level three of being technologically-oriented. Level four follows with 13 respondents.

In a macro point of view, respondents in general consider their company to be moderately technologically-oriented. After analyzing more deeply, it is possible to conclude that the area of work where most respondents (>80%) believe their company is very technologically-oriented (level 5) are those related to audit and assurance, automotive and assembly, information technologies, public and social sectors, R&D and tourism. It wasn't possible to identify any relationship between the level of income and the level of extent to which respondents' organizations are technologically-oriented.

In addition, the statistical data shows that despite the high levels of technologic integration in the workers' companies, most people consider that the organization is not making use of these automation trends in respondents' current functions (low or very low extent).

Overall, in Portugal, the companies included in the responses are not quite technologically-driven.

To your notion, to what extent is your organization technology-oriented? (Being 1 - to a very limited extent; 5 - to a very large extent)
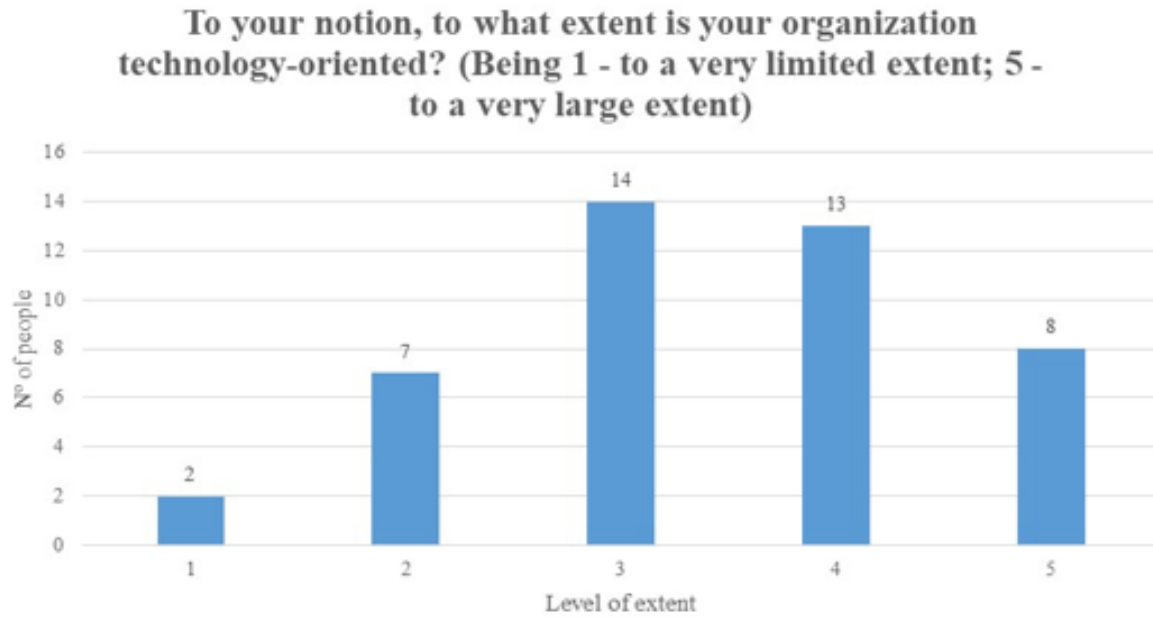
Figure 44: Degree to which respondents believe their organization is technology-oriented

Source: Own elaboration

Most of the people (24) agree that their own organization sees automation as an important or very important tool to improve quality, improve lead-time, reduce cost, and others. The areas of work where most people consider this are audit and assurance, banking biotechnology, healthcare, information technologies, R&D and transportation and logistics. However, on the other hand, a significant amount considers automation as not being relevant to improve the mentioned features, represented by 15 respondents. The areas of work where most respondents believe this statement are accommodation and food services, architecture, CSR consultancy, educational services, and tourism (level of significance of >70%).

The majority of people who don't regard the benefits of automation as a value-added asset to the company, consider themselves as being acquainted but do not seek to know more about the consequences. Contrarily, the ones who are more acquainted with the impacts of automation and seek further research of its various dimensions are also those who represent the highest portion of people who agree with the advantages provided by automation technologies.

This can mean that that the organization isn't making significant efforts to use automation as a strong pillar in the company or the respondents aren't knowledgeable enough about the uses and impacts of automation. In addition, it can also mean that more informed

people also tend to better understand the benefits of automation-related technologies in business.

To what extent do you agree your organization sees automation as an important tool to improve quality, improve lead-time, reduce cost, etc.?

5%
7%
18%
34%
36%

- I don't know
- Very low
- Low
- High
- Very high
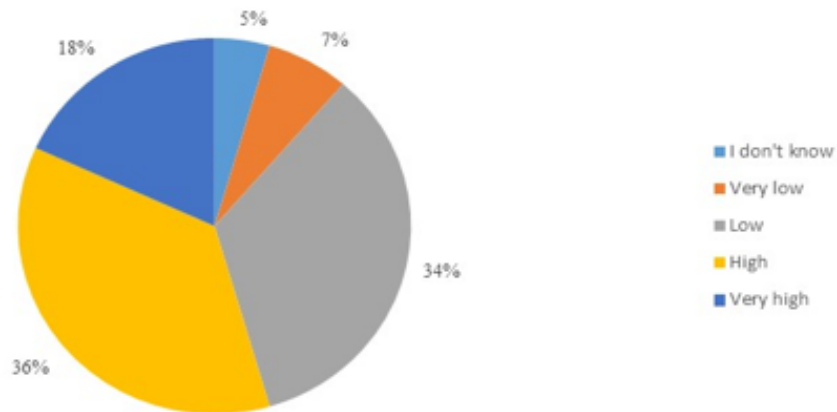
Figure 45: Degree to which respondents agree that their organization sees automation as an important tool to improve quality, improve lead-time, reduce cost, etc.

Source: Own elaboration

Most respondents consider the four mentioned trends to be already relevant or in the near future (1-4 years) in their industry. In other words, they agree that automation, demand for new skills, contingent workers, global recruitment, and aging workforce to be having impact on their industry at the present time or in the next few years. This shows that workers in Portugal are aware that the impacts of the technologic trends are already happening in the workforce and industries. The two trends that are considered to be most relevant in the time-being are automation and global recruitment. This not only indicates that humans are increasingly destined to work with technologies or to be substituted by them but also demonstrates that one no longer is destined to work in the location where their studies were carried. With globalization, recruiters pursue different skills and life experiences in order to enhance and diversify their workforce.

Regarding the automation of tasks and activities in specific, figure 32 sustains the data in figure 31, since 41.5% believe automation is already relevant to the respondents' industry. 21.5% is the second highest rate and defines the amount of people who considers automation

to become relevant to their industry in the next 1-4 years. This means that people are aware that automation is a present trend and is not a futuristic framework.
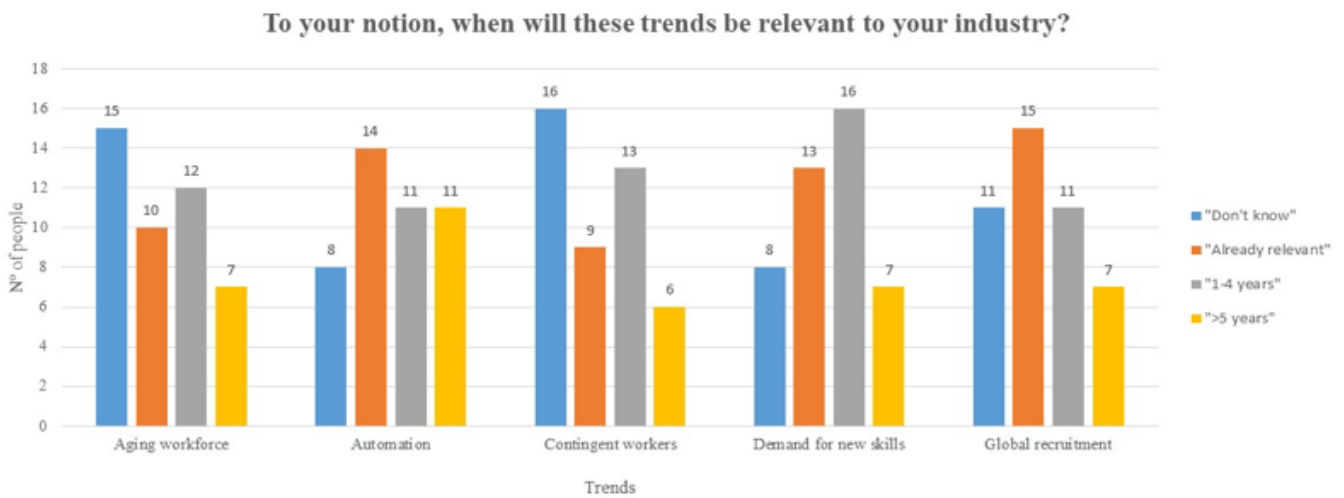
Figure 46: Distribution of opinions regarding relevance of trends in individuals' industry

Source: Own elaboration

Considering that more than 60% of respondents within each area of work, the industries where people believe automation of tasks/activities is already relevant are automotive and assembly, banking, information and technologies, law, marketing and transportation and logistics. In contrast, the majority of people belonging to industries like architecture, audit and assurance, media and entertainment and tourism, think automation will only break in, in more than five years. 100% of people working in CSR consultancy, educational services and life sciences are unsure about the timeline of the impacts of automation in these areas of work. This shows that a great portion of workers already feel the integration and uses of automation within the labor market, yet there are still many others who believe it will still take some time for such to happen. This way, it is possible to note a contradiction: according to workers' perception of time and knowledge about the subject, either companies in Portugal are taking too long to use automation as a daily work tool as means of achieving higher productivity, or working with technologies nowadays comes so naturally, that it becomes difficult not to complement work with automated processes.

When comparing the level of concern with job loss with the prediction of time span in which automation will become relevant in a certain industry it is possible to take a few conclusions: most people who are not very concerned or not concerned at all about losing

their job support that automation is already integrated in their industry. People who are somehow concerned suggest that automation will only become part of their business within the next few years. This suggests that people who are currently acquainted with automated processes and work alongside with them on a daily basis are less concerned than those who still do not work with these technologies. This shows a relationship between fear of losing a job and uncertainty about the impacts and uses of automation in the business.
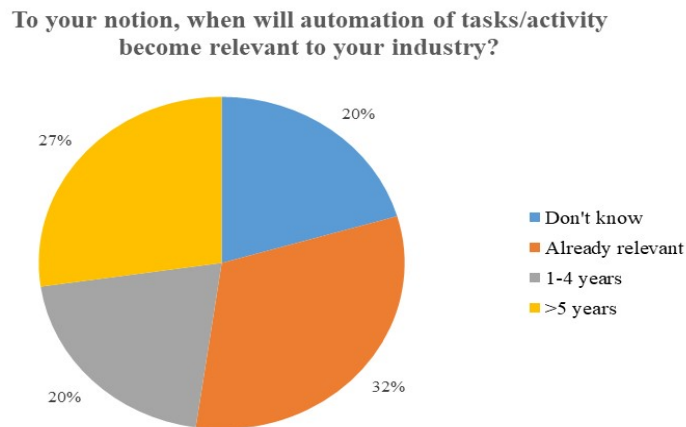
Figure 47: Timeline of the relevance of different trends in respondents' own industry
Source: Own elaboration

Even though the data above proves that the respondents are aware that automation will be part of their daily activities at work, the graph below (figure 48) shows that the majority of the respondents believe that this technologic era will not cause a significant gain or loss in jobs. A study conducted by HR professionals (The State of Artificial Intelligence in HR 2017), presents the same answers. In this case, 58% - also the majority of the respondents – stand in the same position as workers in Portugal.

The second highest percentage is also correspondent in both cases. The study conducted in the Portuguese market demonstrates that 36% of the respondents believe there will be a slight net job loss, while in the study conducted by the HR professionals, 27% also considers a potential loss in jobs.

The two studies show that there are similarities in the predictions and beliefs about the future regarding the job gains or losses in the next five years.

When comparing the level to which respondents agree that over the next 5 years, employees will increasingly take directions/orders from AI management, with the opinion regarding how will technology affect the number of jobs in the same period of time, most respondents believe there will not be a significant gain or loss or there will be a slight job

loss. This translates a non-dramatic scenario meaning that people are aware that automation will affect the labor market, yet it will not be catastrophic.

In addition, regardless of the level of extent to which respondents believe their organization will be making use of AI/automation in 5 years, in their own department/functions most people still consider that jobs won't be too affected or just a few will suffer job loss.

In addition, the majority of those who are a little or very concerned or not very concerned about losing their own job believe that there will be a slight net loss in jobs, while those who are not concerned at all believe that there will not be a significant job loss or gain. This way, the level of concern with maintaining the job is somewhat related to the chances of automation substituting occupations currently performed by humans.
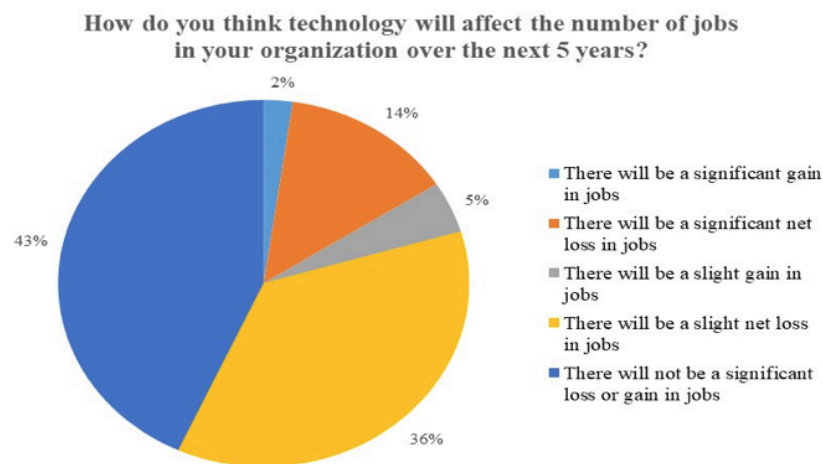
Figure 48: Degree to which respondents believe technology will affect the number of jobs in their organization of the next 5 years

Source: Own elaboration

From the graph below (figure 49), it is possible to observe that respondents agree that automation of jobs through new technologies in the workplace has mostly benefited adults, whether they are Portuguese citizens or foreign citizens working in Portugal, despite their ethnic race. However, there are still many that do not know the impact or believe that automation neither hurt not helped workers in their jobs. Still, when comparing to the Portuguese population, there are more people who believe that foreign citizens are more hurt by automation of jobs in Portugal.

When considering the age range, the majority (58%) believes that people between 18-49 years old and graduates (59%) are the ones who most benefit from automation-related

technologies at work. On the other hand, people who are more than 50 years old or non-graduates are considered to be the most negatively affected by these technologies in their jobs.

However, it is possible to note a high percentage of people who do not know what to answer, possibly meaning that the knowledge about the impacts of automation in different categories rather than one's own job is quite low.
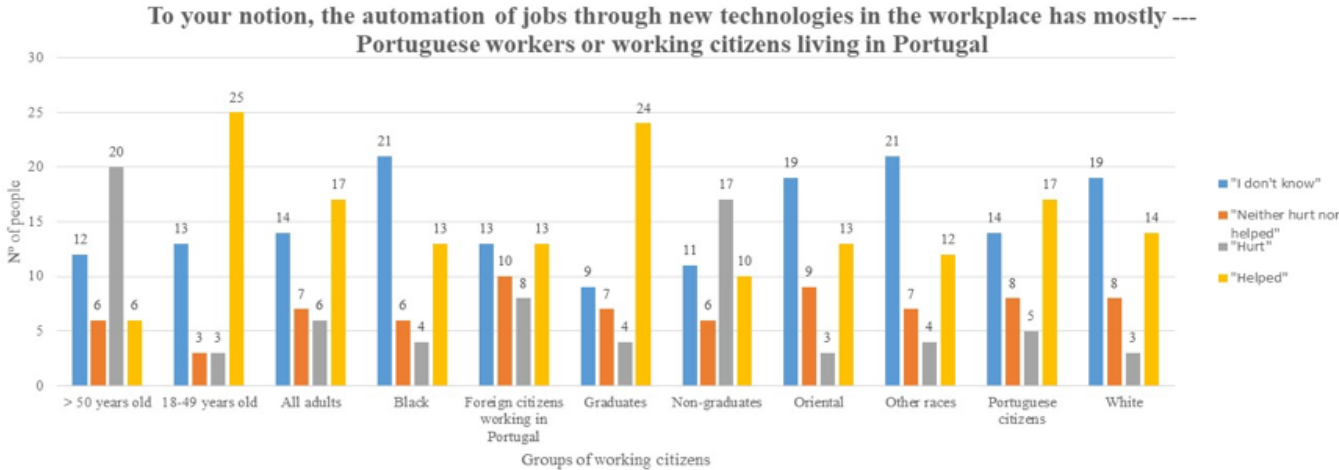
Figure 49: Distribution of opinions regarding the way automation of jobs affected workers in Portugal
Source: Own elaboration

59% consider that there is a combined responsibility of the Government and of the individuals to take action for the consequences of automation in human jobs. This means that most of the people agree that the Government should compromise to take care of displaced workers, even if it means raising taxes exponentially together with the individuals' duty of taking care of their own well-being, meaning that they must adjust and adapt to the market needs and consequences of job automation.

20% of the respondents believe the Government must secure the workers' well-being at any cost, while 18% believes workers have the obligation to adjust to the consequences automation is having on jobs.

Most respondents included in the age category 18-41 consider that it is both individuals' and the Government's responsibility to react to (potential) job loss. Also, the majority of the female and male respondents think it is a combined responsibility. However, people between 42-49 years old consider it is the Government's obligation to take care of displaced workers, regardless of the measures to be taken. All people earning less than 700€, between 3001-

5000€, or more than 7500€ considered the option including the combination of individuals and the Government. This way, it is difficult to conclude that there is a relationship between level of income and opinion regarding who's responsible of taking action for job loss consequences due to automation. However, it is possible to conclude that people who are closer to retirement age are more propitious of holding the Government for the impacts of automation on labor force.
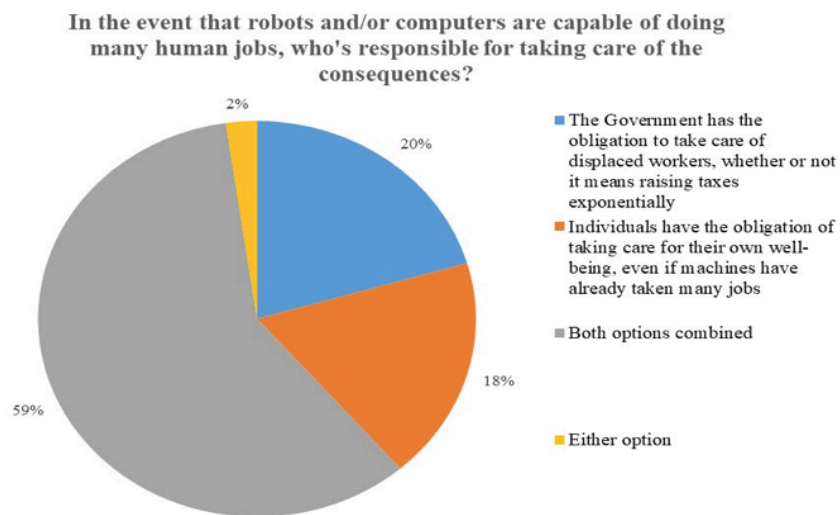
Figure 50: Distribution of opinions regarding who's responsible for the consequences in the event that robots/computers capability of doing many human jobs
Source: Own elaboration

66% of the total respondents consider that 1-25% of the internal tasks and processes will be automated within their own company in the next 3-5 years. 27% consider that a portion of 26-50% of the tasks will be automated in the referred time.

Statistics show that the main areas of work where most respondents fundament a 1-25% portion of automation of internal tasks and processes are accounting, architecture, audit and assurance, automotive and assembly, banking, CSR consultancy, educational services, law, life sciences, media and entertainment, public and social sectors, research and development, retail, services, tourism, transportation and logistics. This means that in almost all areas of work presented, people are keen to believe that ¼ of the tasks will be automated thus suggesting confidence in automation coming as means of complementing work rather than substituting the entire occupation.

To your notion, what portion of the internal tasks and processes will be automated in the next 3-5 years? [In your organization]

- 0
- 1 - 25%
- 26 - 50%
- 51 - 75%

2%
5%
27%
66%
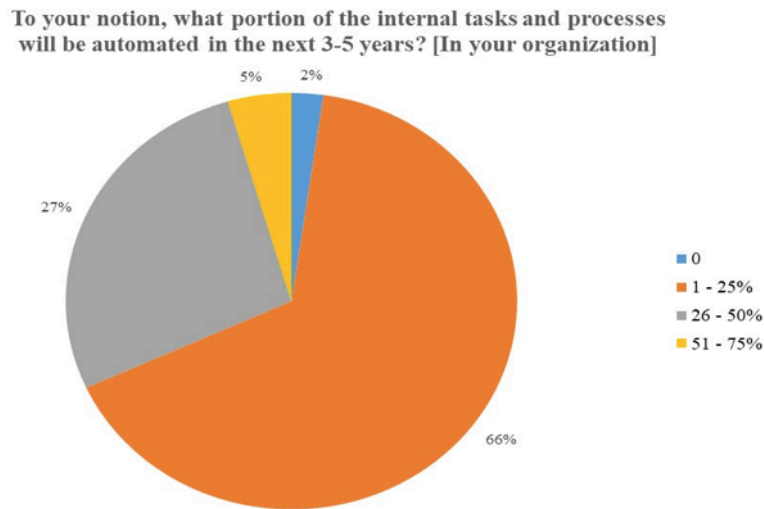
Figure 51: Distribution of opinions regarding the portion of internal tasks and processes being automated in the next 3-5 years

Source: Own elaboration

The majority, represented by 39% of the respondents, believe that it is somewhat that there will be an increase of the disparities between the rich and poor but still 30% isn't sure about the socio-economic inequalities.

If robots and computers perform most of the jobs currently being done by humans, it is --- that: [Inequality between rich and poor would increase]

- Not sure
- Not very likely
- Somewhat likely
- Very likely

14%
30%
39%
18%
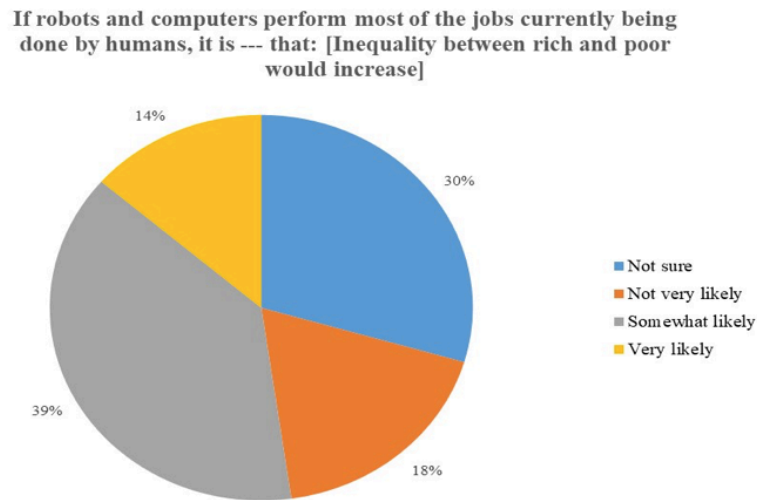
Figure 52: Distribution of respondents according to level of economic inequality and employment quality
Source: Own elaboration

50% of the inquired people consider that it is not very likely or not likely at all that the economy would create many new and better paying jobs for humans in the event that robots and computers perform most of the jobs currently done by humans. On the other hand, 34% of the respondents consider to be somewhat likely that this happens.

If robots and computers perform most of the jobs currently being
done by humans, it is --- that: [The economy would create many
new, better paying jobs for humans]
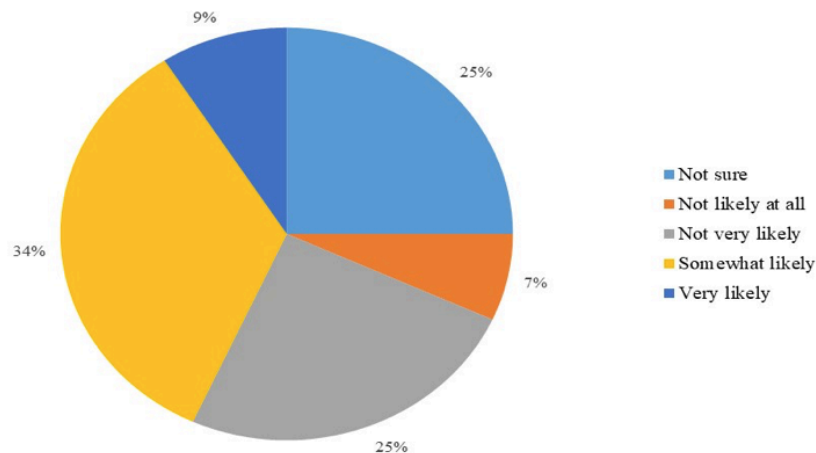
Figure 53: Distribution of opinions regarding the portion of internal tasks and processes being automated in the next 3-5 years

Source: Own elaboration

Overall, the majority of the respondents (73%) have a straightforward and positive vision about a future where automation, AI, robots and other technologies walk side-by-side with humans, complementing their professional tasks. Even though respondents are aware that many jobs currently performed by humans are at risk of being eradicated, they believe new jobs will emerge.

Still, more than ¼ of the respondents (27%) believe in a worst-case scenario, where AI, robots, and other technologies will take over human jobs and they fear a new revolution is about to bloom.

Statistics show that in general, people are quite confident about a positive future where automation technologies can walk side-by-side with humans, despite inevitably entailing a few negative consequences. However, the age groups that seem to present a larger concern regarding a dark scenario where automation will take over humans are those from 34-41. The proportion between males and females considering a positive outcome is almost equal to each other (73,68% and 72%, respectively). In addition, it is possible to conclude that the level of education does not influence the opinion, since the majority in all education levels, except for technical and professional studies (with a 50/50 proportion), support a future where humans and technologies complement each other.

To your notion, after this questionnaire, consider one of the following statements:

27%

73%

- I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge

- I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future
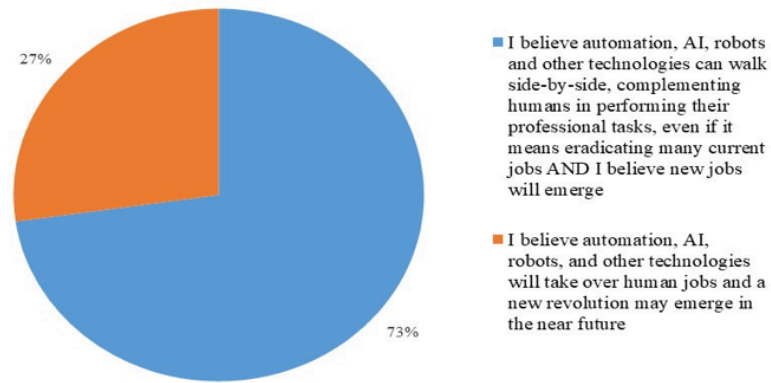
Figure 54: Distribution of respondents according to overall opinion regarding automation and humans

Source: Own elaboration

Synthesis of Results

There were several conclusions drawn from the results: regarding the level of technological maturity, data shows that Portugal is still in a gradually growing phase. The risk of a job being overtaken by automation varies across industry. Considering the Portuguese framework, activities with highest automation capacity are the ones related to factory production, trade, public administration and government. Contrarily, arts and entertainment, financial services and insurance, professional, scientific and technical services are those will the lowest potential. According to the study presented, it is possible to infer that in Portugal, in the meantime, just a small percentage of the amount of work that can potentially be replaced by automation will actually follow this path due to slow technological developments, costs, social and regulatory barriers, and other factors. According to the questionnaire responses, most people consider to be acquainted and interested in the impacts of artificial intelligence on human capital, yet they do not seek to deepen their knowledge on the subject. These are also the ones who do not consider automation as being an added-value asset to companies. Contrarily, the ones who are more acquainted with the impacts of automation and seek further research are also those who represent the highest portion of people who contemplate the benefits of automation. Therefore, this can translate that the higher the knowledge on this subject, the higher the chances of better understanding how automation can be rewarding for the businesses.

The majority who are preparing themselves are female. However, in general, there is an apparent low-level of preparation on behalf of individuals to handle the consequences of automation in their own jobs, despite being aware of the impacts. Data shows that companies in Portugal integrate some technological trends in their business, but not necessarily within workers' own functions/department, yet. In addition, until now, not many workers have been affected by automation-related technologies. These facts can lead to a deficiency in adapting to the new technologic settings in the labor market in the future, since the integration of these trends is currently not one of the main value-added competences.

A relationship between job loss apprehension and uncertainty about the impacts of automation on the workforce can be noted. The ones who consider themselves to be familiar with automated processes are less concerned than those who still do not work with these technologies. However, in general, respondents believe this technologic era will not cause a significant gain or loss in jobs. All in all, people are conscious about the implications of automation in the labor force, yet to not believe it will be shattering. This may due to the

widespread access to information humans are subject to, whether it is through the internet, media, and other forms of communication. Technology overwhelms people every day, worldwide, and at any age, making it easier for any person to be continuously in contact with automation-related subjects.

Respondents believe that automation has mostly benefited adults, essentially Portuguese citizens, with age ranges between 18-49 years old, and graduates, while foreign citizens, and/or more than 50 years old, and/or non-graduates have been more negatively affected by the automation of jobs in Portugal. It can also be interpreted that the level of education does not influence the opinions regarding the subject, possibly due to the increasing access to information world-wide, regardless of the social class.

Regarding the perception of workers in Portugal about the potential impact of automation of jobs (threat vs. opportunity) it was possible to unravel that respondents are aware of the trending and declining skills demanded. Most believe automation will indeed affect the labor force, yet not their own type of work. People between the ages of 18-33 or over 49 are typically less concerned about losing their jobs and believe their work will take several years to be affected, while people between the ages of 34-49 are somehow concerned. This can possibly be related with the perspective on their remaining work time span. In other words, juveniles who still have time to learn new skills or people who are close to the retirement age, seam less worried. Those in an age group where changing work with new skills' demands is more difficult, appear to be more concerned with the consequences of automation on the labor force.

Overall, workers in Portugal are conscious about the technologic delay Portugal withstands, and believe that approximately ¼ of the tasks will be automated. This can mean that people consider automation as a means of complementing work rather than substituting the entire occupation.

Finally, regarding the extent to which workers and their companies are responding to the changes in the workforce, resulting from automation, it was possible to extrapolate that most people seem to be quite positive about a future where automation, AI, robots and automation complement each other in the labor market. Despite being aware that many jobs are at risk and that, inevitably, negative impacts will occur, respondents are confident that new ones will emerge and that it is a shared responsibility between individuals and the Government to handle the consequences of automation. However, still more than ¼ of the respondents (essentially between the ages of 34-41) fear a labor revolution where technology takes over humans.

Conclusions

Technology, in all its forms, is one of the most significant factors that lead to the evolution of societies worldwide, across time. It encompasses several benefits, but inherently, it incorporates many other hindrances and disadvantages, especially regarding the labor force. It impacts societies, individually and as a whole, different cultures across the world, and has several other effects (political, demographical, economical, among others). Despite the innumerous challenges caused by the evolution of technology, humanity has always been able to adapt itself. The research developed presents some elucidations on this adaptation process and evolution.

However, this study carries out several limitations. At first, the aim was to achieve the maximum number of people possible, of which 70 people responded to the questionnaire, yet only 44 filled the requirements for the study meaning that the sample is just a niche, thus not being 100% representative of the population. In addition, the expansion extent was limited to my own network (which probably didn't include many people working in areas with high levels of potential risk of automation or a wide variety of social classes) and dependent of the power of word of mouth. Also, it was difficult to determine a viable level of knowledge about the subjects from the respondents, being the answer mainly based on opinions.

Overall, in the previous industrial revolutions humankind was always able to overcome the difficulties caused by technology, which was the main potentiating factor of the evolution of societies. Because history has seen this happen several times before, there are good reasons to believe that humans will overcome challenges of the presence of automation in its various forms, in the labor market.

The aims of the thesis were to evaluate the level of technological maturity (people and companies), perception of workers in Portugal about the potential impact of automation on jobs (threat vs. opportunity), and the extent to which workers and their companies are responding to the changes resulting from automation in the workforce. Although I believe to have successfully addressed/reached the intended aspirations, the gathered information in this thesis opened path for further research. As such, in the future, it would be interesting to begin by performing this study with a larger sample as the performed survey naturally had scope limitations. This could be done by, for example, expanding the network, performing interviews, undertaking questionnaires in the streets, or others. Also, the same research could be carried out by creating niches of demographic characterization or by evaluating specific industries/sectors. Also, it would be interesting to develop a way to measure knowledgeable

and non-knowledgeable respondents on the subject in order to cross the information as a means of comparison between the groups. These elements could help refine current results. However, despite the limitations and the possibility of filtering even more the research, I believe I was able to correspond to the aims of the thesis.

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Appendices

4.3 Questionnaire

4.3.1 Part I – Impact of automation, AI, robots and other technologic trends in the workforce

1. Country currently working in
2. Employment status
   a. Employed
   b. Not employed
3. Age
   a. 18-25
   b. 26-33
   c. 34-41
   d. 42-49
   e. >49
4. Gender
   a. Female
   b. Male
5. Nationality
6. Level of Education
   a. Bachelor's Degree
   b. Higher Education (High School)
   c. Master's Degree
   d. PhD
   e. Technical and Professional Studies
7. Area of work
   a. Accommodation and food services
   b. Accounting
   c. Architecture
   d. Audit and assurance
   e. Automotive and assembly
   f. Banking

g. Biotechnology

h. CSR consultancy

i. Educational services

j. Healthcare

k. Information and technologies

l. Law

m. Life sciences

n. Management

o. Marketing

p. Media and entertainment

q. Public and social sectors

r. Research and development engineering

s. Retail

t. Services

u. Tourism

v. Transportation and logistics

8. Average gross income (€)

a. <700€

b. 700€-1500€

c. 1501€-3000€

d. 3001€-5000€

e. 5001€-7500€

f. >7500€

4.3.2 Part II – Questions related to the individual

9. Regarding human capital, and considering the technologies of Artificial Intelligence:

a. I am acquainted to the subjects; try to seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages

b. I'm acquainted and interested about the impacts, but do not seek to know more about it than what appears on the news, TV, and other communication sources

c. Other

10. Over the next 3 years, employees will increasingly take directions/orders from AI management that will allocate and assign tasks to them (for example, by using automated project software)

    a. Strongly disagree

    b. Moderately disagree

    c. Neither agree nor disagree

    d. Moderately agree

    e. Strongly agree

11. I am currently preparing myself to handle the individual consequences of automation in my job.

    a. Strongly disagree

    b. Moderately disagree

    c. Neither agree nor disagree

    d. Moderately agree

    e. Strongly agree

12. In your current functions/department, to what extent is your organization making use of AI/automation today.

    a. Very low

    b. Low

    c. I don't know

    d. High

    e. Very high

13. For your own functions/department, to what extent do you think your organization will be making use of AI/automation in five years?

    a. Very low

    b. Low

    c. I don't know

    d. High

    e. Very high

14. Consider the following policies in the event that robots and computers are capable of doing many human jobs

    a. In the case of the use of machines being limited to doing dangerous or unhealthy jobs currently done by humans

b. I wouldn't mind if machines are cable of doing human jobs if the government offered all Portuguese a guaranteed income that would meet their basic needs

15. Select the features you would most like to see in an AI-powered application in your own functions (choose 3)

    a. Ability to analyze

    b. Ability to predict

    c. Ability to personalize

    d. Ability to diagnose

    e. Ability to organize

    f. Ability to augment skills

    g. Ability to simulate

    h. Ability to gauge emotions

    i. Ability to automatize repetitive cognitive tasks

    j. Ability to automatize physical tasks

16. In your opinion, select one of the options (trending or declining) regarding the human skills demanded in 2022

    a. Analytical thinking and innovation

    b. Manual dexterity, endurance and precision

    c. Active learning and learning strategies

    d. Memory, verbal, auditory and spatial abilities

    e. Technology use, monitoring and control

    f. Visual, auditory and speech abilities

    g. Creativity, originality and initiative

    h. System analysis and evaluation

    i. Management of personnel

    j. Leadership and social influence

    k. Quality control and safety awareness

    l. Coordination and time management

    m. Complex problem-solving

    n. Technology, installation and maintenance

    o. Reading, writing, math and active listening

    p. Emotional intelligence

    q. Reasoning, problem-solving and ideation

r. Technology, design and programming

s. Critical thinking and analysis

t. Management of financial, material resources

17. Within the next 20 years, robots / computer will ----- do:

    a. Much of the work done by humans

        a. Definitely not

        b. Probably not

        c. I don't know

        d. Probably

        e. Definitely

    b. The type of work I do

        a. Definitely not

        b. Probably not

        c. I don't know

        d. Probably

        e. Definitely

18. I have already lost a job or had pay of hours reduced because employers replaced my position (or some aspect of my job) with a machine, robot or computer program

    a. Yes

    b. No

19. To whom answered "yes": What effect did the change-over technologies (AI, automation, robotization, others) have on your job?

    a. I was prompted

    b. I was transferred to another job

    c. I kept the same job, but the work was greatly changed

    d. I kept the same job, but the work was only slightly changed

    e. I kept the same job, and the work was not changed

    f. Other (please specify)

20. How did I feel about this?

    a. I disliked it very much

    b. I didn't like it much

    c. It made no difference

    d. I liked it

    e. I liked it very much

21. I am ---- about losing my current job
    a. Not concerned at all
    b. Not very concerned
    c. I don't know
    d. A little concerned
    e. Very concerned

22. I believe that the new technologic trends (AI, automation, robotics, others) will affect my job in the next years:
    a. 1 to 2
    b. 3 to 4
    c. 5 to 6
    d. > 6
    e. Never

23. How do I feel about this?
    a. I dislike it very much
    b. I don't like it much
    c. It makes no difference
    d. I like it
    e. I like it very much

24. How has this aspect of your job changed in the past year? (1- No changes at all; 5 - Significantly changed)
    a. Amount of pay
    b. Amount of responsibility demanded by the job
    c. Amount of security felt
    d. Amount of supervision
    e. Amount of variety
    f. Amount of work required
    g. Chance of promotion to a better job
    h. Degree of accuracy
    i. Extent to which one can pace its own work

25. Taking everything into account, how satisfied are you with your current job?
    a. Completely unsatisfied
    b. Unsatisfied
    c. Neutral

    d. Satisfied

    e. Very satisfied

4.3.3 Part III – Questions related to organization

26. To your notion, to that extent is your organization technology-oriented? (Being 1 - to a very limited extent through 5 - to a very large extent)

27. To what extent do you agree that your organization sees automation as an important tool to improve quality, improve lead-time, reduce cost, etc.

    a. Very low

    b. Low

    c. I don't know

    d. High

    e. Very high

28. To your notion, when will these trends be relevant to your industry?

    a. Aging workforce

    b. Automation

    c. Contingent workers

    d. Demand for new skills

    e. Global recruitment

        a. Already relevant

        b. 1-4 years

        c. > 5 years

        d. Not applicable

        e. I don't know

29. To your notion, when will automation of tasks / activities become relevant to your industry?

        a. Already relevant

        b. 1-4 years

        c. > 5 years

        d. Not applicable

        e. I don't know

30. How do you think technology will influence the number of jobs in your organization over the next five years?

a. There will be a significant net loss in jobs

b. There will be a slight net loss in jobs

c. There will not be a significant loss or gain in jobs

d. There will be a slight gain in jobs

e. There will be a significant gain in jobs

31. To your notion, the automation of jobs through new technology in the workplace has mostly:

a. All adults

b. Portuguese citizens

c. Foreign citizens working in Portugal

d. White

e. Black

f. Oriental

g. Other

h. 18-49 years old

i. > 50 years old

j. Graduates

k. Non-graduates

   a. Hurt

   b. Helped

   c. Neither hurt nor helped

32. In the event that robots and computers are capable of doing many human jobs, who´s responsible for taking care of the consequences?

a. Government has the obligation to take care of displaces workers, even if it means raising taxes substantially

b. Individuals have the obligation to take care for own well-being, even if machines have already taken many jobs

c. Either option

d. Both options combined

33. To your notion, what portion of the internal tasks and processes will be automated in the next 3-5 years (in your organization)?

a. 0%

b. 1-25%

c. 26-50%

    d. 51-75%

    e. 76-100%

4.3.4 Part IV – Other/general questions

34. If robots and computers perform most of the jobs currently being done by humans, it is ----- that:

    a. Inequality between rich and poor would increase

    b. The economy would create many new, better-paying jobs for humans

        a. Not likely at all

        b. Not very likely

        c. Not sure

        d. Likely

        e. Very likely

35. To your notion, after this questionnaire, consider one of the following statements

    a. I believe automation, AI, robots, and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge

    b. I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future

    c. I do not have an opinion

4.4 Pivot tables (results) and others
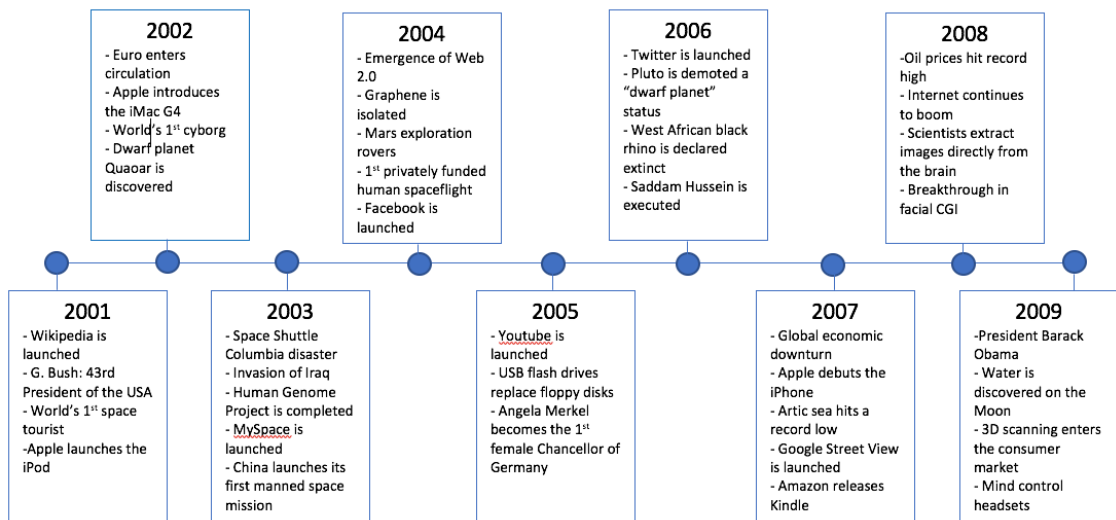
Figure 55: 2000-2009 timeline contents

Source: Adapted from future timeline.net (2018)

Figure 56: Age/ Regarding human capital, and considering the technologies, I:

Source: Own elaboration

Figure 57: Gender / Regarding human capital, and considering the technologies, I:

Source: Own elaboration

Area of work / Regarding human capital, and considering the technologies of AI:	
Rótulos de Linha	Contagem de 10. Regarding human capital, and considering the technologies of Artificial Intelligence, I:
⊙ Accommodation and food servicesO+A52:B104	9,09%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	25,00%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	75,00%
⊙ Accounting	6,82%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	66,67%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	33,33%
⊙ architecture	2,27%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
⊙ Audit and assurance	2,27%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
⊙ Automotive and assembly	2,27%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	100,00%
⊙ Banking	9,09%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	75,00%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	25,00%
⊙ Biotechnology	2,27%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	100,00%
⊙ CSR consultancy	2,27%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
⊙ Educational services	2,27%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
⊙ Healthcare	9,09%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	50,00%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	50,00%
⊙ Information	2,27%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	100,00%
⊙ Information Technologies	2,27%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	100,00%
⊙ Law	2,27%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	100,00%
⊙ Life Sciences	2,27%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
⊙ Management	11,36%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	80,00%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	20,00%
⊙ Marketing	6,82%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	66,67%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	33,33%
⊙ Media and entertainment, Marketing	2,27%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
⊙ Public and social sectors	4,55%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	50,00%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	50,00%
⊙ Research and development engineering	2,27%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
⊙ Retail	4,55%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
⊙ Services	6,82%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	33,33%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	33,33%
I'm curious	33,33%
⊙ Tourism	2,27%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
⊙ Transportation and logistics	2,27%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
⊙ Retail	4,55%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
⊙ Services	6,82%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	33,33%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	33,33%
I'm curious	33,33%
⊙ Tourism	2,27%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
⊙ Transportation and logistics	2,27%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
Total Geral	100,00%

Figure 59: Area of work / Regarding human capital, and considering the technologies, I:

Source: Own elaboration

Level of Education / Regarding human capital, and considering the technologies of AI:	
Rótulos de Linha	Contagem de 10. Regarding human capital, and considering the technologies of Artificial Intelligence, I:
⊙ Bachelor Degree	20,45%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	33,33%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	66,67%
⊙ Higher Education (High School)	6,82%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
⊙ Masters Degree	63,64%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	64,29%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	32,14%
I'm curious	3,57%
⊙ PhD	4,55%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	50,00%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	50,00%
⊙ Technical and Professional Studies	4,55%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
Total Geral	100,00%

Figure 58: Level of Education / Regarding human capital, and considering the technologies, I:

Source: Own elaboration

Avergade gross income / Regarding human capital, and considering the technologies of AI:	
Rótulos de Linha	Contagem de 10. Regarding human capital, and considering the technologies of Artificial Intelligence, I:
⊟ < 700€ (Minimum Portuguese Wage)	11,36%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	60,00%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	40,00%
⊟ > 7500€	2,27%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
⊟ 1501€ - 3000€	22,73%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	40,00%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	50,00%
I'm curious	10,00%
⊟ 3001€ - 5000€	2,27%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	100,00%
⊟ 5001€ - 7500€	2,27%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	100,00%
⊟ 700€ - 1500€	59,09%
I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	69,23%
I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	30,77%
Total Geral	100,00%

Figure 60: Average gross income / Regarding human capital, and considering the technologies, I:

Source: Own elaboration

Age / Over the next 5 years, employees will increasingly take directions/orders from AI management that will allocate and assign tasks to them	
Rótulos de Linha	Over the next 5 years, employees will increasingly take directions/orders from AI management that will allocate and assign tasks to them (for example, by using automated project software)
⊟ > 49	9,09%
Moderately agree	25,00%
Neither agree nor disagree	25,00%
Strongly agree	25,00%
Strongly disagree	25,00%
⊟ 18 - 25	36,36%
Moderately agree	31,25%
Moderately disagree	31,25%
Neither agree nor disagree	12,50%
Strongly agree	25,00%
⊟ 26 - 33	47,73%
Moderately agree	57,14%
Moderately disagree	23,81%
Neither agree nor disagree	4,76%
Strongly agree	4,76%
Strongly disagree	9,52%
⊟ 34 - 41	2,27%
Moderately disagree	100,00%
⊟ 42 - 49	4,55%
Moderately agree	50,00%
Neither agree nor disagree	50,00%
Total Geral	100,00%

Figure 61: Age / Directions from AI management

Source: Own elaboration

Rótulos de Linha	Over the next 5 years, employees will increasingly take directions/orders from AI management that will allocate and assign tasks to them (for example, by using automated project software)
⊟ Female	56,82%
Moderately agree	32,00%
Moderately disagree	28,00%
Neither agree nor disagree	16,00%
Strongly agree	16,00%
Strongly disagree	8,00%
⊟ Male	43,18%
Moderately agree	57,89%
Moderately disagree	21,05%
Neither agree nor disagree	5,26%
Strongly agree	10,53%
Strongly disagree	5,26%
Total Geral	100,00%

Figure 62: Gender / Directions from AI management

Source: Own elaboration

Rótulos de Linha	Over the next 5 years, employees will increasingly take directions/orders from AI management that will allocate and assign tasks to them (for example, by using automated project software)
⊟ Bachelor Degree	20,45%
Moderately agree	44,44%
Moderately disagree	11,11%
Neither agree nor disagree	22,22%
Strongly agree	22,22%
⊟ Higher Education (High School)	6,82%
Moderately agree	100,00%
⊟ Masters Degree	63,64%
Moderately agree	42,86%
Moderately disagree	35,71%
Strongly agree	10,71%
Strongly disagree	10,71%
⊟ PhD	4,55%
Neither agree nor disagree	50,00%
Strongly agree	50,00%
⊟ Technical and Professional Studies	4,55%
Neither agree nor disagree	100,00%
Total Geral	100,00%

Figure 63: Level of Education / Directions from AI management

Source: Own elaboration

Area of work / Over the next 5 years, employees will increasingly take directions/orders from AI management that will allocate and assign tasks to them	
Rótulos de Linha	Over the next 5 years, employees will increasingly take directions/orders from AI management that will allocate and assign tasks to them (for example, by using automated project software)
⊟ Accommodation and food services	9,09%
Moderately agree	75,00%
Moderately disagree	25,00%
⊟ Accounting	6,82%
Moderately agree	100,00%
⊟ architecture	2,27%
Moderately disagree	100,00%
⊟ Audit and assurance	2,27%
Moderately disagree	100,00%
⊟ Automotive and assembly	2,27%
Moderately agree	100,00%
⊟ Banking	9,09%
Moderately agree	50,00%
Neither agree nor disagree	25,00%
Strongly agree	25,00%
⊟ Biotechnology	2,27%
Neither agree nor disagree	100,00%
⊟ CSR consultancy	2,27%
Moderately disagree	100,00%
⊟ Educational services	2,27%
Strongly agree	100,00%
⊟ Healthcare	9,09%
Moderately agree	50,00%
Strongly agree	50,00%
⊟ Information	2,27%
Moderately agree	100,00%
⊟ Information Technologies	2,27%
Moderately disagree	100,00%
⊟ Law	2,27%
Moderately disagree	100,00%
⊟ Life Sciences	2,27%
⊟ Marketing	6,82%
Moderately agree	33,33%
Neither agree nor disagree	33,33%
Strongly agree	33,33%
⊟ Media and entertainment, Marketing	2,27%
Strongly disagree	100,00%
⊟ Public and social sectors	4,55%
Moderately agree	100,00%
⊟ Research and development engineering	2,27%
Moderately disagree	100,00%
⊟ Retail	4,55%
Moderately agree	50,00%
Moderately disagree	50,00%
⊟ Services	6,82%
Moderately disagree	33,33%
Strongly agree	33,33%
Strongly disagree	33,33%
⊟ Tourism	2,27%
Neither agree nor disagree	100,00%
⊟ Transportation and logistics	2,27%
Neither agree nor disagree	100,00%
Total Geral	100,00%

Figure 64: Area of work / Directions from AI management

Source: Own elaboration

133

Age / I am currently preparing myself to handle the individual consequences of AI and/or automation in my job	
Rótulos de Linha	I am currently preparing myself to handle the individual consequences of AI and/or automation in my job
> 49	9,09%
Moderately agree	50,00%
Neither agree nor disagree	25,00%
Strongly disagree	25,00%
18 - 25	36,36%
Moderately agree	25,00%
Moderately disagree	12,50%
Neither agree nor disagree	25,00%
Strongly agree	18,75%
Strongly disagree	18,75%
26 - 33	47,73%
Moderately agree	19,05%
Moderately disagree	42,86%
Neither agree nor disagree	14,29%
Strongly agree	9,52%
Strongly disagree	14,29%
34 - 41	2,27%
Moderately disagree	100,00%
42 - 49	4,55%
Moderately agree	100,00%
Total Geral	100,00%

Figure 65: Age / Current own preparation

Source: Own elaboration

Gender / I am currently preparing myself to handle the individual consequences of AI and/or automation in my job	
Rótulos de Linha	I am currently preparing myself to handle the individual consequences of AI and/or automation in my job
Female	56,82%
Moderately agree	28,00%
Moderately disagree	32,00%
Neither agree nor disagree	16,00%
Strongly agree	8,00%
Strongly disagree	16,00%
Male	43,18%
Moderately agree	26,32%
Moderately disagree	21,05%
Neither agree nor disagree	21,05%
Strongly agree	15,79%
Strongly disagree	15,79%
Total Geral	100,00%

Figure 66: Gender / Current own preparation

Source: Own elaboration

Rótulos de Linha	I am currently preparing myself to handle the individual consequences of AI and/or automation in my job
⊟ Accommodation and food services	9,09%
Moderately agree	25,00%
Moderately disagree	25,00%
Neither agree nor disagree	25,00%
Strongly disagree	25,00%
⊟ Accounting	6,82%
Moderately agree	100,00%
⊟ architecture	2,27%
Strongly disagree	100,00%
⊟ Audit and assurance	2,27%
Neither agree nor disagree	100,00%
⊟ Automotive and assembly	2,27%
Strongly agree	100,00%
⊟ Banking	9,09%
Moderately agree	25,00%
Moderately disagree	50,00%
Strongly agree	25,00%
⊟ Biotechnology	2,27%
Strongly agree	100,00%
⊟ CSR consultancy	2,27%
Strongly disagree	100,00%
⊟ Educational services	2,27%
Neither agree nor disagree	100,00%
⊟ Healthcare	9,09%
Moderately agree	75,00%
Moderately disagree	25,00%
⊟ Information	2,27%
Moderately disagree	100,00%
⊟ Information Technologies	2,27%
Moderately agree	100,00%
⊟ Law	2,27%
Neither agree nor disagree	100,00%
⊟ Life Sciences	2,27%
Strongly disagree	100,00%
⊟ Management	11,36%
Moderately agree	20,00%
Moderately disagree	40,00%
Neither agree nor disagree	20,00%
Strongly agree	20,00%
⊟ Marketing	6,82%
Moderately disagree	33,33%
Neither agree nor disagree	33,33%
Strongly agree	33,33%
⊟ Media and entertainment, Marketing	2,27%
Neither agree nor disagree	100,00%
⊟ Public and social sectors	4,55%
Moderately agree	50,00%
Moderately disagree	50,00%
⊟ Research and development engineering	2,27%
Strongly disagree	100,00%
⊟ Retail	4,55%
Moderately disagree	50,00%
Strongly disagree	50,00%
⊟ Services	6,82%
Moderately disagree	33,33%
Neither agree nor disagree	33,33%
Strongly disagree	33,33%
⊟ Tourism	2,27%
Moderately disagree	100,00%
⊟ Transportation and logistics	2,27%
Moderately agree	100,00%
Total Geral	100,00%

Figure 67: Area of work / Current own preparation

Source: Own elaboration

Rótulos de Linha	In your current functions/department, to what extent is your organization making use of AI/automation today?
⊕ Accommodation and food services	9,09%
Low	100,00%
⊕ Accounting	6,82%
High	33,33%
Low	66,67%
⊕ architecture	2,27%
Very low	100,00%
⊕ Audit and assurance	2,27%
Low	100,00%
⊕ Automotive and assembly	2,27%
High	100,00%
⊕ Banking	9,09%
High	50,00%
Low	50,00%
⊕ Biotechnology	2,27%
Low	100,00%
⊕ CSR consultancy	2,27%
Low	100,00%
⊕ Educational services	2,27%
Low	100,00%
⊕ Healthcare	9,09%
High	75,00%
Very low	25,00%
⊕ Information	2,27%
Low	100,00%
⊕ Information Technologies	2,27%
High	100,00%
⊕ Law	2,27%
Low	100,00%
⊕ Life Sciences	2,27%
Low	100,00%
⊕ Management	11,36%
Low	80,00%
Very low	20,00%
⊕ Marketing	6,82%
High	33,33%
Low	66,67%
⊕ Media and entertainment, Marketing	2,27%
Low	100,00%
⊕ Public and social sectors	4,55%
Very high	50,00%
Very low	50,00%
⊕ Research and development engineering	2,27%
Very low	100,00%
⊕ Retail	4,55%
Low	50,00%
Very low	50,00%
⊕ Services	6,82%
Low	33,33%
Very low	66,67%
⊕ Tourism	2,27%
Low	100,00%
⊕ Transportation and logistics	2,27%
Very low	100,00%
Total Geral	**100,00%**

Figure 68: Area of work / Extent to which organization uses automation in current functions (today)

Source: Own elaboration

Area of work / For your own functions/department, to what extent do you believe your organization will be making use of AI/automation in 5 years?	
Rótulos de Linha	For your own functions/department, to what extent do you believe your organization will be making use of AI/automation in 5 years?
⊚ Accommodation and food services	9,09%
High	25,00%
I don´t know	25,00%
Low	50,00%
⊚ Accounting	6,82%
High	33,33%
Low	66,67%
⊚ architecture	2,27%
Low	100,00%
⊚ Audit and assurance	2,27%
I don´t know	100,00%
⊚ Automotive and assembly	2,27%
Very high	100,00%
⊚ Banking	9,09%
High	50,00%
Low	50,00%
⊚ Biotechnology	2,27%
I don´t know	100,00%
⊚ CSR consultancy	2,27%
Very low	100,00%
⊚ Educational services	2,27%
Low	100,00%
⊚ Healthcare	9,09%
High	50,00%
I don´t know	25,00%
Low	25,00%
⊚ Information	2,27%
High	100,00%
⊚ Information Technologies	2,27%
High	100,00%
⊚ Law	2,27%
High	100,00%
⊚ Life Sciences	2,27%
Low	100,00%
⊚ Management	11,36%
High	60,00%
I don´t know	20,00%
Low	20,00%
⊚ Marketing	6,82%
High	33,33%
Low	33,33%
Very high	33,33%
⊚ Media and entertainment, Marketing	2,27%
I don´t know	100,00%
⊚ Public and social sectors	4,55%
I don´t know	50,00%
Very high	50,00%
⊚ Research and development engineering	2,27%
Very low	100,00%
⊚ Retail	4,55%
Low	100,00%
⊚ Services	6,82%
Low	66,67%
Very low	33,33%
⊚ Tourism	2,27%
Low	100,00%
⊚ Transportation and logistics	2,27%
I don´t know	100,00%
Total Geral	100,00%

Figure 69: Area of work / extent to which organization uses automation in current functions (5 years)

Source: Own elaboration

Area of work / Features you would most like to see in na AI-powered application in own functions	
Rótulos de Linha	Select the features you would most like to see in an AI-powered application in your own functions (choose 3)
⊚ Accommodation and food services	9,09%
Ability to analyze, Ability to predict, Ability to organize	25,00%
Ability to analyze, Ability to predict, Ability to simulate	25,00%
Ability to organize, Ability to simulate, Ability to automatize repetitive cognitive tasks	25,00%
Ability to predict, Ability to organize, Ability to automatize repetitive physical tasks	25,00%
⊚ Accounting	6,82%
Ability to predict, Ability to augment skills, Ability to gauge emotions	33,33%
Ability to predict, Ability to automatize repetitive cognitive tasks, Ability to automatize repetitive physical tasks	33,33%
Ability to predict, Ability to diagnose, Ability to organize	33,33%
⊚ architecture	2,27%
Ability to personalize, Ability to organize, Ability to simulate	100,00%
⊚ Audit and assurance	2,27%
Ability to analyze, Ability to organize, Ability to automatize repetitive physical tasks	100,00%
⊚ Automotive and assembly	2,27%
Ability to analyze, Ability to predict, Ability to automatize repetitive cognitive tasks	100,00%
⊚ Banking	9,09%
Ability to analyze, Ability to predict, Ability to diagnose	25,00%
Ability to predict, Ability to diagnose, Ability to automatize repetitive physical tasks	25,00%
Ability to predict, Ability to personalize, Ability to augment skills	25,00%
Ability to simulate, Ability to automatize repetitive cognitive tasks, Ability to automatize repetitive physical tasks	25,00%
⊚ Biotechnology	2,27%
Ability to predict, Ability to simulate, Ability to gauge emotions	100,00%
⊚ CSR consultancy	2,27%
Ability to simulate	100,00%
⊚ Educational services	2,27%
Ability to predict, Ability to diagnose, Ability to augment skills	100,00%
⊚ Healthcare	9,09%
Ability to analyze, Ability to augment skills, Ability to simulate	25,00%
Ability to analyze, Ability to diagnose, Ability to augment skills	25,00%
Ability to analyze, Ability to organize, Ability to automatize repetitive cognitive tasks	25,00%
Ability to analyze, Ability to predict, Ability to automatize repetitive cognitive tasks	25,00%
⊚ Information	2,27%
Ability to diagnose, Ability to organize, Ability to automatize repetitive physical tasks	100,00%
⊚ Information Technologies	2,27%
Ability to analyze, Ability to diagnose, Ability to automatize repetitive cognitive tasks	100,00%
⊚ Law	2,27%
Ability to analyze, Ability to organize, Ability to simulate	100,00%
⊚ Life Sciences	2,27%
Ability to automatize repetitive cognitive tasks	100,00%
⊚ Management	11,36%
Ability to analyze, Ability to personalize, Ability to organize	20,00%
Ability to analyze, Ability to predict, Ability to personalize, Ability to augment skills, Ability to simulate, Ability to automatize repetitive co|	20,00%
Ability to augment skills, Ability to automatize repetitive cognitive tasks, Ability to automatize repetitive physical tasks	20,00%
Ability to predict, Ability to diagnose, Ability to augment skills	20,00%
Ability to simulate, Ability to automatize repetitive cognitive tasks, Ability to automatize repetitive physical tasks	20,00%
⊚ Marketing	6,82%
Ability to analyze, Ability to diagnose, Ability to organize	33,33%
Ability to personalize, Ability to augment skills, Ability to automatize repetitive cognitive tasks	33,33%
Ability to predict, Ability to organize, Ability to automatize repetitive cognitive tasks	33,33%
⊚ Media and entertainment, Marketing	2,27%
Ability to analyze, Ability to predict, Ability to personalize, Ability to diagnose	100,00%
⊚ Public and social sectors	4,55%
Ability to analyze, Ability to diagnose, Ability to organize	50,00%
Ability to analyze, Ability to predict, Ability to automatize repetitive cognitive tasks	50,00%
⊚ Research and development engineering	2,27%
Ability to predict, Ability to augment skills, Ability to simulate	100,00%
⊚ Marketing	6,82%
Ability to analyze, Ability to diagnose, Ability to organize	33,33%
Ability to personalize, Ability to augment skills, Ability to automatize repetitive cognitive tasks	33,33%
Ability to predict, Ability to organize, Ability to automatize repetitive cognitive tasks	33,33%
⊚ Media and entertainment, Marketing	2,27%
Ability to analyze, Ability to predict, Ability to personalize, Ability to diagnose	100,00%
⊚ Public and social sectors	4,55%
Ability to analyze, Ability to diagnose, Ability to organize	50,00%
Ability to analyze, Ability to predict, Ability to automatize repetitive cognitive tasks	50,00%
⊚ Research and development engineering	2,27%
Ability to predict, Ability to augment skills, Ability to simulate	100,00%
⊚ Retail	4,55%
Ability to personalize, Ability to organize, Ability to simulate	50,00%
Ability to predict, Ability to simulate, Ability to automatize repetitive cognitive tasks	50,00%
⊚ Services	6,82%
Ability to analyze, Ability to predict, Ability to personalize	33,33%
Ability to organize, Ability to automatize repetitive cognitive tasks, Ability to automatize repetitive physical tasks	33,33%
Ability to organize, Ability to simulate, Ability to automatize repetitive physical tasks	33,33%
⊚ Tourism	2,27%
Ability to personalize, Ability to diagnose, Ability to augment skills	100,00%
⊚ Transportation and logistics	2,27%
Ability to analyze, Ability to organize, Ability to simulate	100,00%
Total Geral	**100,00%**

Figure 70: Area of work / Preference of AI-powered features in own function

Source: Own elaboration

Income / Features you would most like to see in na AI-powered application in own functions	
Rótulos de Linha	Select the features you would most like to see in an AI-powered application in your own functions (choose 3)
⊟ < 700€ (Minimum Portuguese Wage)	11,36%
Ability to analyze, Ability to predict, Ability to personalize	20,00%
Ability to analyze, Ability to predict, Ability to personalize, Ability to augment skills, Ability to simulate, Ability to automatize repetitive co|	20,00%
Ability to analyze, Ability to predict, Ability to simulate	20,00%
Ability to personalize, Ability to organize, Ability to simulate	40,00%
⊟ > 7500€	2,27%
Ability to augment skills, Ability to automatize repetitive cognitive tasks, Ability to automatize repetitive physical tasks	100,00%
⊟ 1501€ - 3000€	22,73%
Ability to analyze, Ability to diagnose, Ability to automatize repetitive cognitive tasks	10,00%
Ability to analyze, Ability to organize, Ability to simulate	10,00%
Ability to analyze, Ability to predict, Ability to automatize repetitive cognitive tasks	30,00%
Ability to diagnose, Ability to organize, Ability to automatize repetitive physical tasks	10,00%
Ability to organize, Ability to automatize repetitive cognitive tasks, Ability to automatize repetitive physical tasks	10,00%
Ability to predict, Ability to diagnose, Ability to augment skills	10,00%
Ability to simulate, Ability to automatize repetitive cognitive tasks, Ability to automatize repetitive physical tasks	20,00%
⊟ 3001€ - 5000€	2,27%
Ability to analyze, Ability to organize, Ability to simulate	100,00%
⊟ 5001€ - 7500€	2,27%
Ability to predict, Ability to diagnose, Ability to augment skills	100,00%
⊟ 700€ - 1500€	59,09%
Ability to analyze, Ability to augment skills, Ability to simulate	3,85%
Ability to analyze, Ability to diagnose, Ability to augment skills	3,85%
Ability to analyze, Ability to diagnose, Ability to organize	7,69%
Ability to analyze, Ability to organize, Ability to automatize repetitive cognitive tasks	3,85%
Ability to analyze, Ability to organize, Ability to automatize repetitive physical tasks	3,85%
Ability to analyze, Ability to personalize, Ability to organize	3,85%
Ability to analyze, Ability to predict, Ability to diagnose	3,85%
Ability to analyze, Ability to predict, Ability to organize	3,85%
Ability to analyze, Ability to predict, Ability to personalize, Ability to diagnose	3,85%
Ability to automatize repetitive cognitive tasks	3,85%
Ability to organize, Ability to simulate, Ability to automatize repetitive cognitive tasks	3,85%
Ability to organize, Ability to simulate, Ability to automatize repetitive physical tasks	3,85%
Ability to personalize, Ability to augment skills, Ability to automatize repetitive cognitive tasks	3,85%
Ability to personalize, Ability to diagnose, Ability to augment skills	3,85%
Ability to predict, Ability to augment skills, Ability to gauge emotions	3,85%
Ability to predict, Ability to augment skills, Ability to simulate	3,85%
Ability to predict, Ability to automatize repetitive cognitive tasks, Ability to automatize repetitive physical tasks	3,85%
Ability to predict, Ability to diagnose, Ability to automatize repetitive physical tasks	3,85%
Ability to predict, Ability to diagnose, Ability to organize	3,85%
Ability to predict, Ability to organize, Ability to automatize repetitive cognitive tasks	3,85%
Ability to predict, Ability to organize, Ability to automatize repetitive physical tasks	3,85%
Ability to predict, Ability to personalize, Ability to augment skills	3,85%
Ability to predict, Ability to simulate, Ability to automatize repetitive cognitive tasks	3,85%
Ability to predict, Ability to simulate, Ability to gauge emotions	3,85%
Ability to simulate	3,85%
Total Geral	**100,00%**

Figure 71: Level of income / Preference of AI-powered features in own function

Source: Own elaboration

Age / Within the next 20 years, robots/computers will do much of the work done by humans	
Rótulos de Linha	Within the next 20 years, robots/computers will --- do: [Much of the work done by humans]
⊟ > 49	9,09%
Probably	50,00%
Probably not	50,00%
⊟ 18 - 25	36,36%
I don't know	6,25%
Probably	68,75%
Probably not	25,00%
⊟ 26 - 33	47,73%
Definitely	9,52%
I don't know	23,81%
Probably	42,86%
Probably not	23,81%
⊟ 34 - 41	2,27%
Probably	100,00%
⊟ 42 - 49	4,55%
Probably not	100,00%
Total Geral	**100,00%**

Figure 72: Age / Work done by robots/computers in the next 20 years

Source: Own elaboration

12. / Within the next 20 years, robots/computers will do the type of work I do	
Rótulos de Linha ▼	Within the next 20 years, robots/computers will --- do: [The type of work I do]
Moderately agree	**27,27%**
Definitely not	25,00%
I don't know	16,67%
Probably	25,00%
Probably not	33,33%
Moderately disagree	**27,27%**
Definitely not	8,33%
I don't know	33,33%
Probably	25,00%
Probably not	33,33%
Neither agree nor disagree	**18,18%**
Definitely	12,50%
Definitely not	25,00%
I don't know	12,50%
Probably not	50,00%
Strongly agree	**11,36%**
Definitely not	20,00%
I don't know	20,00%
Probably	40,00%
Probably not	20,00%
Strongly disagree	**15,91%**
Definitely not	28,57%
Probably not	71,43%
Total Geral	**100,00%**

Figure 73: Currently preparing for individual consequences of AI / Work done by robots/computers in next 20 years (individual type of work)

Source: Own elaboration

Gender / Within the next 20 years, robots/computers will do much of the work done by humans	
Rótulos de Linha ▼	Within the next 20 years, robots/computers will --- do: [Much of the work done by humans]
Female	**56,82%**
I don't know	12,00%
Probably	56,00%
Probably not	32,00%
Male	**43,18%**
Definitely	10,53%
I don't know	15,79%
Probably	47,37%
Probably not	26,32%
Total Geral	**100,00%**

Figure 74: Gender / Work done by robots/computers in the next 20 years (work done by humans)

Source: Own elaboration

Area work / I have already lost a job or had pay hours reduced	
Rótulos de Linha ▼	I have already lost a job or had pay hours reduced because employers replaced my position (or some aspect of my job) with a machine, robot or computer program
⊟ Accommodation and food services	9,09%
No	100,00%
⊟ Accounting	6,82%
No	66,67%
Yes	33,33%
⊟ architecture	2,27%
No	100,00%
⊟ Audit and assurance	2,27%
No	100,00%
⊟ Automotive and assembly	2,27%
No	100,00%
⊟ Banking	9,09%
No	75,00%
Yes	25,00%
⊟ Biotechnology	2,27%
No	100,00%
⊟ CSR consultancy	2,27%
No	100,00%
⊟ Educational services	2,27%
No	100,00%
⊟ Healthcare	9,09%
No	100,00%
⊟ Information	2,27%
No	100,00%
⊟ Information Technologies	2,27%
No	100,00%
⊟ Law	2,27%
No	100,00%
⊟ Life Sciences	2,27%
No	100,00%
⊟ Management	11,36%
No	100,00%
⊟ Marketing	6,82%
No	100,00%
⊟ Media and entertainment, Marketing	2,27%
No	100,00%
⊟ Public and social sectors	4,55%
No	100,00%
⊟ Research and development engineering	2,27%
No	100,00%
⊟ Retail	4,55%
No	100,00%
⊟ Services	6,82%
No	100,00%
⊟ Tourism	2,27%
No	100,00%
⊟ Transportation and logistics	2,27%
No	100,00%
Total Geral	100,00%

Figure 75: Area of work / Reduction of pay hours

Source: Own elaboration

Income / I have already lost a job or had pay hours reduced	
Rótulos de Linha ▼	I have already lost a job or had pay hours reduced because employers replaced my position (or some aspect of my job) with a machine, robot or computer program
⊟ < 700€ (Minimum Portuguese Wage)	11,36%
No	100,00%
⊟ > 7500€	2,27%
No	100,00%
⊟ 1501€ - 3000€	22,73%
No	100,00%
⊟ 3001€ - 5000€	2,27%
No	100,00%
⊟ 5001€ - 7500€	2,27%
No	100,00%
⊟ 700€ - 1500€	59,09%
No	92,31%
Yes	7,69%
Total Geral	100,00%

Figure 76: Level of income / Reduction of pay hours

Source: Own elaboration

Area of work / To whom answered "yes": what effect did the change-over technologies have on your job?	
Rótulos de Linha	To whom answered "yes": What effect did the change-over technologies (AI, automation, robotization, others) have on your job?
⊟ Accommodation and food services	9,09%
I answered "No"	100,00%
⊟ Accounting	6,82%
I answered "No"	66,67%
I was prompted	33,33%
⊟ architecture	2,27%
I answered "No"	100,00%
⊟ Audit and assurance	2,27%
I answered "No"	100,00%
⊟ Automotive and assembly	2,27%
I answered "No"	100,00%
⊟ Banking	9,09%
I answered "No"	75,00%
I was transferred to another job	25,00%
⊟ Biotechnology	2,27%
I answered "No"	100,00%
⊟ CSR consultancy	2,27%
I answered "No"	100,00%
⊟ Educational services	2,27%
I answered "No"	100,00%
⊟ Healthcare	9,09%
I answered "No"	100,00%
⊟ Information	2,27%
I answered "No"	100,00%
⊟ Information Technologies	2,27%
I answered "No"	100,00%
⊟ Law	2,27%
I answered "No"	100,00%
⊟ Life Sciences	2,27%
I answered "No"	100,00%
⊟ Management	11,36%
I answered "No"	100,00%
⊟ Marketing	6,82%
I answered "No"	100,00%
⊟ Media and entertainment, Marketing	2,27%
I answered "No"	100,00%
⊟ Public and social sectors	4,55%
I answered "No"	100,00%
⊟ Research and development engineering	2,27%
I answered "No"	100,00%
⊟ Retail	4,55%
I answered "No"	100,00%
⊟ Services	6,82%
I answered "No"	100,00%
⊟ Tourism	2,27%
I answered "No"	100,00%
⊟ Transportation and logistics	2,27%
I answered "No"	100,00%
Total Geral	100,00%

Figure 77: Area of work / Effects of change-over on job

Source: Own elaboration

Age / I am --- about losing my job	
Rótulos de Linha	I am --- about losing my job
⊟ > 49	9,09%
Not concerned at all	75,00%
Not very concerned	25,00%
⊟ 18 - 25	36,36%
Not concerned at all	43,75%
Not very concerned	50,00%
Very concerned	6,25%
⊟ 26 - 33	47,73%
A little concerned	19,05%
Not concerned at all	28,57%
Not very concerned	42,86%
Very concerned	9,52%
⊟ 34 - 41	2,27%
Very concerned	100,00%
⊟ 42 - 49	4,55%
A little concerned	50,00%
Very concerned	50,00%
Total Geral	100,00%

Figure 78: Age / Effects of change-over on job

Source: Own elaboration

Age / To whom answered "yes": what effect did the change-over technologies have on your job?	
Rótulos de Linha	Contagem de 21. To whom answered "yes": What effect did the change-over technologies (AI, automation, robotization, others) have on your job?
> 49	9,09%
I answered "No"	100,00%
18 - 25	36,36%
I answered "No"	100,00%
26 - 33	47,73%
I answered "No"	95,24%
I was prompted	4,76%
34 - 41	2,27%
I answered "No"	100,00%
42 - 49	4,55%
I answered "No"	50,00%
I was transferred to another job	50,00%
Total Geral	100,00%

Figure 79: Age / Concern about losing job

Source: Own elaboration

Gender / I am --- about losing my job	
Rótulos de Linha	I am --- about losing my job
Female	56,82%
A little concerned	8,00%
Not concerned at all	32,00%
Not very concerned	48,00%
Very concerned	12,00%
Male	43,18%
A little concerned	15,79%
Not concerned at all	42,11%
Not very concerned	31,58%
Very concerned	10,53%
Total Geral	100,00%

Figure 80: Gender / Concern about losing job

Source: Own elaboration

Area work / I am --- about losing my job	
Rótulos de Linha	**I am --- about losing my job**
Accommodation and food services	**9,09%**
A little concerned	25,00%
Not concerned at all	50,00%
Very concerned	25,00%
Accounting	**6,82%**
A little concerned	66,67%
Not very concerned	33,33%
architecture	**2,27%**
Not very concerned	100,00%
Audit and assurance	**2,27%**
Not very concerned	100,00%
Automotive and assembly	**2,27%**
Not very concerned	100,00%
Banking	**9,09%**
A little concerned	25,00%
Not concerned at all	25,00%
Not very concerned	25,00%
Very concerned	25,00%
Biotechnology	**2,27%**
Not concerned at all	100,00%
CSR consultancy	**2,27%**
Not very concerned	100,00%
Educational services	**2,27%**
Not concerned at all	100,00%
Healthcare	**9,09%**
Not concerned at all	25,00%
Not very concerned	50,00%
Very concerned	25,00%
Information	**2,27%**
Not concerned at all	100,00%
Information Technologies	**2,27%**
Not concerned at all	100,00%
Law	**2,27%**
Not very concerned	100,00%
Life Sciences	**2,27%**
Not very concerned	100,00%
Management	**11,36%**
Not concerned at all	40,00%
Not very concerned	20,00%
Very concerned	40,00%
Marketing	**6,82%**
Not concerned at all	33,33%
Not very concerned	66,67%
Media and entertainment, Marketing	**2,27%**
Not very concerned	100,00%
Public and social sectors	**4,55%**
A little concerned	50,00%
Not concerned at all	50,00%
Research and development engineering	**2,27%**
Not concerned at all	100,00%
Retail	**4,55%**
Not concerned at all	50,00%
Not very concerned	50,00%
Services	**6,82%**
Not concerned at all	33,33%
Not very concerned	66,67%
Tourism	**2,27%**
Not very concerned	100,00%
Transportation and logistics	**2,27%**
Not concerned at all	100,00%
Total Geral	**100,00%**

Figure 81: Area of work / Concern about losing job

Source: Own elaboration

Regarding human capital, and considering the technologies of AI: / I am --- about losing my job	
Rótulos de Linha	**I am --- about losing my job**
⊟ I'm acquainted and interested about the im	**61,36%**
A little concerned	11,11%
Not concerned at all	29,63%
Not very concerned	51,85%
Very concerned	7,41%
⊟ I'm acquainted to the subjects; try to under	**36,36%**
A little concerned	12,50%
Not concerned at all	50,00%
Not very concerned	18,75%
Very concerned	18,75%
⊟ I'm curious	**2,27%**
Not very concerned	100,00%
Total Geral	**100,00%**

Figure 82: Human capital and AI / Concern about losing job

Source: Own elaboration

I am currently preparing myself to handle the individual consequences of AI and/or automation in my job / I am --- about losing my job	
Rótulos de Linha	**I am --- about losing my job**
⊟ **Moderately agree**	**27,27%**
A little concerned	25,00%
Not concerned at all	33,33%
Not very concerned	25,00%
Very concerned	16,67%
⊟ **Moderately disagree**	**27,27%**
A little concerned	16,67%
Not concerned at all	33,33%
Not very concerned	33,33%
Very concerned	16,67%
⊟ **Neither agree nor disagree**	**18,18%**
Not concerned at all	50,00%
Not very concerned	50,00%
⊟ **Strongly agree**	**11,36%**
Not concerned at all	40,00%
Not very concerned	40,00%
Very concerned	20,00%
⊟ **Strongly disagree**	**15,91%**
Not concerned at all	28,57%
Not very concerned	71,43%
Total Geral	**100,00%**

Figure   83: Current preparation to handle consequences of automation / Concern about losing job

Source: Own elaboration

Age / I believe that the new technologic trends will affect my job in the next years	
Rótulos de Linha	I believe that the new technologic trends (AI, automation, robotics, others) will affect my job in the next years
⊟ > 49	9,09%
> 6	50,00%
3 to 4	25,00%
5 to 6	25,00%
⊟ 18 - 25	36,36%
> 6	31,25%
3 to 4	18,75%
5 to 6	25,00%
Never	25,00%
⊟ 26 - 33	47,73%
> 6	57,14%
1 to 2	4,76%
3 to 4	14,29%
Never	23,81%
⊟ 34 - 41	2,27%
5 to 6	100,00%
⊟ 42 - 49	4,55%
1 to 2	50,00%
3 to 4	50,00%
Total Geral	**100,00%**

Figure 84: Age / Belief that technologic trends will affect own job

Source: Own elaboration

Gender / I believe that the new technologic trends will affect my job in the next years	
Rótulos de Linha	I believe that the new technologic trends (AI, automation, robotics, others) will affect my job in the next years
⊟ **Female**	**56,82%**
> 6	48,00%
1 to 2	4,00%
3 to 4	16,00%
5 to 6	12,00%
Never	20,00%
⊟ **Male**	**43,18%**
> 6	36,84%
1 to 2	5,26%
3 to 4	21,05%
5 to 6	15,79%
Never	21,05%
Total Geral	**100,00%**

Figure 85: Gender / Belief that technologic trends will affect own job

Source: Own elaboration

Area work / I believe that the new technologic trends will affect my job in the next years	
Rótulos de Linha	I believe that the new technologic trends (AI, automation, robotics, others) will affect my job in the next years
⊟ Accommodation and food se	9,09%
> 6	50,00%
3 to 4	25,00%
Never	25,00%
⊟ Accounting	6,82%
> 6	33,33%
3 to 4	33,33%
5 to 6	33,33%
⊟ architecture	2,27%
> 6	100,00%
⊟ Audit and assurance	2,27%
> 6	100,00%
⊟ Automotive and assembly	2,27%
5 to 6	100,00%
⊟ Banking	9,09%
> 6	25,00%
3 to 4	50,00%
5 to 6	25,00%
⊟ Biotechnology	2,27%
5 to 6	100,00%
⊟ CSR consultancy	2,27%
Never	100,00%
⊟ Educational services	2,27%
3 to 4	100,00%
⊟ Healthcare	9,09%
> 6	75,00%
3 to 4	25,00%
⊟ Information	2,27%
Never	100,00%
⊟ Information Technologies	2,27%
1 to 2	100,00%
⊟ Law	2,27%
3 to 4	100,00%
⊟ Life Sciences	2,27%
Never	100,00%
⊟ Management	11,36%
> 6	40,00%
3 to 4	20,00%
5 to 6	40,00%
⊟ Marketing	6,82%
> 6	66,67%
Never	33,33%
⊟ Media and entertainment, M	2,27%
Never	100,00%
⊟ Public and social sectors	4,55%
1 to 2	50,00%
Never	50,00%
⊟ Research and development e	2,27%
Never	100,00%
⊟ Retail	4,55%
> 6	100,00%
⊟ Services	6,82%
> 6	66,67%
Never	33,33%
⊟ Tourism	2,27%
> 6	100,00%
⊟ Transportation and logistics	2,27%
> 6	100,00%
Total Geral	**100,00%**

Figure 86: Area of work / Belief that technologic trends will affect own job

Source: Own elaboration

Within the next 20 years, robots/computers will do the type of work I do / I believe that the new technologic trends will affect my job in the next years	I believe that the new technologic trends (AI, automation, robotics, others) will affect my job in the next years
Rótulos de Linha	
Definitely	2,27%
3 to 4	100,00%
Definitely not	20,45%
> 6	11,11%
1 to 2	22,22%
3 to 4	11,11%
5 to 6	22,22%
Never	33,33%
I don't know	18,18%
> 6	87,50%
Never	12,50%
Probably	18,18%
> 6	37,50%
3 to 4	25,00%
5 to 6	37,50%
Probably not	40,91%
> 6	44,44%
3 to 4	22,22%
5 to 6	5,56%
Never	27,78%
Total Geral	100,00%

Figure 87: Within the next 20 years robots/computer will do the type of work I do / Belief that technologic trends will affect own job

Source: Own elaboration

I am --- about losing my job / I believe that the new technologic trends will affect my job in the next years	I believe that the new technologic trends (AI, automation, robotics, others) will affect my job in the next years
Rótulos de Linha	
A little concerned	11,36%
> 6	60,00%
1 to 2	20,00%
3 to 4	20,00%
Not concerned at all	36,36%
> 6	25,00%
1 to 2	6,25%
3 to 4	18,75%
5 to 6	18,75%
Never	31,25%
Not very concerned	40,91%
> 6	50,00%
3 to 4	16,67%
5 to 6	11,11%
Never	22,22%
Very concerned	11,36%
> 6	60,00%
3 to 4	20,00%
5 to 6	20,00%
Total Geral	100,00%

Figure 88: Concern about losing job / Belief that technologic trends will affect own job

Source: Own elaboration

Age/ Taking everything into account, how satisfied are you with your current job?	
Rótulos de Linha ▼	Taking everything into account, how satisfied are you with your current job?
⊟ > 49	9,09%
Neutral	25,00%
Satisfied	25,00%
Unsatisfied	25,00%
Very satisfied	25,00%
⊟ 18 - 25	36,36%
Neutral	18,75%
Satisfied	56,25%
Unsatisfied	12,50%
Very satisfied	12,50%
⊟ 26 - 33	47,73%
Neutral	23,81%
Satisfied	33,33%
Unsatisfied	9,52%
Very satisfied	33,33%
⊟ 34 - 41	2,27%
Neutral	100,00%
⊟ 42 - 49	4,55%
Neutral	100,00%
Total Geral	**100,00%**

Figure 89: Age / Job satisfaction

Source: Own elaboration

Gender / Taking everything into account, how satisfied are you with your current job?	
Rótulos de Linha ▼	Taking everything into account, how satisfied are you with your current job?
⊟ **Female**	**56,82%**
Neutral	36,00%
Satisfied	32,00%
Unsatisfied	16,00%
Very satisfied	16,00%
⊟ **Male**	**43,18%**
Neutral	15,79%
Satisfied	47,37%
Unsatisfied	5,26%
Very satisfied	31,58%
Total Geral	**100,00%**

Figure 90: Gender / Job satisfaction

Source: Own elaboration

Rótulos de Linha	Taking everything into account, how satisfied are you with your current job?
⊟ Accommodation and food services	9,09%
Neutral	25,00%
Satisfied	25,00%
Unsatisfied	25,00%
Very satisfied	25,00%
⊟ Accounting	6,82%
Neutral	33,33%
Satisfied	33,33%
Unsatisfied	33,33%
⊟ architecture	2,27%
Neutral	100,00%
⊟ Audit and assurance	2,27%
Satisfied	100,00%
⊟ Automotive and assembly	2,27%
Satisfied	100,00%
⊟ Banking	9,09%
Neutral	50,00%
Satisfied	25,00%
Very satisfied	25,00%
⊟ Biotechnology	2,27%
Satisfied	100,00%
⊟ CSR consultancy	2,27%
Very satisfied	100,00%
⊟ Educational services	2,27%
Satisfied	100,00%
⊟ Healthcare	9,09%
Satisfied	50,00%
Unsatisfied	25,00%
Very satisfied	25,00%
⊟ Information	2,27%
Satisfied	100,00%
⊟ Information Technologies	2,27%
Very satisfied	100,00%
⊟ Law	2,27%
Very satisfied	100,00%
⊟ Life Sciences	2,27%
Satisfied	100,00%
⊟ Management	11,36%
Neutral	20,00%
Satisfied	20,00%
Very satisfied	60,00%
⊟ Marketing	6,82%
Satisfied	100,00%
⊟ Media and entertainment, Marketing	2,27%
Neutral	100,00%
⊟ Public and social sectors	4,55%
Neutral	50,00%
Very satisfied	50,00%
⊟ Research and development engineer	2,27%
Satisfied	100,00%
⊟ Retail	4,55%
Neutral	50,00%
Unsatisfied	50,00%
⊟ Services	6,82%
Neutral	100,00%
⊟ Tourism	2,27%
Satisfied	100,00%
⊟ Transportation and logistics	2,27%
Unsatisfied	100,00%
Total Geral	**100,00%**

Figure 91: Area of work / Job satisfaction

Source: Own elaboration

Income / Taking everything into account, how satisfied are you with your current job?	
Rótulos de Linha ▽	**Taking everything into account, how satisfied are you with your current job?**
⊟ < 700€	**11,36%**
Neutral	60,00%
Satisfied	20,00%
Unsatisfied	20,00%
⊟ > 7500€	**2,27%**
Very satisfied	100,00%
⊟ 1501€ - 3000€	**22,73%**
Neutral	20,00%
Satisfied	40,00%
Unsatisfied	10,00%
Very satisfied	30,00%
⊟ 3001€ - 5000€	**2,27%**
Very satisfied	100,00%
⊟ 5001€ - 7500€	**2,27%**
Very satisfied	100,00%
⊟ 700€ - 1500€	**59,09%**
Neutral	26,92%
Satisfied	46,15%
Unsatisfied	11,54%
Very satisfied	15,38%
Total Geral	**100,00%**

Figure 92: Income / Job satisfaction

Source: Own elaboration

I am --- about losing my job / Taking everything into account, how satisfied are you with your current job?	
Rótulos de Linha ▽	**Taking everything into account, how satisfied are you with your current job?**
⊟ A little concerned	**11,36%**
Neutral	60,00%
Satisfied	20,00%
Unsatisfied	20,00%
⊟ Not concerned at all	**36,36%**
Neutral	12,50%
Satisfied	37,50%
Unsatisfied	6,25%
Very satisfied	43,75%
⊟ Not very concerned	**40,91%**
Neutral	27,78%
Satisfied	44,44%
Unsatisfied	11,11%
Very satisfied	16,67%
⊟ Very concerned	**11,36%**
Neutral	40,00%
Satisfied	40,00%
Unsatisfied	20,00%
Total Geral	**100,00%**

Figure 93: Concern about losing job / Job satisfaction

Source: Own elaboration

Rótulos de Linha	To your notion, to what extent is your organization technology-oriented? (Being 1 - to a very limited extent; 5 - to a very large extent)
⊕ Accommodation and food services	**6,67%**
2	40,00%
3	60,00%
⊕ Accounting	**6,67%**
3	60,00%
4	40,00%
⊕ architecture	**2,00%**
3	100,00%
⊕ Audit and assurance	**3,33%**
5	100,00%
⊕ Automotive and assembly	**3,33%**
5	100,00%
⊕ Banking	**9,33%**
2	14,29%
4	85,71%
⊕ Biotechnology	**2,67%**
4	100,00%
⊕ CSR consultancy	**2,00%**
3	100,00%
⊕ Educational services	**2,00%**
3	100,00%
⊕ Healthcare	**9,33%**
2	14,29%
3	21,43%
4	28,57%
5	35,71%
⊕ Information	**3,33%**
5	100,00%
⊕ Information Technologies	**3,33%**
5	100,00%
⊕ Law	**2,67%**
4	100,00%
⊕ Life Sciences	**2,67%**
4	100,00%
⊕ Management	**10,67%**
2	12,50%
3	37,50%
4	50,00%
⊕ Marketing	**7,33%**
3	27,27%
4	72,73%
⊕ Media and entertainment, Marketing	**2,00%**
3	100,00%
⊕ Public and social sectors	**4,00%**
1	16,67%
5	83,33%
⊕ Research and development engineering	**3,33%**
5	100,00%
⊕ Retail	**2,00%**
1	33,33%
2	66,67%
⊕ Services	**6,67%**
3	60,00%
4	40,00%
⊕ Tourism	**3,33%**
5	100,00%
⊕ Transportation and logistics	**1,33%**
2	100,00%
Total Geral	**100,00%**

Figure 94: Area of work / Extent to which company is technology-oriented

Source: Own elaboration

Income / To your notion, to what extent is your organization technology-oriented?	
Rótulos de Linha	To your notion, to what extent is your organization technology-oriented? (Being 1 - to a very limited extent; 5 - to a very large extent)
⊟ < 700€	9,33%
1	7,14%
3	64,29%
4	28,57%
⊟ > 7500€	2,00%
3	100,00%
⊟ 1501€ - 3000€	25,33%
2	10,53%
3	15,79%
4	21,05%
5	52,63%
⊟ 3001€ - 5000€	2,67%
4	100,00%
⊟ 5001€ - 7500€	1,33%
2	100,00%
⊟ 700€ - 1500€	59,33%
1	1,12%
2	8,99%
3	26,97%
4	40,45%
5	22,47%
Total Geral	100,00%

Figure 95: Income / Extent to which company is technologically-oriented

Source: Own elaboration

In your current functions/department, to what extent is your organization making use of AI/automation today? / To your notion, to what extent is your organization technology-oriented?	
Rótulos de Linha	Soma de 28. To your notion, to what extent is your organization technology-oriented? (Being 1 - to a very limited extent; 5 - to a very large extent)
⊟ High	24,67%
3	16,22%
4	43,24%
5	40,54%
⊟ Low	57,33%
2	9,30%
3	31,40%
4	41,86%
5	17,44%
⊟ Very high	0,67%
1	100,00%
⊟ Very low	17,33%
1	3,85%
2	23,08%
3	34,62%
5	38,46%
Total Geral	100,00%

Figure 96: Extent to which organization uses automation today in own functions / Extent to which company is technologically-oriented

Source: Own elaboration

For your own functions/department, to what extent do you believe your organization will be making use of AI/automation in 5 years? / To your notion, to what extent is your organization technology-oriented?	
Rótulos de Linha	To your notion, to what extent is your organization technology-oriented? (Being 1 - to a very limited extent; 5 - to a very large extent)
⊟ High	32,67%
2	4,08%
3	18,37%
4	57,14%
5	20,41%
⊟ I don´t know	20,00%
2	6,67%
3	30,00%
4	13,33%
5	50,00%
⊟ Low	33,33%
1	2,00%
2	20,00%
3	36,00%
4	32,00%
5	10,00%
⊟ Very high	6,67%
1	10,00%
4	40,00%
5	50,00%
⊟ Very low	7,33%
3	54,55%
5	45,45%
Total Geral	100,00%

Figure 97: Extent to which organization will use automation in 5 years in own functions / Extent to which company is technologically-oriented

Source: Own elaboration

Area work / To what extent do you agree your organization sees automation as na important tool to improve quality, improve lead-time, reduce cost etc?	
Rótulos de Linha	To what extent do you agree your organization sees automation as an important tool to improve quality, improve lead-time, reduce cost, etc.?
⊟ Accommodation and food services	9,09%
Low	75,00%
Very high	25,00%
⊟ Accounting	6,82%
I don't know	33,33%
Low	33,33%
Very high	33,33%
⊟ architecture	2,27%
Low	100,00%
⊟ Audit and assurance	2,27%
High	100,00%
⊟ Automotive and assembly	2,27%
Very high	100,00%
⊟ Banking	9,09%
High	75,00%
Low	25,00%
⊟ Biotechnology	2,27%
Very high	100,00%
⊟ CSR consultancy	2,27%
Low	100,00%
⊟ Educational services	2,27%
Low	100,00%
⊟ Healthcare	9,09%
High	75,00%
Very high	25,00%
⊟ Information	2,27%
Very high	100,00%
⊟ Information Technologies	2,27%
Very high	100,00%
⊟ Law	2,27%
High	100,00%
⊟ Life Sciences	2,27%
I don't know	100,00%
⊟ Management	11,36%
High	40,00%
Low	40,00%
Very high	20,00%
⊟ Marketing	6,82%
High	66,67%
Low	33,33%
⊟ Media and entertainment, Marketing	2,27%
Very low	100,00%
⊟ Public and social sectors	4,55%
High	50,00%
Very low	50,00%
⊟ Research and development engineering	2,27%
High	100,00%
⊟ Retail	4,55%
Low	50,00%
Very low	50,00%
⊟ Services	6,82%
High	33,33%
Low	66,67%
⊟ Tourism	2,27%
Low	100,00%
⊟ Transportation and logistics	2,27%
High	100,00%
Total Geral	100,00%

Figure 98: Area of work / extent to which organization sees automation as important tool

Source: Own elaboration

Regarding human capital, and considering the technologies of AI / To what extent do you agree your organization sees automation as na important tool to improve quality, improve lead-time, reduce cost etc?	
Rótulos de Linha	To what extent do you agree your organization sees automation as an important tool to improve quality, improve lead-time, reduce cost, etc.?
⊟ I'm acquainted and interested about the impacts but do not seek to know more about it than wha	61,36%
High	37,04%
I don't know	7,41%
Low	44,44%
Very low	11,11%
⊟ I'm acquainted to the subjects; try to understand and seek further research of their various dimen	36,36%
High	37,50%
Low	12,50%
Very high	50,00%
⊟ I'm curious	2,27%
Low	100,00%
Total Geral	100,00%

Figure 99: Human capital and AI Technologies / extent to which organization sees automation as important tool

Source: Own elaboration

Area work / To your notion, when will automation of tasks/activities become relevant to your industry?	
Rótulos de Linha ▼	To your notion, when will automation of tasks/activity become relevant to your industry?
⊟ Accommodation and f	9,09%
>5 years	25,00%
1-4 years	50,00%
Don't know	25,00%
⊟ Accounting	6,82%
>5 years	66,67%
1-4 years	33,33%
⊟ architecture	2,27%
>5 years	100,00%
⊟ Audit and assurance	2,27%
>5 years	100,00%
⊟ Automotive and asser	2,27%
Already relevant	100,00%
⊟ Banking	9,09%
1-4 years	25,00%
Already relevant	75,00%
⊟ Biotechnology	2,27%
1-4 years	100,00%
⊟ CSR consultancy	2,27%
Don't know	100,00%
⊟ Educational services	2,27%
Don't know	100,00%
⊟ Healthcare	9,09%
>5 years	25,00%
1-4 years	50,00%
Don't know	25,00%
⊟ Information	2,27%
Already relevant	100,00%
⊟ Information Technolo	2,27%
Already relevant	100,00%
⊟ Law	2,27%
Already relevant	100,00%
⊟ Life Sciences	2,27%
Don't know	100,00%
⊟ Management	11,36%
>5 years	40,00%
Already relevant	40,00%
Don't know	20,00%
⊟ Marketing	6,82%
1-4 years	33,33%
Already relevant	66,67%
⊟ Media and entertainn	2,27%
>5 years	100,00%
⊟ Public and social secto	4,55%
1-4 years	50,00%
Don't know	50,00%
⊟ Research and develop	2,27%
Don't know	100,00%
⊟ Retail	4,55%
>5 years	50,00%
Already relevant	50,00%
⊟ Services	6,82%
>5 years	33,33%
Already relevant	33,33%
Don't know	33,33%
⊟ Tourism	2,27%
>5 years	100,00%
⊟ Transportation and lo|	2,27%
Already relevant	100,00%
Total Geral	**100,00%**

Figure 100: Area of work / Number of years for automation of tasks/activities to become relevant in industry

Source: Own elaboration

Within the next 20 years, robots/computers will do the type of work I do / To your notion, when will these trends become relevant to your industry?	
Rótulos de Linha To your notion, when will automation of tasks/activity become relevant to your industry?	
Definitely	**2,27%**
Already relevant	100,00%
Definitely not	**20,45%**
>5 years	11,11%
Already relevant	33,33%
Don't know	55,56%
I don't know	**18,18%**
>5 years	37,50%
1-4 years	25,00%
Already relevant	25,00%
Don't know	12,50%
Probably	**18,18%**
>5 years	50,00%
1-4 years	12,50%
Already relevant	37,50%
Probably not	**40,91%**
>5 years	22,22%
1-4 years	33,33%
Already relevant	27,78%
Don't know	16,67%
Total Geral	**100,00%**

Figure 101: Level to which robots/computers will do individuals' type of work / When will trends become relevant to industry

Source: Own elaboration

I am --- about losing my job / To your notion, when will these trends become relevant to your industry?	
Rótulos de Linha To your notion, when will automation of tasks/activity become relevant to your industry?	
A little concerned	**11,36%**
>5 years	60,00%
Already relevant	20,00%
Don't know	20,00%
Not concerned at all	**36,36%**
>5 years	12,50%
1-4 years	25,00%
Already relevant	37,50%
Don't know	25,00%
Not very concerned	**40,91%**
>5 years	33,33%
1-4 years	11,11%
Already relevant	33,33%
Don't know	22,22%
Very concerned	**11,36%**
>5 years	20,00%
1-4 years	60,00%
Already relevant	20,00%
Total Geral	**100,00%**

Figure 102: Concern about losing job / When will trends become relevant to industry

Source: Own elaboration

I am --- about losing my job / How do you think technology will affect the number of jobs in your organization over the next 5 years?	
Rótulos de Linha	How do you think technology will affect the number of jobs in your organization over the next 5 years?
⊟A little concerned	**11,36%**
There will be a significant net loss in jobs	20,00%
There will be a slight net loss in jobs	60,00%
There will not be a significant loss or gain in jobs	20,00%
⊟Not concerned at all	**36,36%**
There will be a significant gain in jobs	6,25%
There will be a significant net loss in jobs	6,25%
There will be a slight gain in jobs	6,25%
There will be a slight net loss in jobs	18,75%
There will not be a significant loss or gain in jobs	62,50%
⊟Not very concerned	**40,91%**
There will be a significant net loss in jobs	5,56%
There will be a slight net loss in jobs	50,00%
There will not be a significant loss or gain in jobs	44,44%
⊟Very concerned	**11,36%**
There will be a significant net loss in jobs	60,00%
There will be a slight gain in jobs	20,00%
There will be a slight net loss in jobs	20,00%
Total Geral	**100,00%**

Figure 103: Concern about losing job / How technology will affect number of jobs in the next 5 years

Source: Own elaboration

Age / In the event that robots/computers are capable of doing many human jobs, who's responsible for taking care of the consequences?	
Rótulos de Linha	In the event that robots and/or computers are capable of doing many human jobs, who's responsible for taking care of the consequences?
⊟> 49	**9,09%**
Both options combined	50,00%
The Government has the obligation to take care of displaced workers, whether or not it means raising taxes exponentially	50,00%
⊟18 - 25	**36,36%**
Both options combined	62,50%
Individuals have the obligation of taking care for their own well-being, even if machines have already taken many jobs	18,75%
The Government has the obligation to take care of displaced workers, whether or not it means raising taxes exponentially	18,75%
⊟26 - 33	**47,73%**
Both options combined	61,90%
Either option	4,76%
Individuals have the obligation of taking care for their own well-being, even if machines have already taken many jobs	23,81%
The Government has the obligation to take care of displaced workers, whether or not it means raising taxes exponentially	9,52%
⊟34 - 41	**2,27%**
Both options combined	100,00%
⊟42 - 49	**4,55%**
The Government has the obligation to take care of displaced workers, whether or not it means raising taxes exponentially	100,00%
Total Geral	**100,00%**

Figure 104: Age / Responsibility for displaced jobs due to automation

Source: Own elaboration

Gender / In the event that robots/computers are capable of doing many human jobs, who's responsible for taking care of the consequences?	
Rótulos de Linha	In the event that robots and/or computers are capable of doing many human jobs, who's responsible for taking care of the consequences?
⊟ Female	56,82%
Both options combined	64,00%
Either option	4,00%
Individuals have the obligation of taking care for their own well-being, even if machines have already taken many jobs	8,00%
The Government has the obligation to take care of displaced workers, whether or not it means raising taxes exponentially	24,00%
⊟ Male	43,18%
Both options combined	52,63%
Individuals have the obligation of taking care for their own well-being, even if machines have already taken many jobs	31,58%
The Government has the obligation to take care of displaced workers, whether or not it means raising taxes exponentially	15,79%
Total Geral	100,00%

Figure 105: Gender / Responsibility for displaced jobs due to automation

Source: Own elaboration

Income / In the event that robots/computers are capable of doing many human jobs, who's responsible for taking care of the consequences?	
Rótulos de Linha	In the event that robots and/or computers are capable of doing many human jobs, who's responsible for taking care of the consequences?
⊟ < 700€	11,36%
Both options combined	100,00%
⊟ > 7500€	2,27%
Both options combined	100,00%
⊟ 1501€ - 3000€	22,73%
Both options combined	50,00%
Either option	10,00%
Individuals have the obligation of taking care for their own well-being, even if machines have already taken many jobs	20,00%
The Government has the obligation to take care of displaced workers, whether or not it means raising taxes exponentially	20,00%
⊟ 3001€ - 5000€	2,27%
Both options combined	100,00%
⊟ 5001€ - 7500€	2,27%
Individuals have the obligation of taking care for their own well-being, even if machines have already taken many jobs	100,00%
⊟ 700€ - 1500€	59,09%
Both options combined	53,85%
Individuals have the obligation of taking care for their own well-being, even if machines have already taken many jobs	19,23%
The Government has the obligation to take care of displaced workers, whether or not it means raising taxes exponentially	26,92%
Total Geral	100,00%

Figure 106: Income / Responsibility for displaced jobs due to automation

Source: Own elaboration

Regarding human capital, and considering the technologies of AI: / In the event that robots/computers are capable of doing many human jobs, who's responsible for taking care of the consequences?	
Rótulos de Linha	In the event that robots and/or computers are capable of doing many human jobs, who's responsible for taking care of the consequences?
⊟ I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communicati	61,36%
Both options combined	59,26%
Individuals have the obligation of taking care for their own well-being, even if machines have already taken many jobs	18,52%
The Government has the obligation to take care of displaced workers, whether or not it means raising taxes exponentially	22,22%
⊟ I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the	36,36%
Both options combined	62,50%
Either option	6,25%
Individuals have the obligation of taking care for their own well-being, even if machines have already taken many jobs	18,75%
The Government has the obligation to take care of displaced workers, whether or not it means raising taxes exponentially	12,50%
⊟ I'm curious	2,27%
The Government has the obligation to take care of displaced workers, whether or not it means raising taxes exponentially	100,00%
Total Geral	100,00%

Figure 107: Human capital and AI technologies / Responsibility for displaced jobs due to automation

Source: Own elaboration

Area work / To your notion, what portion of the internal tasks and processes will be automated in the next 3-5 years? (in your organization)	
Rótulos de Linha ▼	To your notion, what portion of the internal tasks and processes will be automated in the next 3-5 years? [In your organization]
⊙ Accommodation a	**9,09%**
1 - 25%	50,00%
26 - 50%	50,00%
⊙ Accounting	**6,82%**
1 - 25%	66,67%
26 - 50%	33,33%
⊙ architecture	**2,27%**
1 - 25%	100,00%
⊙ Audit and assuranc	**2,27%**
1 - 25%	100,00%
⊙ Automotive and as	**2,27%**
26 - 50%	100,00%
⊙ Banking	**9,09%**
1 - 25%	75,00%
26 - 50%	25,00%
⊙ Biotechnology	**2,27%**
26 - 50%	100,00%
⊙ CSR consultancy	**2,27%**
1 - 25%	100,00%
⊙ Educational servic	**2,27%**
1 - 25%	100,00%
⊙ Healthcare	**9,09%**
1 - 25%	50,00%
26 - 50%	50,00%
⊙ Information	**2,27%**
1 - 25%	100,00%
⊙ Information Techn	**2,27%**
26 - 50%	100,00%
⊙ Law	**2,27%**
1 - 25%	100,00%
⊙ Life Sciences	**2,27%**
1 - 25%	100,00%
⊙ Management	**11,36%**
1 - 25%	40,00%
26 - 50%	40,00%
51 - 75%	20,00%
⊙ Marketing	**6,82%**
0	33,33%
1 - 25%	33,33%
26 - 50%	33,33%
⊙ Media and enterta	**2,27%**
1 - 25%	100,00%
⊙ Public and social s	**4,55%**
1 - 25%	100,00%
⊙ Research and deve	**2,27%**
1 - 25%	100,00%
⊙ Retail	**4,55%**
1 - 25%	100,00%
⊙ Services	**6,82%**
1 - 25%	66,67%
51 - 75%	33,33%
⊙ Tourism	**2,27%**
1 - 25%	100,00%
⊙ Transportation and	**2,27%**
1 - 25%	100,00%
Total Geral	**100,00%**

Figure 108: Area of work / Portion of internal tasks/processes that will be automated in the next 3-5 years in own organization

Source: Own elaboration

Age / 38. To your notion, after this questionnaire, consider one of the following statements:	
Rótulos de Linha	To your notion, after this questionnaire, consider one of the following statements:
⊟ > 49	9,09%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	75,00%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	25,00%
⊟ 18 - 25	36,36%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	81,25%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	18,75%
⊟ 26 - 33	47,73%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	71,43%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	28,57%
⊟ 34 - 41	2,27%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	100,00%
⊟ 42 - 49	4,55%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	50,00%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	50,00%
Total Geral	100,00%

Figure 109: Age / Statements

Source: Own elaboration

Gender / To your notion, after this questionnaire, consider one of the following statements:	
Rótulos de Linha	To your notion, after this questionnaire, consider one of the following statements:
⊟ Female	56,82%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	72,00%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	28,00%
⊟ Male	43,18%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	73,68%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	26,32%
Total Geral	100,00%

Figure 110: Gender / Statements

Source: Own elaboration

Level education / To your notion, after this questionnaire, consider one of the following statements:	
Rótulos de Linha	To your notion, after this questionnaire, consider one of the following statements:
⊟ Bachelor Degree	20,45%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	55,56%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	44,44%
⊟ Higher Education (High School)	6,82%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	66,67%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	33,33%
⊟ Masters Degree	63,64%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	78,57%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	21,43%
⊟ PhD	4,55%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	100,00%
⊟ Technical and Professional Studies	4,55%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	50,00%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	50,00%
Total Geral	100,00%

Figure 111: Level of income / Statements

Source: Own elaboration

Income / To your notion, after this questionnaire, consider one of the following statements:	
Rótulos de Linha	To your notion, after this questionnaire, consider one of the following statements:
⊕ < 700€	11,36%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	80,00%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	20,00%
⊕ > 7500€	2,27%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	100,00%
⊕ 1501€ - 3000€	22,73%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	60,00%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	40,00%
⊕ 3001€ - 5000€	2,27%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	100,00%
⊕ 5001€ - 7500€	2,27%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	100,00%
⊕ 700€ - 1500€	59,09%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	73,08%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	26,92%
Total Geral	**100,00%**

Figure 112: Income / Statements

Source: Own elaboration

Regarding human capital, and considering the technologies of AI: / To your notion, after this questionnaire, consider one of the following statements:	
Rótulos de Linha	To your notion, after this questionnaire, consider one of the following statements:
⊕ I'm acquainted and interested about the impacts but do not seek to know more about it than what appears on the news, TV, and other communication sources	61,36%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	77,78%
I believe automation, AI, robots and other technologies will take over human jobs and a new revolution may emerge in the near future	22,22%
⊕ I'm acquainted to the subjects; try to understand and seek further research of their various dimensions, on a regular basis; I believe I understand the advantages/disadvantages	36,36%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	68,75%
I believe automation, AI, robots and other technologies will take over human jobs and a new revolution may emerge in the near future	31,25%
⊕ I'm curious	2,27%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	100,00%
Total Geral	**100,00%**

Figure 113: Human capital and AI-technologies / Statements

Source: Own elaboration

I am — about losing my job / To your notion, after this questionnaire, consider one of the following statements:	
Rótulos de Linha	To your notion, after this questionnaire, consider one of the following statements:
⊕ A little concerned	11,36%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	40,00%
I believe automation, AI, robots and other technologies will take over human jobs and a new revolution may emerge in the near future	60,00%
⊕ Not concerned at all	36,36%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	93,75%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	6,25%
⊕ Not very concerned	40,91%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	77,78%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	22,22%
⊕ Very concerned	11,36%
I believe automation, AI, robots and other technologies can walk side-by-side, complementing humans in performing their professional tasks, even if it means eradicating many current jobs AND I believe new jobs will emerge	20,00%
I believe automation, AI, robots, and other technologies will take over human jobs and a new revolution may emerge in the near future	80,00%
Total Geral	**100,00%**

Figure 114: Concern about losing job / Statements

Source: Own elaboration