ISCTE ◈ Business School
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KEY COMPETENCIES FOR TECHNOLOGICAL WORK:

EMPLOYERS AND EMPLOYEES OPINION

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COMPETENCIES THAT LEAD TO A WORKER'S POSITIVE REACTION
TO A TECHNOLOGICAL PRESENCE IN WORKPLACE - EMPLOYER
VS EMPLOYEE PERCEPTION

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I.   Abstract

The purpose of this research is to identify which competencies are more valuable for workers who handle technology or robots in their workplaces. This aspect is explored both by the perspective of employees and employers. Results are gathered through a Delphi study within a group of experts (employers) and a questionnaire within a group of Portuguese workers (employees). It is finding that employees and employers perception of the most valuable competencies are not aligned. Identifying this failure, this research intends to contribute to its overcome.

I.   Resumo

O objetivo desta investigação é identificar as competências que são mais úteis para trabalhadores que lidam com tecnologia ou robots nos seus locais de trabalho. Este aspeto é explorado por ambas as perspetivas: empregados e empregadores. Os resultados são recolhidos através do método Delphi, aplicado a um grupo de peritos (empregadores), e através da utilização de um questionário, aplicado a um grupo de trabalhadores portugueses (empregados). Constata-se que a perceção dos empregados e empregadores não está alinhada. Através da identificação desta falha, esta investigação pretende contribuir para potenciar a sua superação.

JEL Classificação: J240 - Human Capital; Skills; Occupational Choice; Labor Productivity

Palavras-chave: Competências, Tecnologia, Delphi; Peritos

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VI.   Introduction

The research question of this dissertation is which competencies are the ones that makes a worker leads and responds positively to a technological implementation in their workplace.

Furthermore, the main point of this dissertation is to compare both the perspectives: of the employees and the employers.

Not only in a way to understand how the employee should adapt himself to the presence of that technology, learning how to work with that, but also to understand, which competencies are more valuable in a market of constant technological changes and implementations.

On top of that, it appears as crucial to know and understand the factors, intrinsic and dependent to the worker, which relate the presence of technology and robotic and a worker positive reaction to that.

In order to accomplish this objective, it will be used the Delphi Method and a questionnaire to a sample of Portuguese workers.

It is important to understand that this research question is an important object of discussion and study because of two main points.

Firstly, there is the evidence of the impact of automation and artificial intelligence in almost all jobs and functions of the current job market, as well as the urgency to understand the phenomena and to act within that.

While automation and artificial intelligence will eliminate very few jobs and occupations during the next decades, they will affect and be present for sure portions of almost all jobs, either in a greater or lesser degree.

The certainty of this impact conduct academic and business worlds to concern about that, analysing and tending to take conclusions about next decades regarding workplace and workers capacities to deal with that. It seems to be crucial to understand the phenomena before it grows unduly and uncontrolled.

Secondly, there is the need that companies have to clarify and help their own employees in understand the impact of automation in their workplace. This is important because, nowadays, the impact and relevance of the increasing automation in production and services is yet seen for many as a cause of aggregate unemployment.

Companies, mostly managers and decision-takers, have the liability to put this problem not in a negative perspective but in a positive one, considering not the question *robot vs people* (which sees robotic and artificial intelligence as a way of steeling jobs and functions of humans – the first ones, robots, are collectors of the people's jobs) but the question of which competencies should an employee have or develop to make himself as an adaptable employee, an employee who has a positive reaction to a technological change in his functions or even in his workplace.

As stated, this problem gathered two different perspectives: the one from the employers and the one from the employees. Different perspectives, different perceptions and different needs conducts mainly, and naturally, to different actions and performances.

As important to understand this problem of robotic and technological implementation and its presence in companies is to understand which competencies are considered important when facing this.

During this research, as previously referred, a Delphi Method will be conducted to understand which competencies employers more value in a worker who handle technology or robots in his workplace.

After this Delphi Study, it will be assessed competencies to which the Portuguese population of workers attribute more value regarding the main topic of this research.

Conclusions of this research dissertation are expected to be useful for practitioners, in order to them to use information gathered and conclusions taken to define approaches and strategies to develop and promote competencies more valuable within the employees.

VII. Review of the Literature

For the past decades, employee's competencies have played an important role within both the labour market and the academical literature. Realising the importance of certain characteristics of the employees, companies, employers and academics have further look to these characteristics.

Furthermore, competencies have attracted much attention in practical and theoretical fields. Quoting Dubois, 1996, Rothwell and Lindholm say 'there is growing interest in competencies in medium-sized and smaller organisations' as well as

> 'Interest in using competencies as a foundation for human resource management programmes stems from continued downsizing in organisations, declining profit margins, increasing market volatility in many industries, and growing acceptance of behaviourally-based research.'(Rothwell and Lindholm, 1999).

Given this reality, the first step of this research project is to review the field, surveying, synthesising, critically analysing and presenting in more detail the existing literature. By this revision of the literature, it will be possible to identify gaps in current knowledge, avoid researching something already researched and carrying on the research from where other authors have already reached.

Competencies: Historical Review, Definitions and Discussions

In order to build a critical and constructive analysis in the scope of competencies, with the aim to critically analyse the existing research and literature, and knowing that there are, through the existent literature, a proliferation of meanings, discussions and researches assigned to the concept of competence, it is needed to pass through not only the historical path of the concept of competencies but also through discussions and investigations taking into account competencies.

In this sense, in the section here presented, it will be pointed many definitions presented in literature for the concept of competencies. Although the importance of the literature references and expert authors, in this scope is also important to analyse other sources of information, that is the reason why it is also presented in this section the definitions of *competence* provided by OECD - Organisation for Economic Co-operation and Development and UNESCO.

In 1953, David McClelland, an American expert in the field of management, for the first time documented a human trait: the "competence", so he called.

Then in 1959, Robert White, and later McLagan, Boyatzis, Spencer and Ulrich, outstandingly developed the concept of 'competencies for the organization's survival and sustained competitive advantage'.

In the year of 1973, David McClelland, Professor of Psychology at Harvard University, wrote his paper, the "*Testing for Competence Rather than Intelligence*", (McClelland, 1973) stirring the field of industrial psychology. According to McClelland, as cited by Chouhan and Srivastava (2014)

> 'McClelland's research indicated that although traditional academic aptitude and knowledge content tests were good predictors of academic performance, they seldom predicted on-the-job performance (…) went on to argue that the best predictors of outstanding on-the-job performance were underlying, enduring personal characteristics that he called ―competencies'(Chouhan and Srivastava, 2014).

McClelland presented

> 'that traditional achievement and intelligence scores may not be able to predict job success and what is required is to profile the exact competencies required to perform a certain job effectively and measure them using a variety of tests". This author defined "Competence" as "a personal trait or set of habits that leads to more effective or superior job performance‖, in other words, an ability that adds clear economic value to the efforts of a person on the job'(Chouhan and Srivastava, 2014).

The McClelland work was majority focused on application on the education sector, Boyatzis was the responsible for the business perspective of competence (Boyatzis, 2008).

In his book "The Competent Manager", Boyatzis (1982) defines competency as "*an underlying characteristic of a person which results in effective and/ or superior performance in a job*", an underlying characteristic, it is proposed by the author, could include a motive, trait, skill, an aspect of one's self-image or social role, or a body of knowledge. Boyatzis (1982, 2007) identified that there were 19 generic competencies that outstanding managers tend to have. He gathered those 19 generic management competencies into five distinct clusters, as *a "goal and action management, leadership, human resource management, directing subordinates and focus on others*"(Boyatzis, 2008).

In 1980, Klempt defined competency as 'an underlying characteristic of a person which results in effective and/or superior performance on the job' (Klempt, 1980).

During the year of 1989, quoted by Chouhan and Srivastava (2014), Hornby and Thomas (1989) refer that

'Competency is the ability to perform effectively the functions associated with management in a work situation", for Jacobs (1989) "Competency is an observable skill or ability to complete a managerial task successfully" and for Hogg B (1989) "Competencies are the characteristics of a manager that lead to the demonstration of skills and abilities, which result in effective performance within an occupational area. Competency also embodies the capacity of transfer skills and abilities from one area to another'(Chouhan and Srivastava, 2014)

Spencer and Spencer (1993), who furthered Boyatzis' original work, define competency

'as an underlying characteristic of an individual that is causally related to criterion referenced effective and/or superior performance in a job or situation". They also say that "Competencies are skills & abilities-things you can do -acquired through work experience, life experience, study or training' (Spencer and Spencer, 1993)

Page and Wilson (1994) after revising 337 citations regarding competencies, defined it as 'the skills, abilities, and personal characteristics required by an "effective" or "good" manager'(Page and Wilson, 1994). This definition also includes both directly observable and testable competencies, such as knowledge and skills, and the less assessable competencies related to personal characteristics or personal competencies.

During the year of 1998, Evarts defined competency as an 'underlying characteristic of a manager which causally relates to his/her superior performance in the job' and Woodall and Winstanley maintain competency as 'the skills, knowledge and understanding, qualities and attributes, sets of values, beliefs and attitudes which lead to effective managerial performance in a given context, situation or role'.

Many definitions of the term "competency" have risen over the last years. According to Chouhan and Srivastava (2014), the definition that is most preferred is that 'Competencies include the collection of success factors necessary for achieving important results in a specific job or work role in a particular organization'. Additionally, these authors enhance that 'success factors are combinations of knowledge, skills, and abilities (more historically called ―KSA's)

that are described in terms of specific behaviours and are demonstrated by superior performers in those jobs or work roles'.

The *Observatoire des Réformes en Education*, from UNESCO, which is composed by Philippe Jonnaert, Johanne Barrette, Domenico Masciotra and Mane Yayarefers, in their Revisiting the Concept of Competence as an Organizing Principle for Programs of Study: From Competence to Competent Action refer that "an analysis of the literature in certain fields that frequently appeal to the concept of competence reveals both discrepancies and uniformities in how this concept is understood."

According to the OECD, in its paper The Definition and Selection of Key Competencies,

> 'a competency is more than just knowledge and skills. It involves the ability to meet complex demands, by drawing on and mobilising psychosocial resources (including skills and attitudes) in a particular context. For example, the ability to communicate effectively is a competency that may draw on an individual's knowledge of language, practical IT skills and attitudes towards those with whom he or she is communicating.'

When UNESCO reviews the concept of competence, it refers that there are authors who propose a definition of competence from a situate perspective. Jonnaert (2002) refers that "situation is both the origin and the criterion of competence". For other word, according to this author, that is only in situation that a person develops his/her competence, and therefore the situation is the source of competence. Besides, it is only by dealing successfully with this situation that a person can be considered competent: Unesco writes that "the competent handling of a situation thus constitutes the principal criterion for evaluating situated competence". As Jonnaert (2002) indicates,

> '... competencies can only be defined in relation to situations and are therefore as much situated as knowledge is situated in its physical and social context. The concept of situation thus takes on a central role in the learning process: it is only in situation that a learner can construct, modify or disconfirm his/her situated knowledge and develop competencies that are equally situated. This constitutes a determining factor in school learning ... Education is no longer a matter of teaching decontextualized subject-matter content (geometric shapes, addition of fractions, mental calculations, rules of syntax, verb conjugations, etc.), but rather of identifying situations in which learners can construct, transform or repudiate the knowledge and competencies associated with this content. Subject-matter content is no longer seen as an end-in-itself, but rather as a

means at the service of handling situations, just as any other resource.'(Jonnaert *et al.*, 2007)

In what concerns to "situated competence", the *Observatoire des Réformes en Éducation*, defined it as a dynamic structure, powerfully rooted in the person's experience and practice in situation. It is through her activity that a person develops her competencies.

UNESCO also says that 'the starting point for analysing competencies is the actions that a person in situation undertakes and the resources required to perform those actions'. This is what the authors have designated by the expression "competent action in situation".

From UNESCO report, it is possible to conclude that a competence cannot be reduced to a simple description of an expected action or behaviour, 'it is much more than that'. Authors from the field called, by UNESCO observatory, 'Ergonomics and didactics of vocational training' consider competence as an 'organising structure of activity'.

Masten and Coatsworth (1998) define competence as

'a pattern of effective adaptation in the environment, either broadly defined in terms of reasonable success with major developmental tasks expected for a person of a given age and gender in the context of his or her culture, society, and time, or more narrowly defined in terms of specific domains of achievement, such as academics, peer acceptance, or athletics.'(Masten and Coatsworth, 1998)

It carries a dual significance that there is a track record of such achievement (*competent performance*) and also that the individual has the proficiency to perform satisfactory in the future. It last item refers to good adjustment and not necessarily to superb achievement.

Peters and Zelewski (2005) refer that the concept of competence can be defined as the ability of an employee to utilize his or her knowledge to achieve a predefined goal, such as an effective and efficient execution of a task. These authors also organize competences in a, so they call, "competence hierarchy" (Peters and Zelewski, 2005)

As Le Deist and Winterton say, in their "What Is Competence?" publication, "the concept of competence or competency (…) dominated the management strategy literature of the 1990s, which emphasized 'core competence' as a key organizational resource that could be exploited to gain competitive advantage"(Le Deist and Winterton, 2005).

It is usual to seen references to both the concept of "competence" and the concept of "competency". In fact, even Le Deist and Winterton, as seen previously in this review of the

litherature, started their "What is competence?" paper presenting both concepts, stating that ''competence' generally refers to functional areas and 'competency' to behavioural areas but usage is inconsistent, as shown below'(Le Deist and Winterton, 2005).

Teodorescu (2006) devoted herself to understand not only the distinction, but also the approximation, of both concepts: competence and competency, <u>analysing</u> information resulted from David Dubois and Thomas Gilbert research.

According to Dubois (1998), competencies (plural for competency) are "those characteristics—knowledge, skills, mindsets, thought patterns, and the like—that when used whether singularly or in various combinations, result in successful performance".

In the other hand, according to Gilbert (1996), "Human competence is a function of worthy performance (W), which is a function of the ratio of valuable accomplishments (A) to costly behaviour (B)", it means

$$W = \frac{A}{B} \quad (1)$$

$$Performance = B + A. \quad (2)$$

This author also refers that "competent people are those who can create valuable results without excessively costly behaviour".

In the scope of this distinction, which appears to be not so distinctive like it was supposed to, it performs as important, according to Teodorescu (2006), to understand the area of focus of *"competency models"* and "*competence models"*.

About "*Competency models*", the focus is to define skills, knowledge, attributes, and behaviours that successful people have. Teodorescu believe as "*if other people know what skills, knowledge, attributes, and behaviours successful people have, these others will be motivated to acquire them and will in turn become more successful"*. The desired results for these competency models us to replicate the competencies of the successful people in less successful people through hiring, training, assessment and development programmes.

Moreover, the area of focus of "*Competence Models*" is the "*definition of measurable, specific, and objective milestones describing what people have to accomplish to consistently achieve or exceed the goals for their role, team, division, and whole organization"*. As the author refers, the role expected to "*Competence Models*" to play is the role of Roadmap to Success.

Regarding "*Core Competencies*", Prahalad and Hamel (1990) defined it as 'the collective learning in the organization, especially how to coordinate diverse production skills and integrate multiple streams of technologies'(Prahalad and Hamel, 1990). These authors offer three tests to identify a core competence, namely, as Jurow (1996) synthetize:

- A core competence 'provides a long-term strategic advantage';
- A core competence 'contributes to customer benefit'; and
- A core competence is 'difficult for other to imitate'.(Jurow, 1996)

Leonard-Barton (1996) distinguishes core competencies from supplemental or enabling capabilities in the following way: supplemental capabilities 'add value to the core competence but can be imitated by others' and enabling capabilities are the ones which are 'necessary to success, but which are not marks of superiority'.

This author also extends core competencies to more than the knowledge and skills of employees, including the ways in which work gets done in an organization, considering also the technical and managerial systems, and the culture of the organization.

Realising that a competence cannot be reduced to a simple definition, it can be considered two levels of competences, the "Actual Competence" and the "Virtual Competence" (Jonnaert *et al.*, 2007).

According to Jonnaert et al. (2007), an "Actual Competence" refers to 'the competence that a person develops in action in order to adapt to situations, whether these are teaching/learning situations, real-life situations or work-related situations'. This is the result of all the actions that a person undertakes by mobilising and using a group of resources in order to handle a situation in which is involved.

Furthermore, proposed by Jonnaert et al., the *"Actual Competence"* of a person ($\frac{AC}{P}$), in determined situation (Si), is given by:

$$\frac{AC}{P} \times Si = \{Co \times In \times iResources \times eResources \times AP \times CR \times \ldots\} \quad (3)$$

Where:

- *Co* is the comprehension that the person has of the situation;
- *In* is the degree of involvement of the person in the situation in order to achieve certain goals;

- *iResources* is the person internal resources (cognitive, dispositional and physical) that are useful in dealing with the situation;
- *eResources* is the external resources (material, social and spatiotemporal), inherent in the situation and the context that are useful in dealing with the situation;
- *AP* is the person's action possibilities that are constrained by the situation and the context;
- *CR* is the person's critical reflection on his/her own actions and their results.

The description of the Actual Competence of a person is made after the facts occurrence and takes into consideration all factors an external observer uncovers during the observation.

In the other hand, a "Virtual Competence" is

'only a hypothesis (a virtuality) formulated in an educational programme and indicates how a person could potentially handle situations with competence if he/she appropriates a certain number of resources prescribed by the programme.'

In this same work, Jonnaert et al., analysed the literature regarding competence from different perspectives: situated action; situated cognition; distributed cognition; distributed intelligence; collective intelligence and enation. Having these six perspectives, it is possible to define and characterize four types of competences: "situated competence"; "distributed competence"; "collective competence" and "enacted competence".

Jonnaert et al. refer that proponents of "Situated competence", namely Lucy A. Schuman (1985), argue that 'all action is grounded in a situation, outside of which it would no longer have the same meaning'. According to Jonnaert et al., a situated competency is a truism, as far as it is necessarily situated, as well as the resources that it engages.

Although, competences are necessarily situated, they are also distributed. Perkins (1993) introduced the concept of "Distributed Competence", including the *person-plus* notion, as opposite of the *person-solo* notion. Person-plus notion refers to the elements of person's immediate surroundings, which include, according to Perkins, the physical, social and spatiotemporal resources.

"Collective Competence" is, according to Jonnaert et al. (2007), the s the property of a group of people who are concerned by a common situation. Authors highlight the fact that a collective competency is not the sum of individual competencies. Quoting Lave and Wenger (1991), 'in fact, the group can impair or even impede the development of a collective competency'.

And eventually, for "Enacted Competence" Jonnaert refers that, whether competence pertains to a person-in-situation, so "situations are occasions for individuals to enact themselves, to be fully engaged through their action possibilities". Points also that being competent means doing something in a field of action, and that a person is competent in action.

Chan et al. (2017), use in their work the expression ''generic competencies', an umbrella term inclusive of different types of generic skills (such as communication, teamwork, problem-solving, f and time management), positive values and attitudes (such as consideration, respect, appreciation and lifelong learning) for student development.' (Chan et al., 2017), assuming that this topic of research has generated a lot of discussions among key stakeholders, namely students, employers, academics and parents.

Due to the importance given to "generic competencies" by these key stakeholders, it is possible to recognize that this concept plays an important role for competencies not only in the psychological field, but also in the business one. If there is so many relevance in the topic, its ways of measure appears as a concern to all these referred stakeholders, as logic. However, research by Badcocko et al. (2010) and Chan (2012) point that "due to their different natures and properties, many generic competencies may not be amenable to assessment and cannot be represented or rated on scales." So that, it was possible, for the authors, to identify that there are really difficulties in the assessment/measurement of generic competencies, mainly because they are rarely assessed and reported as individual learning outcomes, bur more holistically within the disciple knowledge – in a perspective of the university teaching.

According to Tucker and Cofsky (1994), quoted by Chouhan and Srivastava (2014), there are five major components of competency:

1) "Knowledge -This refers to information and learning resting in a person, such as surgeon's knowledge of Human Anatomy.
2) Skill -This refers to a person's ability to perform a certain task, such as surgeon's skill to perform a surgery.
3) Self-Concepts and Values -This refers to a person's attitudes, values and self-image. An example is self-confidence, a person's belief that he or she can be successful in a given situation, such as a surgeons self confidence in carrying out a complex surgery.
4) Traits -Traits refer to physical characteristics and consistent responses to situations or information. Good eyesight is a necessary trait for surgeons, as is self-control is an ability to remain calm under stress.

5) Motives -Motives are emotions, desires, physiological needs or similar impulses that prompt action. For example, surgeons with high interpersonal orientation take personal responsibility for working well with other members of the operating team.'(Chouhan and Srivastava, 2014)

Katz and Kahn (1986) grouped competency into three areas which later expanded into the following four: Technical or Functional (knowledge, attitudes, skills, etc. associated with the technology or functional expertise required to perform the role); Managerial (knowledge, attitudes, skills, etc. required to plan, organize, mobilize and utilize various resources); Human (knowledge, attitudes and skills required to motivate, utilize and develop human resources); and Conceptual (abilities to visualize the invisible, think at abstract levels and use the thinking to plan future business).(Chouhan and Srivastava, 2014)

Carrol and McCrackin (1988) organized competencies into three main categories.

1) Core competencies (Hamel and Prahalad, 1994): A core competency forms the basis for strategic direction; it is something a company does well relative to other competitors. Core competencies refer to the elements of behaviour that are important for all employees to possess as, for example, a core competency in "result/quality orientation";

2) Leadership/managerial competencies: This category involves competencies that are related to leading an organization and people. Some examples include "visionary leadership", "strategic thinking", and "developing people";

3) Functional competencies: These are job-specific skills required to perform a particular job role or profession (Ozcelik and Ferman, 2006:75).

As seen by the presentation of all these existing literature and authors, and as referred by Shippman et al. in their paper "The practice of competency model" (2000), terms like "competent" or "competency" appeared for the first times in fields like law and, later, clinical psychology. In these fields, initially, the term where the term 'evolved to define legal standards of mental capacity and awareness, the ability to care for oneself or others, and/or the ability to function in multiple activities of "daily living"' (Shippman et al., 2000)

It seems to be very interesting to summarise some peculiarities of the terms "competency" and "competent" before proceeding with this study. "Competency" was included in the vocational counselling profession to define broad areas of knowledge, skills, and abilities linked to specific occupations. The word also has an extensive history in the field of education with an

emphasis on broader traditional "knowledge" areas (e.g., mathematics, English). Immediately, industrial psychologists used the term "competent" to describe successful individuals in specific professions. Furthermore, as pointed by Shippman et al. (2000) "in all of the above contexts-legal, clinical psychology, vocational, educational, and industrial psychology-the term "competence" defines "successful" performance of a certain task or activity, or "adequate" knowledge of a certain domain of knowledge or skill", which seems to be very opportune for this study.

Although all the previous presentation of different meaning and definitions for the concept of "competency" or "competence", both terms are, as seen, still subject to debate within the academic population.

In this scope, and marking the relevance of the topic, Shippman et al. (2000) refer that

> 'Clearly, there is a wide range of definitions, even among a fairly homogeneous expert population, underscoring the difficulty of pinpointing a standard definition of the term. This lack of consensus shouldn't be too surprising, given the multiple domains in which the terms "competent" or "competency" are prevalent.'(Shippman et al., 2000)

For the purposes of these research, it was adopted the definition proposed by Dubois, in his book "The Competency Casebook", where he defined, as previously presented, competencies (plural for competency) are 'those characteristics - knowledge, skills, mindsets, thought patterns, and the like - that when used whether singularly or in various combinations, result in successful performance'

Competencies, Skills and Labour Market

Teijeiro, Rungo and Freire (2013) refer that 'there is no agreement about the best combination of competencies for enhancing labour market success'. In fact, when dealing and referring to the labour market, one can understand the complexity in establish and state a group of competencies that all professionals valorise in same way. These authors present as a possible reason for this lack of consensus the 'difficulty in measuring competencies and the variety of approaches available for doing so', as well as observable within the different literature used through this section (Teijeiro, Rungo and Freire, 2013)

These authors analysed the fit, or the inexistence of that, between graduates and professionals, using both samples. Outputs from the sample of the graduates allow to analyse the "mean

scores of professional competencies that these young individuals claim to have acquired". Teijeiro, Rungo and Freire (2013) gather, from the graduates sample, results:

'ranging from a minimum of 4.31, equivalent to ''reasonable'' acquired competencies in decision making, to a maximum score of 5.441, in this case, i.e. ''sufficient or good capacity for learning.'''(p.289)

From business professionals, these authors presented 'the scores given by business professionals reflecting what they require of their workers by way of competencies.' gathering the following information:

'the evaluation of the competencies ranges from a minimum of 5.49 for the ability to work independently, to a maximum of 6.6 points for responsibility at work. Among the next highest values are, the ability to learn with a score of 6.326, which is only slightly higher than the two that follows: motivation to work and problem solving with 6.309 and 6.308, respectively. The rest of the items analysed score significantly lower than the scores mentioned.' (Teijeiro, Rungo and Freire, 2013)

In this scope, these authors noticed differences between items considered as acquired by graduates and items that business professionals demand for their companies. They refer that, within competencies analysed, the ones which professionals values more and graduates less are 'problem solving' and the 'ability to apply knowledge to practical situations'. In other hand, competencies more valuable by graduates and less by professionals (and, consequently, companies) are 'ability to work independently' and 'interpersonal abilities'.

The work carried out by Teijeiro, Rungo and Freire is, once more, an alert for the fact that competencies expected, and demanded, by companies in their employees are a topic marked by a lack of consensus, and where is important to have new and renewable results.

For this lack of consensus, it is pointed by authors that:

'It could be argued that each firm, or at least each productive sector, requires a specific set of competences; if so, the definition of a unique set of competences that increase success at work would be meaningless.' (Teijeiro, Rungo and Freire, 2013)

For the purposes of the research here presented it is also important to analyse and point competencies gathered and proposed by Teijeiro, Rungo and Freire in their study. Table 1 illustrates those 19 competencies classified by types, as defined by the authors. (Teijeiro, Rungo and Freire, 2013: p.288).

Table 1 – Types of Competencies used by Teijeiro, Rugo and Freire (2013)

Instrumental	Basic knowledge of the profession
	Ability to communicate
	Problem solving
	Ability to organize and plan
	Decision making
	Information management abilities
	Ability to analyse and synthesize
Interpersonal	Ability to work as a team
	Interpersonal abilities
Systemic	Ethical commitment
	Responsibility at work
	Ability to learn
	Motivation for work
	Concern about quality and improvement
	Ability to apply knowledge to practical situations
	Motivation to reach goals
	Ability to adapt to new situations
	Ability to work independently
	Ability to generate new ideas

This distinction in three main domains was based on the study entitled ''Tuning Education Structures in Europe'' (2007), carried out by over 100 universities, coordinated by the University of Deusto (Spain) and the University of Groninger (The Netherlands) and supported by the European Commission. In this scope, authors defined these three domains as:

'Instrumental competencies are defined as cognitive, methodological, technological and linguistic abilities, which are necessary for understanding, construction, operation and critical use in different professional activities. Interpersonal competencies are related to one's ability to interact and network with people, as well as the ability to actively participate in specific or multidisciplinary work groups. Systemic competencies are skills relative to systems, and require a combination of understanding, sensitivity and knowledge that allows one to see how the parts of a whole relate and come together.' (Teijeiro, Rungo and Freire, 2013)

Teijeiro, Rungo and Freire (2013) 'emphasise the role of skills that are transferable across jobs, such as problem-solving skills, interpersonal skills, and the ability to learn' (Blásquez, Herrarte and Llorente-Heras, 2018). These authors showed that only the proximity of systemic skills, such as the 'ability to learn' or the 'ability to work independently', influence the probability of employment (Teijeiro, Rungo and Freire, 2013).

Cotton (1993) find out, reviewing existent literature from different author, that 'the "critical employability skills" identified by these different researchers vary considerably in the way they are organized.' However, the author also notes a great level of agreement within skills and traits identified through the literature.

This author has done a work of comparison, stating and gathering the attributes listed more frequently among the literature, which were organized in three categories: basic skills; higher-order thinking skills; affective skills and traits, as shown in table 2 (Cotton, K., 1993). In her research, she states that 'It should also be noted that, within each of the three categories, the skills and traits are arranged in descending order according to the frequency with which each was cited in the research.'. (Cotton, 1993).

Table 2 – Categories of traits and skills, by Cotton (1993)

Basic Skills	Oral communication (speaking, listening)
	Reading, esp. understanding and following instructions
	Basic arithmetic
	Writing
High-Order Thinking Skills	Problem Solving
	Learning Skills
	Creative, innovative thinking
	Decision making
Affective Skills and Traits	Dependability/responsibility
	Positive attitude towards work
	Conscientiousness, punctuality, efficiency
	Interpersonal skills, cooperation, working as a team member
	Self-confidence, positive self-image
	Adaptability, flexibility
	Enthusiasm, motivation
	Self-discipline, self-management
	Appropriate dress, grooming

	Honest, integrity
	Ability to work without supervision

Cotton (1993) cites Charner (1988), identifying and cataloguing reasons given by employers for not hiring young people for entry-level jobs, namely:

- 'Low grades and low levels of academic accomplishments;
- Poor attitudes, lack of self-confidence;
- Lack of goals, poorly motivated;
- Lack of enthusiasm, lack of drive, little evidence of leadership potential;
- Lack of preparation for the interview;
- Excessive interest in security and benefits, unrealistic salary demands and expectations;
- Inadequate preparation for type of work, inappropriate background;
- Lack of extracurricular activities;
- Inadequate basic skills (reading, writing, math).' (Charner, 1998)

Charner (1988), in this scope, also refers that:

'Although a high school diploma may demonstrate a certain level of maturity, motivation, perseverance, and some specific academic skills, it does not provide an adequate picture of the employability or marketable skills, knowledge, and competencies that an individual possesses. In order for youth to make successful transitions to work they need more than their high school diplomas.'

This author defends that young employees, recently graduated, need more than their diplomas, they need an 'employability credential' which identifies and describes their developmental experiences, converting these ones to component competencies (Charner, 1988). This will, according to Charner (1988), help newly employee understanding their own marketability, as well as their personal brand and competencies.

Gainer summarized a group of competencies in four categories, namely Individual Competence; Personal Reliability Skills; Economic Adaptability Skills and Group and Organizational Skills (Gainer, 1988). Each one of these groups has a list of competencies, like detailed in Table 3.

Table 3 – Skills and competencies, by Gainer (1988)

Individual Competence	Communication skills
	Comprehension
	Computation
	Culture
Personal Reliability Skills	Personal management
	Ethics
	Vocational maturity
Economic Adaptability Skills	Problem solving
	Learning
	Employability
	Career development
Group and Organizational Effectiveness Skills	Interpersonal skills
	Organizational skills
	Skills in negotiation, creativity, and leadership

In other hand, (Lankard, 1990) suggests seven categories of employability skills, offering, additionally, competency-based training modules for each. This last part, suggested by the author does not seems as relevant for the topic under analysis within this research work, but appears as important to the understanding of the field of study.

Table 4 presents the seven categories identified by Lanckard (1987). As observable, some of these capabilities or competencies are, or not, evident in employees to employers even in the job interview phase.

Table 4 – Seven categories of employability skills, by Lanckard (1987)

Present a Positive Image	Follow good grooming practices
	Practice good health habits
	Dress appropriately for the job
	Exhibit self-confidence
Exhibit Positive Work Attitudes	Use basic social skills,
	Be creative and willing to learn
	Take pride in your work
Practice Good Work Habits	Maintain regular attendance
	Be thorough and diligent
	Follow safety practices
	Exercise integrity and good judgment

Practice Ethical Behaviour	Respect property
	Follow company rules
Communicate Effectively	Demonstrate speech, writing, and nonverbal communication skills;
	Demonstrate good listening habits
Cooperate with Others	Work as a member of a team,
	Work under supervision

Regarding automation and current challenges for businesses, managers and decision makers, Lanckard (1990) refers that:

'Increased automation has reduced the need for supervision of entry-level workers. These workers are now expected to operate independently in roles that require problem-solving and decision-making skills. Increased competition from national and international markets is also influencing changes in the workplace. (Lankard, 1990)

According to this researcher, current competition is a key factor conducting business to be more efficient and to employ strategies that will improve production, service, and product quality. Consequently, strategies involve improving worker relationship and cooperation. Due to that, employers need creative, flexible workers, who have a broad range of interpersonal and managerial skills. (Lanckard, 1990)

Work of Young (1986) summarizes the competencies most needed by employees, selected by three studies: High school curriculum study (Baxter and Young, 1980); Getting a job after college - What skills are needed? (Murohy and Jenkins, 1983) and a Johns Hopkins research.

Young (1986) synthetizes his results in a table, Table 5. It seems as important to have the perception of these competencies, and their relevance in the existing literature. Although, one can realise the evolution of the field of study since the 80's until the current state of investigation, these are the basis of current results.

Table 5 – Review of the literature regarding competencies, by Young (1986)

Competence		Baxter & Young	Murphy & Jenks	Johns Hopkins
Interpersonal Skills		Ranked 5th	Cited most often	Ranked 3rd
Work Attitudes & Habits	Dependability	Ranked 1st	Cited often	Ranked 1st
	Stay with task/ Interest	Ranked 3rd	Cited often	(Not ranked)
	Accept supervision/Positive attitude	(Not cited)	Cited often	Ranked 2nd
Communication Skills	Reading	Ranked 2nd	(Not cited)	Ranked 4th
	Speaking/Listening	Ranked 6th	Cited most often	(Not ranked)
	Writing	Ranked 11th	Cited most often	(Not ranked)
Thinking/ Problem-Solving		Ranked 10th	Cited often	(Not ranked)
Basic Arithmetic		Ranked 9th	Cited often	Ranked 7th

As seen in Table 5, the three studies reviewed by Young highlighted the need for employees to develop social skills, positive attitudes about work, and basic skills of communication. Specialized or highly technical skills were not as stressed but were actually deemphasized. If employees are not expected to have these for entry-level positions, it must be assumed that they will acquire them both as part of their on-the-job training and/or on their own initiative, if required from them later (Young, 1986).

Baxter and Young (1982) conclude, through a survey to 96 employers, that they are asking for:

> 'potential workers with good attitudes and the ability to communicate, think, and solve problems and we can teach them specific job skills. Another message is that the high schools share a large part of the responsibility for the development of these qualities in their students.' (Baxter and Young, 1982)

These authors suggested, additionally, seven future implications from their study:

1. 'Schools must recognize the importance of attitudinal development and strive to foster good attitudes. Much can be done by setting an example, providing opportunities, and having high expectations. For example, the teacher who wants students to be in class on time must also be on time. Students must be provided a reasonable amount of time to get to class and then be expected to be there.

2. The current emphasis on "basic" education may be entirely justified, especially if it includes communication skills, thinking, and solving problems.

3. Although important, instruction in vocational skills at the high school level may be less critical comparatively than the attitudes and skills rated so highly by employers.

4. The school curriculum should include coursework on the development and understanding of the world of work, the free enterprise system, and consumerism. Special emphasis should be given to interviewing for a position and working under supervision.

5. Mechanisms should be established to permit educators and lay people to interact so that the curriculum can be structured to meet employment needs.

6. Each school system should have a follow-up on former students in order to keep its curriculum relevant.

7. There should be continuing examination of the schools' curricula and the relationship to employment.' (Baxter and Young, 1982)

This perspective in what concerns to which is, or should be, the school role for the competencies employees have seems important when understanding which competencies can be, or not, developed by the curricula.

During the 1990-1991 school year, Michigan schools piloted an innovative portfolio approach to enable students to discover, document and develop their employability skills (Stemmer, Brownell and Smith, 1992). It is interesting for research to understand their first step in developing their portfolio theory, Michigan Employability Skills Task Force, which includes leaders from business, labour, government and education, defined 'the general skills that every student should have, not only for entry-level jobs but for jobs at all levels' (Stemmer, Brown and Smith, 1992), which is presented in Table 6.

Table 6 – General skills students should have, by Michigan Employability Skills Task Force (Stemmer, Brown and Smith, 1992)

Academic Skills	Read and understand written materials
	Understand charts and graphs
	Understand basic math
	Use mathematics to solve problems
	Use research and library skills
	Use specialized knowledge and skills to get a job done
	Use tools and equipment
	Speak in the language in which business is conducted
	Write in the language in which the business is conducted
	Use scientific method to solve problems
Personal Management Skills	Attend school/work daily on time
	Meet school/work deadlines
	Develop career plans
	Know personal strength and weaknesses
	Demonstrate self-control
	Pay attention to details
	Follow written and oral instructions
	Follow written and oral direction
	Work without supervision
	Learn new skills
	Identify and suggest new ways to get the job done
Teamwork Skills	Maintain regular attendance
	Be thorough and diligent
	Follow safety practices
	Actively participate in a group
	Know the group's rules and values
	Listen to other group members
	Express ideas to other group member
	Be sensitive to the group members' ideas and views
	Be willing to compromise of necessary to best accomplish the goal
	Be a leader or a follower to best accomplish the goal
	Work in changing settings and with people of different backgrounds

As important to retain from this conclusion of Michigan Employability Skills Task Force is the distinction of competencies in three main groups, namely Academic Skills; Personal Management Skills and Teamwork Skills.

Mason (1990) found that, in labour market for engineering, science and IT graduates 'The great majority of mismatches between supply and demand for technical graduates are attributable to quality problems rather than any overall shortfall in quantity.' This author pointed as employability skills for engineering, science and IT graduates the technical competencies they should learn, have and develop (Mason, 1990). According to his research:

> 'The main reasons for the slower growth in electronic engineering graduate output compared to computer science appear to be the following:
>
> – Many prospective students are attracted to the apparently superior salary and career prospects attached to degrees in computing/IT areas.
> – Many students have not studied physics to A level standard at school and are therefore not qualified to study electronic engineering (by contrast, physics is not a prerequisite for studying computer science).
> – Many students with relatively weak mathematical backgrounds believe that they are more likely to be able to 'cope' with computer science than with electronic engineering.' (Mason, 1990)

This author identified work readiness – the knowledge, skills, and commercial understanding which make graduates deploy-able soon after hiring – as one of the most important factors for the employability of engineering and science graduates in the UK (Mason, 1999).

Not only in 80's and 90's, but also in recent years, competencies and skills among higher education graduates have received much attention in both the economics and educational literature. Notwithstanding, while the literature linking cognitive skills to economic success is a substantial area of economics research, and in other social sciences, the effects of non-cognitive skills have only recently been examined by economists.

Mueller and Plug (2006) have shown that 'personality matters and that its impact on earnings is comparable to that of cognitive ability'(Mueller and Plug, 2006). These authors examined personality traits, namely extroversion, agreeableness, conscientiousness, neuroticism, and

openness to experience, in a group of highly educated of mainly white men and women, raised in Wisconsin. Their results indicate that:

> '(a) men who were antagonistic, open, and, to a lesser extent, emotionally stable enjoyed earnings advantages over otherwise similar men; (b) women received a premium for being more conscientious and open; (c) returns to non-agreeableness were very different for men and women; but (d) the positive returns to openness were very similar across gender, suggesting that being creative, unconventional, and artistic was equally important for the man and woman observed.' (Mueller and Plug, 2006)

Using data from National Longitudinal Survey of Youth 1979 (NLSY79), Heckman, Stixrud and Urzua (2006) present evidence that 'both cognitive and non-cognitive abilities determine social and economic success', challenging the existing statement that cognitive skills are more important than non-cognitive ones, mainly diffused by economic and psychology literature.

From this research, authors conclude that:

> 'Although cognitive skills explain much more of the variance of (log) wages, their effects on (log) wages (as measured by skill gradients) are similar to the effects of the noncognitive traits. In fact, noncognitive skills are about equally strong in many outcomes and are stronger for some outcomes. Of course, equal strength in the sense we have used it does not translate into equal cost of changing these skills.' (Heckman, Stixrud and Urzua, 2006)

Additionally, authors evidence that non-cognitive skills are significant in explaining a diverse group of behaviours helps, also, to explain why early childhood programs, like Headstart and the Perry Preschool program, are successful. According to authors, these programs 'do not boost IQ but they raise noncognitive skills and therefore promote success in social and economic life' (Heckman, Stixrud and Urzua, 2006).

In what regards to results of employees' competencies in labour market outcomes, Fletcher (2013) findings suggest that:

> 'personality measures have important associations with labour market outcomes in adulthood and that the results vary considerably by demographic group. The findings also highlight the potential role of extraversion in being associated with favourable

labour market outcomes, which has not been documented in many other studies.' (Fletcher, 2013)

The research of Fletcher (2013) links 'specific personality traits with labour market returns by using a recent national sample of young adults from the US. Fletcher found out a 'large association between extraversion and earnings'. Author point as possible reason to this association 'the differing composition of jobs in the US in recent years, specifically the growth of service jobs and the requirement of social interactions in the workplace.'. Author also refers that:

'Interestingly, the result is not explained by occupational sorting and is large in magnitude compared with more traditional characteristics, such as cognitive skills and even attractiveness. The results also cast some doubt on the robustness of links between conscientiousness and earnings found in the prior literature – the effects are replicated in the baseline models but are then reduced substantially with the inclusion of sibling fixed effects.' (Fletcher, 2012)

Facing expression of discontent with the prevailing measurements of skill mismatch, Sgobbi and Suleman (2013) state that:

'The opposition between core and supplementary skills has proven to be a viable solution for identifying different types of alignment and misalignment between required and provided skills. The results obtained for a sample of Portuguese retail bankers emphasize the importance of accounting for the job-specific nature of skills.' (Sgobbi and Suleman, 2013)

In a review of the literature on the different definitions and measures of non-cognitive skills, Morrison and Schoon (2013) stated that "the term non-cognitive skills refers to a set of attitudes, behaviours, and strategies that are thought to underpin success in school and at work". Explicitly, they identified 8 types of non-cognitive skills: self-perceptions, motivation, perseverance, self-control, meta-cognitive strategies, social competencies, resilience and coping, and creativity.

According to Blásquez, Herrarte and Llorente-Heras (2018), more attention to non-cognitive skills and competencies starts by the fact that the switch from university to work has become a crucial phase in graduates' lives, due to that, it is important to know which competencies will

enable them to benefit of gifted job chances. Additionally, authors refer that to know this is crucial not only from the perspective of the individual but also from the point of view of education policy.

These authors consider that there are two main topics within the studies on this topic, first group observes the correlation between labour market outcomes and skills depending on their cognitive or non-cognitive nature, second one emphasis the specific competencies regardless of whether they are cognitive or non-cognitive.

Regarding the first group of researches and its conception of cognitive and non-cognitive skills, Blásquez, Herrarte and Llorente-Heras (2018) also refer that:

> '(…) cognitive skills are defined as conceptual and intellectual skills such as intelligence, knowledge, analytical thinking, mathematics, and reading, among others. Non-cognitive skills comprise many aspects related to specific aptitudes (interpersonal skills, communication skills, social skills, leadership, etc.) as well as personality traits (motivation, perseverance, self-control and self-confidence, charm, etc.).' (Blázquez, Herrarte and Llorente-Heras, 2018)

This distinction also implies to recognize differences in the way of measure both, the cognitive and non-cognitive skills. In what concerns to this, while cognitive skills can be measured by objectives tests (IQ and other homogenous achievement test scores), non-cognitive skills, harder to measure, are analysed by means of self-reported information. Due to that, most studies have primarily concentrated on cognitive skills 'with the general finding that higher levels of these skills are associated with better labour market out comes', namely 'lower unemployment, higher wages, high-skilled jobs, and others' (Blásquez, Herrarte and Llorente-Heras, 2018).

Based on both, literature review and REFLEX database, which is a large survey conducted among higher education graduates who earned their degree in 1999/2000, Blásquez, Herrarte and Llorente-Heras (2018) define competencies by type (cognitive or non-cognitive), this information is presented in Table 7.

To identify Non-Cognitive Competencies, these authors focus on Morrison and Schoo's (2013) approach and on REFLEX database, being able to identify non-cognitive competencies among the 19 competencies included in this database. According to these authors:

'(Non-Cognitive Competencies) include the ability to negotiate effectively; ability to perform well under pressure; ability to coordinate activities; ability to work productively with others; ability to mobilise the capacities of others; ability to make your meaning clear to others; ability to assert your authority; ability to present products, ideas, or reports to an audience; and ability to use time efficiently.' (Blásquez, Herrarte and Llorente-Heras, 2018)

Table 7 – Competencies by type, by Blásquez, Herrarte and Llorente-Heras (2018)

Cognitive Competencies	Alertness to new opportunities
	Ability to come up with new ideas and solutions
	Willingness to question your own and others' ideas
	Ability to write reports, memos, or documents
	Analytical thinking
	Ability to rapidly acquire new knowledge
	Knowledge of other fields or disciplines
	Mastery of your own field or discipline
	Ability to use computers and the Internet
	Ability to write and speak in a foreign language
Non-Cognitive Competencies	Ability to mobilise the capacities of others
	Ability to make your meaning clear to others
	Ability to assert your authority
	Ability to negotiate effectively
	Ability to perform well under pressure
	Ability to coordinate activities
	Ability to use time efficiently
	Ability to work productively with others
	Ability to present products, ideas, or reports to an audience

Regarding correlation between competencies and hourly earnings, which appears as an interesting topic in current challenges for management, these authors conclude that non-cognitive competencies do not show relation with hourly earnings levels. Although, in the other hand, they conclude that 'leadership appears to be positively associated with graduates' earnings, which is somewhat in line with previous works'. They also notice that:

'In contrast, cognitive skills seem to play a slightly more relevant role in explaining earnings of European graduates. In particular, our results support the well-known

positive relationship between intelligence and earnings' (Blásquez, Herrarte and Llorente-Heras, 2018)

Nevertheless, they concluded that 'for women, (…), intelligence abilities are not related at all with their earnings.'. Cognitive skills are positively related to earnings only for male sample.

This gender distinction also appears, within the results presented by these researchers, in the scope of new technologies skills. These authors find out:

'(…) a positive association between competencies related with new technologies and hourly wages. Nonetheless, this relation appears to be only significant for male graduates working as technicians and associate professionals.'

As conclusion, these authors pointed a lack in the literature regarding the international perception of which competencies are creating value and improving labour market, saying that:

'Taking into account the enormous effort made by European governments to ensure that university graduates acquire the necessary competencies, a similar effort should be made to collect more objective and comparable data that enable researchers to better identify those competencies that are more likely to improve their labour market outcomes. At the moment, very few international comparative projects have attempted to obtain information about competencies and much more research should be done in this area.' (Blásquez, Herrarte and Llorente-Heras, 2018)

Crossing literature, one can notice that some authors refer competencies transversal and transferable across not only jobs, but also personal situations (Baxter and Young, 1982; Teijeiro, Rungo and Freire, 2013) while others distinct specific technical skills by occupation, task or job.

Technologies, Automation and Artificial Intelligence

Before analysing current challenges of technologies and Artificial Intelligence (AI) in workplace, it is important to understand all the noise appeared regarding AI and its role in replacing humans in their jobs. In 1930, John Maynard Keynes described for the first time technological unemployment as a new disease (Wladawsky-Berger, 2018). The review of the literature presented in this section intends to gather information and conclusions regarding technologies and Artificial Intelligence.

Back in 1996, Lawler and Elliot discussed the use of an expert system in both, Human Resources Management (HRM) and other areas where are taken managerial decisions. Firstly, until that date of research, it is important to recognize that expert systems, designed to replicate certain abstract reasoning and problem-solving capabilities of humans (Simon & Kaplan, 1989), are most appropriate in helping users cope with semi-structured problems (Simon, 1978), which are 'those for which a considerable body of knowledge exists as to the ways in which a given problem ought to be tackled' (Lawler and Elliot, 1996)

According to Lawler and Elliot (1996) the way if function and use of an expert system appears like they describe:

> 'Expert systems aid non-experts in solving semi-structured problems by giving them, in effect, on-line access to expertise that may be difficult to develop and in short supply. In typical programs, designers of expert systems utilize various behavioural methods (e.g., verbal protocols) to identify the heuristics of recognized experts.'(Lawler and Elliot, 1996)

With the objective of 'to discern the impact of expert system utilization on problem-solving outcomes within an HRM context', these authors anticipated 'that the human resource management field will increasingly depend upon sophisticated information technology applications' (Lawer and Elliot, 1996). Although their research work, authors conclude that:

> 'We are certainly a long way from being able to create automatons which can replace humans as problem solvers in the HRM field. Managers may see expert systems as a means of economizing on labour costs, much as robotic systems are used in manufacturing. Expert system development costs may be substantial, and the resulting product may not be sufficiently accurate to justify the investment. Yet it is clear that,

under certain circumstances, an expert system can exceed, or at least equal, the accuracy of a conventional problem-solving approach. Thus, despite somewhat ambivalent results, this study does indicate that is feasible to develop expert systems that replicate some nontrivial problem-solving competencies in the HRM field.' (Lawer and Elliot, 1996)

Although the focus of this research work in employee skills, which is a way to know how to improve competitiveness of the companies, it seems important to understand how technology have been appear within the companies' competitiveness view point.

Within this topic, Booth and Philip (1998) focus their work on two different schools of thought on competitiveness, the technology-driven and competency-driven approaches, examining 'the features of each approach and argues the case for a convergence of these opposing views if organizations are to succeed in the 1990s and beyond' (Booth and Philip, 1998).

As early as in 1985, Porter and Millar (1985), referring only to Information Technology (IT), the point under analyses back then, states that 'the question is not whether Information Technology will have a significant impact on a company's competitive position, rather the question is when and how the impact will strike' (Porter and Millar, 1985). So, the inevitability of technological presence in companies and consequently in managerial decisions and workplaces is assumed through literature research since early. The work of Booth and Philip (1998) reveals that point in a very truthful way: their results make them able to redefine Porter's "Model of Industry Structure" which shows the high impact of technology.

Booth and Philip (1998), citing Land (1994), define the competency-approach to competitiveness as acts emphasis the use of IT with other (unique) skills which the organization has at its disposal, states that:

'The acceptance of the competency-driven approach is, to a certain degree, the result of the way in which the environment has changed since Porter's (1980) views were first put forward: global competition, faster product life cycles, increased uncertainty, recession, greater customer awareness, and, increasingly, the introduction of often computerized delivery channels such as the Internet. These have all played a part in the changing nature of competition from a highly-planned and one-dimensional stance, to the need for a more multifaceted, easy to change, and increasingly tailored response.

(…) This new structure is built around flexibility, adaptability, and anticipation of customer needs.' (Booth and Philip, 1998)

Like this, several evidences can be found in the literature recognizing and validating the importance of the technology in companies for their success.

Important is also to understand in what way technologies and technological changes impacts organizations, namely companies with a high level of technological integrations.

Lane Heine, Grover and Malhotra (2003) developed a meta-analysis of the proposed and tested models of technology effectiveness. According to the authors, 'the most part of these models tend to be isolated representations rather than cumulative studies that systematically build upon each other.' (Heine, Grover and Malhotra, 2003).

These authors, from their meta-analysis, conclude for five major insight points. First, they conclude that 'there are very few fit models in technology research'. Most models report role of the technology in terms of moderating or mediating relationships. According, to the authors, fit is important because of its premise that certain levels of each variable give the best match to specific levels of the other. They also refer that:

> 'the level of training, not just a yes—no dichotomization of training, must be fit with the technology attribute. A fully automated technology may require some training, but not at the levels required by a technology with less automation and more functionality.' (Lane Heine, Grover and Malhotra, 2003)

Secondly, authors report, by their research, 'the combining of all business technologies into one group dilutes the impact of individual management techniques' (Lane Heine, Grover and Malhotra, 2003). According to them, to identify categories and attributes of technologies that tend to have similar impacts on performance under different management styles would be an important contribution to technology research.

In third, results are not comparable and generalizable by the lack of external validation, in the way 'studies either lump all technologies together or only look at a specific technology' (Lane Heine, Grover and Malhotra, 2003). Conclusions regarding managerial decisions, approaches or perspectives are not possible without comparisons across-technologies.

Fourth conclusion is that process level research needs a framework for organizing and understanding findings, because it is very often focused on a particular technology and results cannot be used cumulatively to create new conclusions about technology management, in general.

At least, Lane Heine, Grover and Malhotra (2003) state that:

> 'Construct definitions are inconsistent and therefore not comparable. Researchers in the use of technology use a variety of definitions for variables. Technology itself is defined in many ways, from tangible equipment itself, to a combination of people, processes and material.' (Lane Heine, Grover and Malhotra, 2003)

These authors conclude by creating an illustrative model, presented in Figure 1, based on their literature review and which 'needs to be fleshed out in greater detail and better grounded in theory' (Lane Heine, Grover and Malhotra, 2003). Their model contains four dimensions, of which are most relevant for the present research the "Individuals & Roles" one.

Figure 1 – General model of technology and performance, by Lane Heine, Grover and Malhotra (2003)
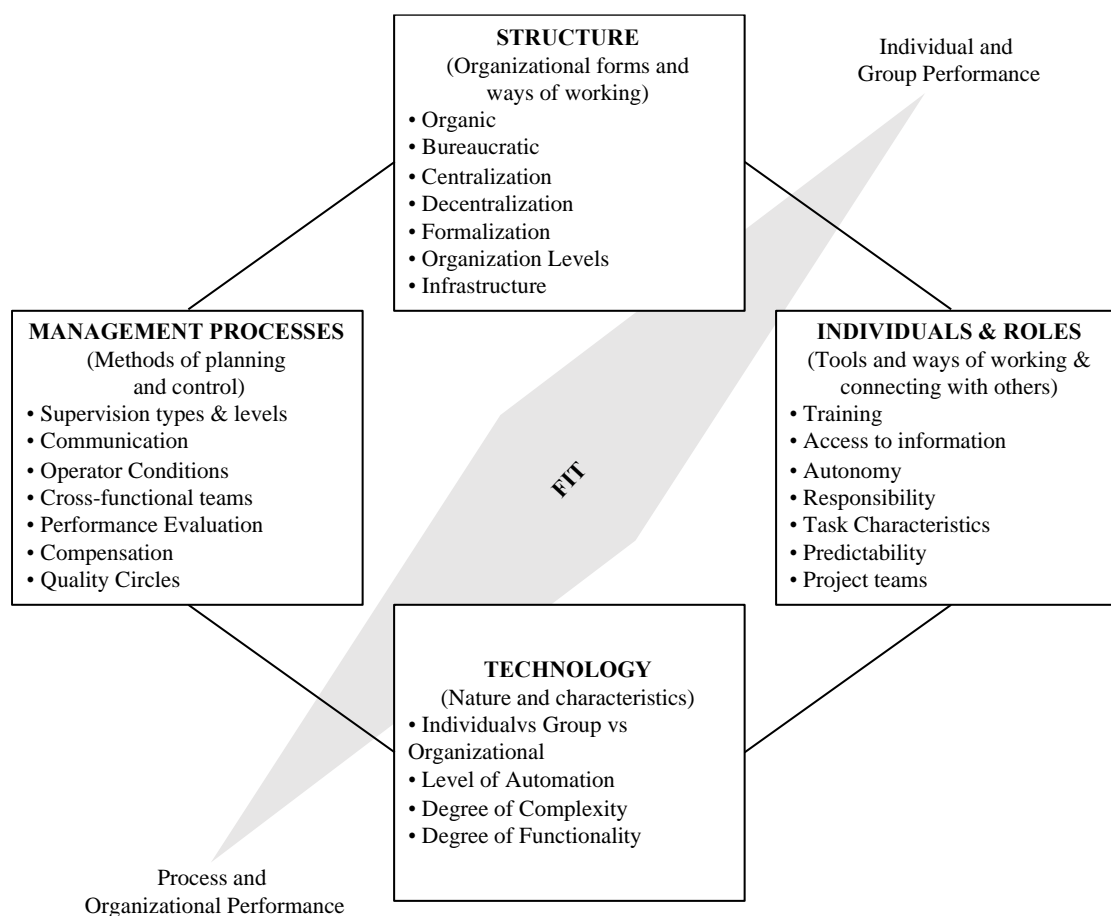
Recognizing the change technology creates in an organization, including its people, procedures and culture, Ghani and Jayabalan (2000) developed a framework analysing the technology implementation effect on a company.

According to these authors, "technology implementation" 'occurs through structural mechanisms that are designed in pursuance of manufacturing objective.' (Ghani and Jayabalan, 2000). Framework, showed in Figure 1, created by these authors:

'describes a firm's technology as an endogenous variable, following the evolutionary models, that undergoes frequent adaptations to remain technically competitive. Any change in market demand affects the product of a manufacturing firm and forces it to redesign the product. Many times the existing technology may be inadequate to incorporate the required change in the products.' (Ghani and Jayabalan, 2000)

Figure 2 – Conceptual Framework of Technological Change and Posited Relationship, by Ghani and Jayabalan (2000)
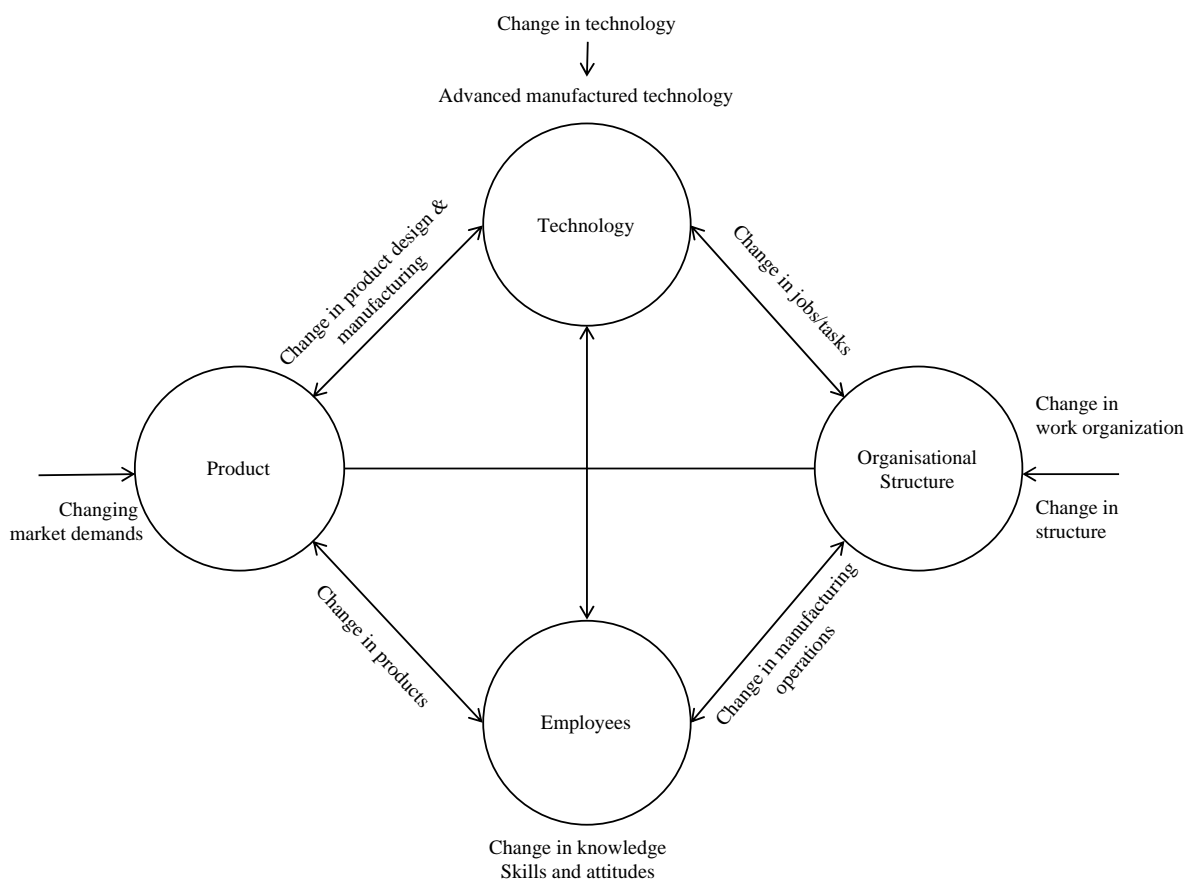
Within this proposed framework, one must look for "Employees" factor, for which authors refer:

> Implementation of AMT[1] in many organizations has failed mostly for reasons of organizational and human dimensions, regardless of technology level. Several studies suggest that technology implementation is more likely to be successful when the technology, organization, and people issues have been designed to complement and integrate with each other and that such integrative planning is rarely done successfully (Preece, 1995; King & Anderson, 1995). Employees' resistance to change factor can lead to work slowdowns, poor employee morale, high maintenance cost, and even sabotages (Davids & Martin, 1992). (Ghani and Jayabalay, 2000)

These authors state that, when there is an implementation of a new technologies, "total productivity" at first falls 'because of natural response of employees' resistance to accept new technology' (Ghani and Jayabalay, 2000). Notwithstanding, as workers familiarize to new technology, their acceptance rate improves and their attitudes towards new technology become more positive. Actually, their proficiency and skill rate turn into considering normal levels. According to Chattopadhyay & Pareek (1982), cited by Ghani and Jayabalay (2000), 'a proactive approach to minimize the resistance to change is to explain the benefits of new technologies to both company and the employees themselves.'

For a better planning of technological change in the organization, AMT could be presented in four levels: low volume flexible technologies; high volume manufacturing technologies; product design technologies; and information exchange technologies. (Ghani and Jayabalay, 2000; Heine, Grover and Malhora, 2003)

Regarding the impact of AMT implementation and change on employees, these authors refer psychological barriers as a factor for unsuccessful implementation. Ghani and Jayabalay (2000) present different factors related to a positive or negative reaction to a technological change, namely:

- inadequate or improper communication, which 'results in confusions and rumours among employees' and 'develops uncertainty, which in turn leads to reluctance and less commitment among employees';

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[1] Advanced Manufactured Technology, by Ghani and Jayabalan (2000)

- job security and job displacement, authors say employees resist technological change being afraid of that implementation would reduce or eliminate the need for their skills, by their employers. 'New technology has the potential to isolate and deskill the worker to diminish the power from the worker.' (Ghani and Jayabalay, 2000)

- phobia and stress, authors say, 'anxiety and emotional fear towards new technology lead to committing mistakes that would cost heavily in AMT' and that 'Technological change induces stress among operators, which is caused by anxiety and tension associated with technological change'

According to Argote, Goodman, and Schkade (1983), workers of AMT experienced more stress than they had in their previous jobs. Another factor of anxiety among blue collar workers is the fear of excess of work, produced by reduction of cycle time is.

Regarding the impact and importance Artificial Intelligence in society and, as well, in workplace and managerial decisions, Gonzalez-Jimenez (2018) advanced two key arguments:

'First, humanoid robots will have important implications for society, retailers and marketers; especially when they develop human-like self-awareness. Second, the article argues that once robots reach such human like self-awareness capabilities, the notion of the consumer should be extended beyond humans as robots may use brands as a means of self-expression.' (Gonzalez-Jimenez, 2018)

It is notorious for authors, and for the civil society, the impact of Artificial Intelligence and robotics in daily-basis. This impact will, certainly, increase and be more and more recognizable.

In what concerns with the crucial question of "Will robots substitute humans?", it seems to be interesting to look for an example Jarrahi (2018) give:

'Chess provides an example. Even chess masters' abilities to predict and process contingencies in the game is largely limited by their cognitive capacities; they are believed to only consider 100 contingencies (almost 10% of the possibilities of a move and response (Simon, 1982)). AI has long surpassed this constrained cognitive capacity, beginning with IBM Deep Blue's 1997 defeat of Gary Kasparov, a chess grandmaster at the time. This marked the beginning of a new era, and many predicted the end of the

game of chess. However, when Kasparov developed his own vision of a new chess league (similar to the idea of freestyle martial arts), the best chess player was neither AI nor human. They were what he called centaurs, essentially partnerships between humans and AI. The example of chess proposes a vision for the complementary roles of humans and AI; they offer different yet complementary capabilities needed for effective decision making.'

However, this author reveals the human advantage of being intuitive in making decisions, referring that 'abstract thinking and an intuitive approach can handle unconventional and creative decision-making situations' (Gardner & Martinko, 1996, quoted by Jarrahi, 2018). This author adds that this intuitive reaction and decision making 'is almost impossible to simulate with AI' (Parikh, Lank, & Neubauer, 1994, quoted by Jarrahi, 2018).

Recognizing there are differences between humans and robots, Jarrahi propose two ways to make a partnership between them. First, this author suggests specializing each one of the intervenients in different aspects, namely:

'AI is likely to be well positioned to tackle complexity issues (using analytical approaches). Humans can focus more on uncertainty and equivocality, using more creative and intuitive approaches.' (Jarrahi, 2018)

Secondly, Jarrahi presents, like showed in Figure 3, that the most complex decisions are likely to involve marks of uncertainty and equivocality, which induces and requires human involvement, author add that 'Therefore, humans and AI will play a combined role in almost all complex decision making' (Jarrahi, 2018).

Figure 3 – Complementarity of humans and AI in decision-making situations, typically characterized by uncertainty, complexity, and equivocality, by Jarrahi (2018)

UNCERTAINTY	**COMPLEXITY**	**EQUIVOCALY**
Humans: Make swift, intuitive decisions in the face of unknown. AI: Provide access to realtime information (e.g. anomaly detection).	Humans: Decide where to seek and gather data. Choose among options with equal data support. AI: Collect, curate, process, and analyse data.	Humans: Negotiate, build consensus and rally support. AI: Analyse sentiments and represent diverse interpretations.

Organizational Change and Employees Reaction

Researchers generally agree that employee resistance is one of the leading causes for the failure of change initiatives, either that change is technological or not (Bovey & Hede, 2001b; Waldersee & Griffiths, 1996). In this scope, it is important to distinguish between the symptoms of their reactions and the causes behind them (Bovey & Hede, 2001b).

Wittig (2012) refer that 'the line in employees' reactions to organizational change between resistance and acceptance is often blurred.' (as shown in figure 4).

Figure 4 – Spectrum of Employees' Reactions to Organizational Change, by Wittig (2012)

Strong Reaction		Strong Reaction
←	●	→
RESISTANCE	NEUTRAL	ACCEPTANCE

According to this author,

'To enable change agents to identify employees' acceptance and resistance, it is important to operationalize definitions of reactions to change. Resistance is a multidimensional attitude toward change, comprising affective (feelings toward the change), cognitive (evaluations of worth and benefit of the change), and behavioural (intention to act against the change) components. Each of these dimensions can be characterized as ranging from

"acceptance" to "resistance." When these three dimensions are considered in the aggregate, the result is the employees' overall acceptance or resistance to change.' (Wittig, 2012)

So, according to this, as change initiatives are not static, and factors continually occur affect employee's reactions, employees' reactions are consistently fluctuating and never stagnant. Employees' reactions to organizational change must be considered "in the moment" rather than over the span of the entire initiative (Lewin, 1951).

VIII. Study Methodology

The methodology used in this dissertation will be applied within three main phases: (i) analysis of information and gather of theoretical evidences, (ii) application of Delphi Method, which literature is reviewed in the through the present section of this work and (iii) application of a questionnaire to a sample of the studied population.

First part was explored in the previous section of this document. Conclusions gathered through the revision of theoretical information, from peer reviewed research, allow to build the initial point to a research with the Panel of experts, through the Delphi Method.

Second part of this study is, as previously presented, run by a Delphi Study, where it will be gathered a consensus from a panel of experts regarding the topic under analysis. The Delphi Method and all the process within this method is explained in following sections.

Finally, the third part of this research is an application of a questionnaire to a sample of Portuguese workers. With this application, it is intended to understand the perception on which competencies population thinks to be important to an employee's positive reaction to a technological implementation in the workplace.

Employers Perception – Delphi Study

Delphi Method

Linestone and Turoff (1975) defined Delphi Method as 'a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem'. This method, as a technique, allows the gather of opinion and/or judgements of experts and practitioners regarding complex matters where precise information or consensus, both of practitioners or academics, is not available.

More than a technique to achieve consensus and to understand what is really going on regarding the topic studied, Delphi Method is also able to produce and develop trends and needs in and for the atmosphere it was created for, in this specific research, the competencies need for an employee who has technologies, automation or robotic in their workplace.

Worthen and Sanders (1987), stated that this "interactive procedure can continue for several more rounds, but the payoff usually begins to diminish quickly after the third round". In this

research, the research done by Delphi Method was conducted by the application of three rounds.

The application of the Delphi method, in the scope of the research developed and presented within this thesis, went through several phases.

Firstly, it was necessary to identify the panel of experts, determining the willingness of individuals to serve on the panel. Every member for the panel was asked to be part of the research by email. When asked, they were introduced to the aim of the research as well as the scope where this research is insert in. It seems important to clarify that every contact stablished with each panel member was done by email.

After the definition of the provisional panel, and the acceptance of some experts contacted, it was gathered a panel with 6 members, whose tenure in their field of action varies from 14 to 28 years.

Following sections of this thesis intend to explain all the different phases of the Delphi Method applied within this research, namely the designing of the panel, the construction of the instrument to data collection, the number of rounds and the results obtained for each round.

Designing the Delphi Panel - sample

Considering that the outcome of a Delphi research is as valid as the opinion of the experts who made up the panel, the definition of the Delphi panel assumes great importance in which concerns to have a great output from the research process. Furthermore, when something regards to forecasting or analysing phenomenon within subjective topics, there are three types of individual predictions, according to Dalkey and Helmer, 1963.

According to Avella, on one hand, there is *Knowledge* which is based on evidences, in the other hand, there is *speculation* which means that, with a lack of evidences, is only based on guesses with a polite intention. In the middle, it can be found *opinions* which are the result of an individual integration in the two extremes. In further detail, an individual integration in the two scenarios defined as opposites and extremes results in an attempt to combine knowledge based on personal experience and the need of being polite and social integrated within the group(Avella, 2016).

In what concerns to the design of the Delphi panel, and defining which experts invite to participate, it is important to avoid the "representativeness" criteria. Avella (2016) refers that

"choosing a representative sample is something typically sought out in quantitative studies so the results can accurately portray the total population", therefore, for a Delphi study, representation is not a quality to fulfil imperatively, but expertise is.

During the process of experts selection, it were considered critical characteristics, presented by Avella (2016), to the execution of the Delphi method in an accurate and adequate way, namely anonymity, feedback and panel membership.

For the first characteristic, anonymity, it is important to keep in mind that the fact of the consensus achieved does not result from a face-to-face discussion turns it easier to reach then output results, which will be more accurate than in other way. So, anonymity is important because "keeping panel members isolated from each other allows each individual freedom of expression without outside pressure or influence" (Avella, 2016).

In order to assure anonymity through the Delphi study within this research, the use of internet was crucial, so the questionnaire was passed using email, maintaining privacy and confidentiality, only existing a communication of each member only with the researcher, who assumes a very important role within the process, as according to Avella:

> '…the researcher needs to exert extreme care in ensuring that communication with each panel member is maintained on that individual basis. It is even possible that two individuals sharing an office could be members of a Delphi Panel but be unaware of the other's participation.' (Avella, 2016)

In order to fulfil this condition, during this research, only researcher contacted each member of the panel, either to ask him or her to join the Panel, or to contact them in order to have their participation in each round.

Regarding the characteristic of feedback, knowing the process of a Delphi study, which consists in achieving consensus by a communication process, this characteristic is crucial for good results. So, to accomplish this characteristic, having a starting point of the panel deliberations based in question of the questionnaire for each one of the members to consider, the results of this initial questionnaire are collected and consolidated by the researcher and then returned to panel members in three *rounds*. During the time of this Delphi study, contacts between the researcher and the members of the panel were consistent and frequent, always by email, in order to build a relation of commitment between research and experts, so it can have a certainty regarding the feedback from both parts.

Selecting individuals who meet expertise qualifications for panel membership is critical and cannot be overstressed. It is well worth nothing that it is the respective disciplines of the panel members that determine what those qualifications are, and not the researcher. Years in specific practice and holding specific certifications or credentials are examples a researcher might use in choosing panel members. Panel membership criteria chosen to assure this criterion of panel recognition was the years working in the field of Human Resources, which is measurable and identifiable, but not subject to researcher judgment. In this scope, it is important to notice that the six members of the panel have a tenure in the field of Human Resources comprehended between 14 and 28 years.

During the process of selecting expert participants, it were contacted, by email and LinkedIn, 7 previous identified experts. It was explained to them, using the email, the purposes of the research, as well as its importance for the literature and for the Human Resources field. To this first contact, researcher obtained six positive answers and one missing answer.

In this scope, it is important to refer the panel is composed by the following members:

- RH Director of an aviation group, with about 11.000 workers around the world;
- General Director of a company within the pharmaceutical industry, with about 35 workers;
- HR consultant, with an important focus in behavioural training;
- HR Director of a delivery company, inside a group of delivering experts across the Europe, with about 800 workers all over Portugal;
- Senior HR Specialist in development in a company within the automotive industry, with about 6.000 workers;
- RH Responsible in a regulatory public agency with about 400 workers.

Furthermore, according to Akins et al. (2005), there are certain criteria that apply to membership on all Delphi Panels, specifically interest, time and written communication.

So, in what concerns to interest as a criterion to membership on Delphi Panels, is worthy of relevance that the participants express interest in the topic and a willingness to contribute to the research inference. Through the process, this interest, which results from the experts' field of action, generate itself enthusiasm and engagement with the research process.

In other hand, regarding time, this was a complex topic for this research is specific, Avella (2016) refers that potential participants should have time available to dedicate to panel activities and that as a general rule, the larger the panel overall, the higher number of groups

comprising the panel, or the more complex the topic the panel is asked to address will individually or collectively demand greater amounts of time on the part of panel members. In fact, the complexity of the topic approached within the research, implies quality and quantity of time dispended, which contributes for the difficulty to gathered information for this research. To mitigate this lack, it was careful explained to the experts, at the beginning of the research, even before they accept to participate, the needed time to be in the process, so they can be aware of this.

Lastly, considering written communication, this criterion seems to be critical in a process of a Delphi method. Facing the fact that the world is now based on instant communication, with social networks like Facebook, Twitter or WhatsApp, or in formal presentations in a PowerPoint basis and not formal reports, Avella refers that "it is important that panel members be able to articulate their written positions clearly and succinctly". In this context, all contacts were performed in Portuguese, a language all experts master. Furthermore, language of the surveys and panel rounds was consensual within the panel members and it was "the one native language most prevalent among panel members or one based on a specific requirement for a language in which panel members shared fluency", as Avella asks to.

Having a definition of the panel, it was important to design and construct the instrument to the data collection, a questionnaire.

Data Collection Instrument – Questionnaire

Within the Delphi study conducted for this research, it was used, as instrument for data collection, a questionnaire.

After the building of a provisional questionnaire, a pilot test was conducted to identify any issues within the overall questionnaire or even the individual items and questions. The goals of these pilot test were to assess: (a) the average amount of time required to complete the questionnaire, (b) clarity of items, (c) clarity of instructions, and (d) adequacy of the format. Five individuals participated in the pilot test, resulting in a group of changes to the provisional questionnaire, with detailed feedback regarding their perception of the questionnaire.

Considering feedback provided, it was built a final questionnaire, presented in Annex A, constituted by four parts, each one with a specific objective for the research.

Part I intend to gather information regarding the experts' characterization, based on the topics discussed by Avella (2016) presented in the previous section, namely their field of action, the

dimension of their companies and the way they consider that they or their employees' companies are impacted by technological or robotic presence or changes. Additionally, it was requested from the experts to give a brief description of an activity or function prosecuted, currently or previously, that contributes to their perception and expertise in what concerns to important competencies for employees who act in a technological and robotic workplace. This part was conducted through a group of five open questions and one group of four closed questions. In this group of questions, used to assess the way they consider that they or their employees' companies are impacted by technological or robotic presence, experts should classify each sentence in a 1-7 Likert Scale, from *totally disagree* to *totally agree*, according to their perception of exposition, or the exposition of their company, to technological changes.

Second part (Part II) of the questionnaire aims to know in what way experts consider important each competency, proposed by Blásquez, Herrarte and Llorente-Heras (2018) within their distinction between cognitive and non-cognitive competencies, referred in the first section of this thesis, for an employee in a company with presence of robots or automation in the workplace. for ac one of the competencies defined by these authors.

Regarding Part III of the questionnaire, it faces experts with a situation (presented in figure 5) and two workers profiles. It is presented professional, academical and personal paths for both workers, and it is asked which competencies experts do identify in each one of the profiles presented, as well as which worker do they think will have a more positive reaction to a technological or robotic intervention or change in their workplace. through this part of the questionnaire, it will be possible to identify which competencies experts consider more valuable for a worker in a situation of robotic changes/implementations. In this scope, it was proposed to experts to classify who has each one of the following competencies more developed, in their opinion:

- Creativity, proposed as a group and organisational effectivness skill, by Gainer (1988);
- Informatic Knowledge, refered and proposed as a component of Informatic Competencies by Staggers, Gassert, Curran (2002);
- Resilience, proposed by Morrison and Schoon (2013) as a non-cognitive skill;
- Computer Skills, refered and proposed as a component of Informatic Competencies by Staggers, Gassert, Curran (2002);
- Autonomy, Robles and Zárraga-Rodriguez(2015) found consensus in what concers to a moderate impact of this competency in entrepreneurship;

– Self-development, as a way to consider 'problem solving' and 'learning', proposed by Gainer (1988)

To this intention to understand who will be the worker with a more positive reaction, it is important to remember that 'employees' reactions are consistently fluctuating and never stagnant' (Wittig, 2012), so a positive reaction will be, when located in the spectrum proposed by Wittig (2012), more in the *acceptance* vector (the right side of the model presented in figure 4).

Figure 5 – Situation presented in Part III of Questionnaire – Delphi Study

Imagine a situation of a company acting in the field of the automotive components industry. There will be a change in the production line, it will be introduced in it a robot which will solve an identified problem. This robot will contribute to a higher productivity of the factory, producing more components per minute, with the same number of employees.

Consider that Employee A and Employee B are employees in this specific factory sector and will be impacted by this new robot. They will need to learn to use the robot and to solve possible problems that can occur.

Personal and professional profile of both employees are the following:

– *Employee A – did not finish high school; started working in automotive industry in his/her first work; never change his/her job or employer; he/she belong to a scoop troup for 7 years, having been responsible for the organization of the main events of the group; use the internet and computer to interact with his/her family and friends; he/she has 2 kids and is raising them alone because their other parent disappear; his/her children are happy and successful young people.*

– *Employee B – frequented 3 art courses in high school; finished high school; have changed job for four times during his/her career path because he/she was unsatisfied with his/her functions; do not use his/her computer; his/her hobby is painting and baking; has no kids or pets; often attends to workshops in his/her area of interest.*

Last part, Part IV, intends to explore experts' opinion, giving them the possibility to fulfil 6 spaces, ordering, by importance, six competencies considered valuable and important to workers in the presence of technology or robotic in their workplace.

This questionnaire was applied through three rounds to all the initial members of the panel.

For each round of the method, following steps were conducted:

1. Gathering of the individual experts' opinions through an online questionnaire - Annex B;

2. Analysing data gathered from the panel;

3. Compiling information and sending again the questionnaire to each panel member for review; analysing the new input and returning to the panel member the distribution of the responses; asking each panel member to study the data and evaluate their own position based in the responses from the group (when individual responses vary significantly from that of the group norm, the individual is asked to provide a rationale for their differing viewpoint while limitations are placed on the length of the remarks in order to keep responses brief; analysing the input, and sharing the minority, supporting statement with the panel, panel member are again asked to review their position and if not within a specified range, to justify the position with a brief statement.

For this Delphi study, there were performed three rounds of the panel, which procedures and results are explained through the following sections of this thesis.

Delphi Study – First Round

First round of this Delphi study was performed during 26 continuous days and distributed to all the 6 experts who accepted participate in this research. For analysis purposes, each expert is identified with a number from 01 to 06, in order to maintain anonymity.

In what concerns to competencies, proposed by Blásquez, Herrarte and Llorente-Heras (2018) within their distinction between cognitive and non-cognitive competencies, and their importance to a worker with technology or robots in workplace, results are the presented in the following table 8 (presented in the following page).

Through these answers, it was possible to conclude that, according to the panel of experts, the more important competencies, and the ones which reunites more consensus, for an employee with technology or robots in the workplace, were *Ability to rapidly acquire new knowledge*, *Alertness to new opportunities* and *Ability to use computers and the Internet*.

In a global perspective, in the experts' opinion, the less valuable competencies for an employee what has technology or robots in the workplace are *Ability to negotiate effectively*, *Knowledge of other fields or disciplines* and *Mastery of your own field or discipline*.

When faced with the situation presented in Part III of the Questionnaire (see Figure 4), experts considered the following:

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- Expert 01 – considered worker B the one with a more positive reaction to a technological change and robot implementation. Simultaneously, considered that worker B has Creativity, Resilience, Autonomy and Self-development more developed.

- Expert 02 – considered worker A the one with a more positive reaction to a technological change and robot implementation. Simultaneously, considered that worker B has Informatic Knowledge, Resilience, Computer Skills, Autonomy and Self-development more developed. This expert also proposed Flexibility and Adaptability as competencies developed by worker A.

- Expert 03 – considered worker B the one with a more positive reaction to a technological change and robot implementation. Simultaneously, considered that worker B has Creativity, Informatic Knowledge, Computer Skills and Autonomy more developed.

- Expert 04 – considered worker A the one with a more positive reaction to a technological change and robot implementation. Simultaneously, considered that worker B has Informatic Knowledge, Resilience, Computer Skills, Autonomy and Self-development more developed.

- Expert 05 – considered worker B the one with a more positive reaction to a technological change and robot implementation. Simultaneously, considered that worker B has Creativity, Informatic Knowledge, Computer Skills, Autonomy and Self-development more developed.

- Expert 06 – considered worker B the one with a more positive reaction to a technological change and robot implementation. Simultaneously, considered that worker B has Creativity, Informatic Knowledge, Resilience, Computer Skills, Autonomy and Self-development more developed.

Regarding Part IV of the questionnaire, experts catalogue competencies, proposed by them, according to the degree of importance they consider each competency has for an employee with a technological presence in the workplace. Results found out for this first round are presented in table 9. In this scope, it is important to consider the information presented in table 9 is exactly the information provided by experts. At this stage of the research, it was not any kind of speech revision or change.

All experts receive a report with the results found out within the first round, presented in Annex B.

Table 8 – Answers to Part II of the questionnaire – First Round – Delphi Study

	Without Importance	Somewhat Important	Relatively Important	Very Important	Extremely Important	Missing Answer
Alertness to new opportunities	0	0	0	4	2	0
Ability to come up with new ideas and solutions	0	0	2	2	2	0
Willingness to question your own and others' ideas	0	0	2	3	1	1
Ability to write reports, memos, or documents	0	0	3	1	1	1
Analytical thinking	0	0	3	2	1	0
Ability to rapidly acquire new knowledge	0	0	0	3	3	0
Knowledge of other fields or disciplines	0	1	2	1	2	0
Mastery of your own field or discipline	0	1	1	3	1	0
Ability to use computers and the Internet	0	0	0	3	3	0
Ability to write and speak in a foreign language	0	0	1	4	1	0
Ability to mobilise the capacities of others	0	0	3	2	1	0
Ability to make your meaning clear to others	0	0	2	1	3	0
Ability to assert your authority	0	0	3	2	1	0
Ability to negotiate effectively	0	2	0	3	1	0
Ability to perform well under pressure	0	0	1	4	1	0
Ability to coordinate activities	0	0	3	2	1	0
Ability to use time efficiently	0	0	1	4	1	0
Ability to work productively with others	0	0	1	4	1	0
Ability to present products, ideas, or reports to an audience	0	0	2	3	1	0

Table 9 – Answers to Part IV of the questionnaire – First Round – Delphi Study

	Expert 01	Expert 02	Expert 03	Expert 04	Expert 05	Expert 06
1st	Innovation	Adaptability to new situations	Adaptability	Ability to Continuously Learn	Innovation and Change Ability	Proactivity
2nd	Opening for Change	Critical Analysis	Adaptability to Change/ Creativity	Team Work	Creativity	Communication
3rd	Resilience	Resilience	Resilience	Adaptability	Adaptability	Opening for Change
4th	Self-examination	Adaptability	Ability to learn	Creativity	Ability to work with informatic tools	Logical Thinking
5th		Decision Making	Analysis Capacity	Technological Knowledge		Analytical Capability
6th		Stress Resistance	Orientation to continuous improvement	Resilience		Creativity

Delphi Study – Second Round

Second round of this Delphi study were performed during 20 continuous days and distributed to all the 6 experts who accepted to participate in this research. Only five experts participated in this round, and each expert is identified with the same number, from 01 to 06, of the previous round, in order to maintain anonymity and keep consistency in the analysis.

In what concerns to competencies, proposed by Blásquez, Herrarte and Llorente-Heras (2018) within their distinction between cognitive and non-cognitive competencies, and their importance to a worker with technology or robots in workplace, results are the presented in the table 10.

Through these answers, it was possible to conclude that, according to the panel of experts, the more important competencies, and the ones which reunites more consensus, for an employee with technology or robots in the workplace, were *Alertness to new opportunities*, *Willingness to question your own and others' ideas* and *Ability to mobilise the capacities of others*.

In a global perspective, in the experts' opinion, the more valuable competencies for an employee who has technology or robots in the workplace are *Alertness to new opportunities*, *Ability to come up with new ideas and solutions*, *Willingness to question your own and others' ideas, Ability to rapidly acquire new knowledge* and *Ability to use computers and the Internet*.

As well in a global perspective, in the experts' opinion, the less valuable competency for an employee who has technology or robots in the workplace is *Ability to negotiate effectively*.

When faced with the situation presented in Part III of the Questionnaire (see Figure 4), experts considered the following:

- Expert 02 – considered worker A the one with a more positive reaction to a technological change and robot implementation. Simultaneously, considered that worker A has Creativity, Informatic Knowledge, Resilience, Autonomy and Self-development more developed. For this round, this expert did not propose more competencies than the proposed ones.

- Expert 03 – considered worker B the one with a more positive reaction to a technological change and robot implementation. Simultaneously, considered that worker B has Creativity, Informatic Knowledge, Resilience, Computer Skills and self-development more developed.

- Expert 04 – considered worker A the one with a more positive reaction to a technological change and robot implementation. Simultaneously, considered that worker B has Informatic Knowledge, Resilience, Computer Skills, Autonomy and Self-development more developed.

- Expert 05 – considered worker B the one with a more positive reaction to a technological change and robot implementation. Simultaneously, considered that worker B has Creativity, Informatic Knowledge, Computer Skills, Autonomy and Self-development more developed.

- Expert 06 – considered worker B the one with a more positive reaction to a technological change and robot implementation. Simultaneously, considered that worker B has Creativity, Informatic Knowledge, Resilience, Computer Skills, Autonomy and Self-development more developed.

Regarding Part IV of the questionnaire, experts catalogue competencies, proposed by them, according to the degree of importance they consider each competency has for an employee with a technological presence in the workplace. Results found out for this second round are presented in table 11. In this scope, please note the information presented in table 11 is exactly the information provided by experts. At this stage of the research, it was not any kind of speech revision.

All experts receive a report with the results found out within this round, presented in Annex C.

Table 10 – Answers to Part II of the questionnaire – Second Round – Delphi Study

	Without Importance	Somewhat Important	Relatively Important	Very Important	Extremely Important	Missing Answer
Alertness to new opportunities	0	0	0	4	1	0
Ability to come up with new ideas and solutions	0	0	0	2	3	0
Willingness to question your own and others' ideas	0	0	0	4	1	0
Ability to write reports, memos, or documents	0	2	0	2	0	0
Analytical thinking	0	0	2	1	2	0
Ability to rapidly acquire new knowledge	0	0	0	2	3	0
Knowledge of other fields or disciplines	0	1	1	2	1	0
Mastery of your own field or discipline	0	0	2	1	2	0
Ability to use computers and the Internet	0	0	0	2	3	0
Ability to write and speak in a foreign language	0	0	1	2	2	0
Ability to mobilise the capacities of others	0	0	1	4	0	0
Ability to make your meaning clear to others	0	0	2	2	1	0
Ability to assert your authority	0	0	3	1	1	0
Ability to negotiate effectively	0	2	1	1	1	0
Ability to perform well under pressure	0	0	2	2	1	0
Ability to coordinate activities	0	0	3	1	1	0
Ability to use time efficiently	0	0	1	2	2	0
Ability to work productively with others	0	1	0	3	1	0
Ability to present products, ideas, or reports to an audience	0	1	1	2	1	0

Table 11 – Answers to Part IV of the questionnaire – Second Round – Delphi Study

	Expert 02	Expert 03	Expert 04	Expert 05	Expert 06
1st	Change Management	Adaptability	Opening for Change	Innovation and Change Ability	Proactivity
2nd	Resilience	Adaptability to Change	Ability to Continuously Learn	Creativity	Communication
3rd	Stress Resistance	Self-learning	Analytical Thinking	Adaptability	Opening for Change
4th	Organization of the work	Orientation to continuous improvement	Team Work	Ability to work with informatic tools	Logical Thinking
5th	Time Management		Resilience		Analytical Capability
6th	Creativity		Positiveness		Creativity

Delphi Study – Third Round

Third round of this Delphi study were performed during 18 continuous days and assigned to all the 6 experts who initially accepted to participate in this research. Only four experts participated in this round, and each expert is identified with the same number as it was for the previous rounds, from 01 to 06, in order to maintain not only the anonymity of the expert but also to keep consistency within the analysis.

In what concerns to competencies, proposed by Blásquez, Herrarte and Llorente-Heras (2018) within their distinction between cognitive and non-cognitive competencies, and their importance to a worker with technology or robots in workplace, results are presented in the table 12.

Through these answers, it is possible to observe three competencies reach a consensus regarding the level of importance for an employee with technological presence in workplace: *Knowledge of other fields or disciplines*; *Ability to perform well under pressure*; *Ability to coordinate activities*. Each one of these competencies was considered by all the experts as Very Important to an employee who deal with technology in the workplace.

Table 12 – Answers to Part II of the questionnaire – Third Round – Delphi Study

	Without Importance	Somewhat Important	Relatively Important	Very Important	Extremely Important	Missing Answer
Alertness to new opportunities	0	1	0	1	2	0
Ability to come up with new ideas and solutions	0	0	0	2	2	0
Willingness to question your own and others' ideas	0	0	0	3	1	0
Ability to write reports, memos, or documents	0	1	1	2	0	0
Analytical thinking	0	0	0	2	2	0
Ability to rapidly acquire new knowledge	0	0	0	2	2	0
Knowledge of other fields or disciplines	0	0	0	4	0	0
Mastery of your own field or discipline	0	0	0	1	3	0
Ability to use computers and the Internet	0	0	0	2	2	0
Ability to write and speak in a foreign language	0	0	0	3	1	0
Ability to mobilise the capacities of others	0	0	1	3	0	0
Ability to make your meaning clear to others	0	0	0	2	2	0
Ability to assert your authority	0	0	0	3	1	0
Ability to negotiate effectively	0	1	1	2	0	0
Ability to perform well under pressure	0	0	0	4	0	0
Ability to coordinate activities	0	0	0	4	0	0
Ability to use time efficiently	0	0	1	2	1	0
Ability to work productively with others	0	1	0	2	1	0
Ability to present products, ideas, or reports to an audience	0	0	1	2	1	0

Additionally, it is possible to conclude that, according to the panel of experts, the more important competencies for an employee with technology or robots in the workplace, the ones which were listed only as Very Important or Extremely Important, apart the ones considered only as Extremely Important, were: *Ability to come up with new ideas and solutions*, *Willingness to question your own and others' ideas*, *Analytical thinking, Ability to rapidly acquire new knowledge, Mastery of your own field or discipline, Ability to use computers and the Internet, Ability to write and speak in a foreign language, Ability to make your meaning clear to others* and *Ability to assert your authority.*

In a global perspective, according to the experts' opinion, the more valuable competency, it means the competency listed by more experts (three in a total of four experts) as Extremely Important, is *Mastery of your own field or discipline*.

As well in a global perspective, in the experts' opinion, the less valuable competencies, within the ones presented to the experts, for an employee who has technology or robots in the workplace are *Ability to negotiate effectively* and *Ability to write reports, memos, or documents*.

When faced with the situation presented in Part III of the Questionnaire (see Figure 4), experts considered the following:

- Expert 02 – considered worker A the one with a more positive reaction to a technological change and robot implementation. Simultaneously, considered that worker A has Creativity, Informatic Knowledge, Resilience, Computer Skills, Autonomy and Self-development more developed. For this round, this expert proposed also that worker A has developed the ability to work under pressure and also the ability to work in a team.

- Expert 03 – considered worker B the one with a more positive reaction to a technological change and robot implementation. Simultaneously, considered that worker B has Creativity, Informatic Knowledge, Computer Skills and Self-Development more developed.

- Expert 05 – considered worker B the one with a more positive reaction to a technological change and robot implementation. Simultaneously, considered that worker B has Creativity, Informatic Knowledge, Computer Skills, Autonomy and Self-development more developed.

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– Expert 06 – considered worker B the one with a more positive reaction to a technological change and robot implementation. Simultaneously, considered that worker B has Creativity, Informatic Knowledge, Resilience, Computer Skills, Autonomy and Self-development more developed.

When questioned regarding the competencies not mentioned that could be important for a positive reaction to the technological implementation described, experts also proposed adaptability to change (expert 02), problem solving (expert 02 and expert 03), decision making capability (expert 02), technical knowledge for the software/equipment (expert 03), process management (expert 03), orientation to continuous improvement (expert 03), quality focus (expert 03), adaptability (expert 05), continuous learning (expert 05), constructive feedback (expert 05) and strategic behaviour (expert 05).

Regarding Part IV of the questionnaire, experts catalogue competencies, proposed by them, according to the degree of importance they consider each competency has for an employee with a technological presence in the workplace. Results found out for this second round are presented in table 13. In this scope, it is important to consider that the information presented in table 13 is exactly the information provided by experts, no changes were made in the speech used by them.

All experts receive a report with the results found out within this round, presented in Annex D.

Table 13 – Answers to Part IV of the questionnaire – Third Round – Delphi Study

	Expert 02	Expert 03	Expert 05	Expert 06
1st	Adaptability to New situations	Adaptability to Change	Innovation and Change Ability	Proactivity
2nd	Adaptability	Adaptability	Creativity	Communication
3rd	Resilience	Self-learning	Adaptability	Opening for Change
4th	Capability to work under pression	Problem solving	Ability to work with informatic tools	Logical Thinking
5th	Self-esteem			Analytical Capability
6th	New challenges appetite			Creativity

Results Analysis – Delphi Study

In the scope of the understanding, from a perspective of the employer, which competencies are valuable for an employee who deal with robots or technology in his workplace, it is important to state the results gathered through the Delphi Study performed.

The previous sections of this dissertation present the process of building, defining and proceeding the Delphi Method. In this section, one intends to expose the general conclusions obtained from the Delphi Study performed.

Regarding collected information, it is important to understand the competencies experts proposed in the last part of the questionnaires (presented for 1st Round, 2nd Round and 3rd Round in Table 9, Table 11 and Table 13, respectively).

It is important to notice that the questionnaire was passed through experts in their mother language, Portuguese, so they can feel more comfortable reading and writing. All proposed competencies were written in Portuguese by the experts, with no guidelines. So, it seems to be natural that the results show different competencies, notwithstanding the possibility different competencies, presented by different experts, has the same meaning at the end of the research. In order to adequate this speech differences, all competencies were reviewed and aligned in a group of major, and more standardized, competencies, as it will be showed in next paragraphs.

For the first round it was proposed a total of 32 competencies by 6 experts, in the second round were proposed a total of 26, by 5 experts, and, within the last round, the third one, it was proposed a total of 20 competencies by 4 experts.

After the revision of the competencies proposed, only in a perspective of language and differences of speech, it is possible to conclude that it were proposed a total of 82 different competencies. So, according to a deep revision of each one of these competencies, reviewing and standardizing the way they were exposed and written by experts, it results in a group of 29 different competencies, presented in table 14.

Table 14 – Competencies proposed by experts through the three rounds of Delphi Study

Competency	Number of times referred through the Delphi Study
Adaptability	10
Creativity	9
Resilience	7
Innovation Ability	5
Opening for Change	5
Analytical Capability	4
Ability to work with informatic tools	4
Learning capability	3
Proactivity	3
Communication	3
Logical Thinking	3
Adaptability to change	3
Stress Resistance	2
Team Work	2
Self-learning	2
Self-examination	1
Decision maker	1
Orientation to continuous improvement	1
Change Management	1
Organization of the work	1
Time management	1
Analytical thinking	1
Positiveness	1
Capability to work under pressure	1
Self esteem	1
New challenges appetite	1
Problem Solving	1

In a more detailed revision of the gathered data, it seems as relevant to analyse the predominance of some competencies, which will be important for the following phases of this research. So, within this scope, it will be analysed the reference, through the three rounds, to Resilience, Adaptability, Informatic Competencies, Learning Skills and Creativity. These competencies were chosen to a deepest analysis based on, not only the number of times it was referred by experts, but also on the literature review done and the personal researcher

understanding of that. Additionally, for an easier analysis, consider Informatic Competencies as the *Ability to work with informatic tools* proposed 4 times through the Delphi Study.

Table 15 – Percentage of reference by experts through the Delphi Study

	1st Round	2nd Round	3rd Round	Weighted Average Percentage of Reference
	6 experts	5 experts	4 experts	
Resilience	66.7%	40.0%	25.0%	46.7%
Adaptability	66.7%	60.0%	75.0%	66.7%
Informatic Competencies	33.3%	20.0%	25.0%	26.7%
Learning Skills	33.3%	40.0%	25.0%	33.3%
Creativity	66.7%	60.0%	50.0%	60.0%

According to the information gathered and displayed in the table 15, it is possible to understand the percentage of experts who refer each competency, as well as the weighted average of reference by the experts for listed competencies. Weighted average is computed as follows:

$$\bar{x} = \frac{sum\ of\ number\ of\ competency\ references\ in\ each\ round}{total\ of\ experts\ participating\ in\ all\ rounds} \quad (4)$$

In this scope, in average, the more referenced competencies were *Adaptability* and *Creativity* with 66.7% and 60.0%, respectively. The less referred was *Informatic Competencies* with 26.7% of references.

Knowing that the intend to this research is to find out which competencies are considered more valuable, both by employees and employers, for a positive reaction of employees when dealing with robots or technology in their workplace. This research intends to answer to this problem by both perspectives: the one of the employers and the one from employees.

The first perspective, from the employers, was explored within the Delphi Study performed and presented in the previous sections of this dissertation. From this study result a group of competencies proposed by the experts, which will be used in the construction of a purposed relation that will be crossed with the results gathered from the Portuguese workers inquired.

So, as result from the Delphi Study performed and the literature reviewed, it is proposed that the reaction of an employee to technology or robots in his workplace is impacted by two big groups of competencies: Informatic Skills (which are constructed based on two different topics

– informatics knowledge and computer skills) and Personal Competencies (based on the competencies proposed by experts, namely *Adaptability*, *Resilience*, *Creativity* and *Learning Skills*).

It is just worth pointing out that it will be considered the integration of the Informatic Skills in the options proposed to the sample of Portuguese employees, although experts do not attribute to these competencies a relevant importance for a positive employee reaction. Notwithstanding this, it seems to be important within the literature in the field to understand the perception of the employees regarding the importance of informatic competencies to deal with technological presences in their workplace.

Additionally, one very important aspect is to realise that all and each one of the competencies proposed by experts, and used in the research within the Portuguese workers, are referred through the literature analysed to perform this research, as listed below.

  – Creativity, proposed as a group and organisational effectivness skill, by Gainer (1988);
  – Resilience, proposed by Morrison and Schoon (2013) as a non-cognitive skill;
  – Informatic Competencies, refered and proposed by Staggers, Gassert, Curran (2002);
  – Adaptability, proposed, by Cotton (1993), as an affective skill and trait; and
  – Learning Skills, proposed, by Cotton (1993), as an high-order thinking skill.

Figure 6 – Proposed relation by experts
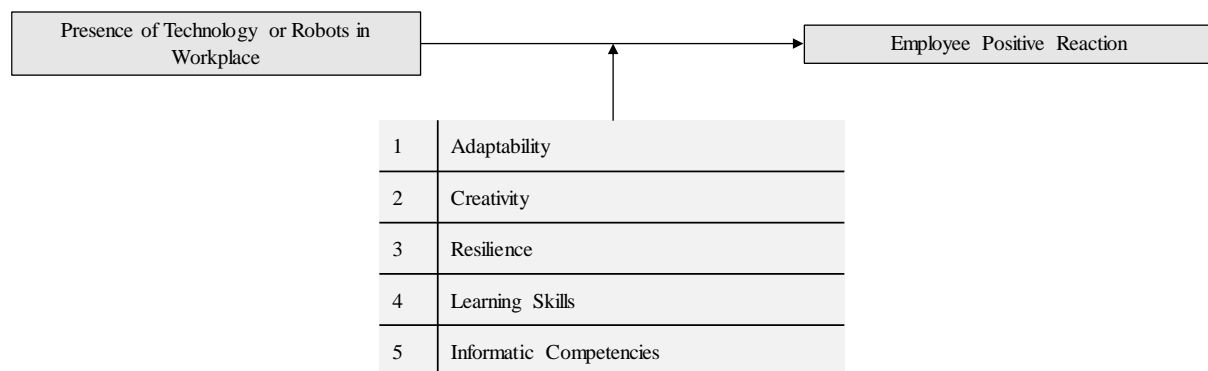
Stating what is associated to the figure above, one can propose that the employees' perception is that the competencies which contributes to a positive reaction between the presence of artificial intelligence or automation in the worker workplace and his positive reaction are, by level of importance attributed by workers: *Adaptability*, *Creativity*, *Resilience*, *Learning Skills* and *Informatic Competencies*.

Regarding what is understand by a positive reaction of an employee, it is important to restate, as previously done, that employees' reactions are consistently fluctuating and never stagnant (Wittig, 2012), so a positive reaction will be, when located in the spectrum proposed by Wittig (2012), more in the acceptance vector (the right side of the model presented in figure 4).

In order to understand if *supra* defined employers' perception are supported or not, it was distributed a questionnaire to the general Portuguese population of workers, which process will be detailed, explored and explained during the following sections of this dissertation.

Employees Perception – Questionnaire Analysis

It is intended to understand the perception on which competencies population thinks to be important to an employee's positive reaction to a technological implementation in the workplace. With this intent it was built a questionnaire, as followed described.

Construction of the data collection instrument – Questionnaire

As well as done for the Delphi Study performed in the second phase of the research presented through this dissertation, for this phase it was used a questionnaire (Annex E), to gather the desired information, consisting in a series of questions. In this specific case, questionnaire should be thought of as a kind of written interview.

A pilot test was conducted to identify any issues within the overall questionnaire or even the individual items and questions. The goals of these pilot test were to assess, as previously done with the Delphi Questionnaire: (a) the average amount of time required to complete the questionnaire, (b) clarity of items, (c) clarity of instructions, and (d) adequacy of the format. Fifteen individuals participated in the pilot test, resulting in a group of changes to the provisional questionnaire, with detailed feedback regarding their perception of the questionnaire.

With the provided feedback, it was built a questionnaire, which will be presented in the following paragraphs.

Questionnaire was carried out online, being distributed using online platforms like email and social networks.

The utilisation of a questionnaire provides a cheap, quick and efficient way of obtaining information from a large sample of people, namely Portuguese workers.

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In this way, through a questionnaire written in Portuguese, data can be collected relatively quickly because the researcher did not need to be present when the questionnaires were completed. This was useful to achieve a representative sample of the population, bigger enough to that, which makes interviews impractical.

Following paragraphs explain and explore the sections of the questionnaire (presented on Annex E)

Part I intend to gather information regarding the respondent characterization, namely: years of experience as worker; gender; professional situation (whether respondent is employed or not, as well as a dependent employee or not); field of action; completed education. Additionally, it was requested to the respondent to describe the frequency he works with computers, internet, programming language and robotic machines. At least, it was requested to the respondent to classify the exposition of his work to technological changes, according to his own perception.

Given the goal to achieve a representative sample of Portuguese population of worker, and to simplify the process of characterization of this sample, this Part of the questionnaire was conducted through seven closed questions. To understand the frequency of use of computers, internet, programming language and robotic machines, it was used a question where are presented four sentences and respondent should classify these ones according to a Likert scale of frequency (from *never* to *in a daily basis*).

Second part of the questionnaire intends to understand the perception of each respondent regarding competencies proposed by the experts within the Delphi Method (Figure 6), namely Creativity, Resilience, Informatic Competencies, Adapatability and Learning Skills.

In order to achieve and improve the respondent perception of his own competencies, it was defined two sentences for each one, a positive and a negative one. Respondent needed to classify each one of the sentences, presented in Table 16, according to a Likert Scale of 5 levels (from *totally disagree* to *totally agree*).

Table 16 – Percentage of reference by experts through the Delphi Study

Competency	Positive Sentence	Negative Sentence
Resilience	When facing a setback, I always try to find a solution	When facing difficulties, I easily feel unmotivated.
Adaptability	When facing changes, I easily adapt myself to that.	In a situation of change, I many times feel myself as powerless.
Informatic Competencies	I frequently use computers and the internet.	I avoid the utilisation of computers or the internet to solve problems.
Learning Skills	When I need to learn something, it is easy to me to do that.	I feel difficulties in leaning every day in my work.
Creativity	I find myself a creative person when approaching new issues or problems.	When I need to be creative, I feel I am less productive than I should.

Using the classification to each one of these sentences, it was possible to define the perception of the respondent regarding each competency, because they are exposed to a positive and a negative example of each competency, although they did not perceive directly which competency is being exposed and explored in each example.

Regarding Part III of the questionnaire, it faces respondents with a situation of technological or robotic change in their workplaces. Facing this, it was asked to respondents to classify a group of sentences, which represent possible reactions of the respondent. Each respondent needed to classify each one of the sentences, listed below, according to a Lickert Scale of 5 levels (from totally disagree to totally agree). This part allows the researcher to understand the reaction that respondents expect to have, when dealing with a technological change in his workplace. The reactions presented to be classified by respondents are:

- I will try to know the technology before its implementation;
- I will attend all the training and briefings offered by the employer about the technology;
- When my colleagues perceive the new technology as difficult, I will wait for the company to help them;
- I will find the bes way to use this new technology in order to increase my productivity at work;
- It is a company obligation to provide constant support and intensive training regarding the new technology implemented;
- In the case of feeling difficulties with the new technology, I will share it with my superiors, reccommended improvements.

After facing all this characteristics of themsvles and the reaction expected by them to have in a situation of technological changes or presence in workplace, respondents had to answer to the last question of questionnaire.

This last question of the questionnaire, Part IV, crucial for this research, is a ordering question, it means that it is presented to the respondents a list of competencies, which the respondent should ordering according to a specific criteria. Specifically, in the case of this questionnaire, it were presented six competencies (*Adaptability*; *Proactivity*; *Learning Skills*; *Informatic Competencies*; *Resilience* and *Creativity*), based on the review of the litherature done and on the results gathered from the panel of experts, which each respondent have to order form 1 – more important to 6 – less important, regarding his own perception about the importance of the competencies for a worker to have a positive reaction to a technological inovation or change in the workplace.

Although proactivity is not a ompetency which results from the more refered by the experts, it is consistently refered by Expert 06, and it makes part of the personal interest of the researcher to understand the vision of the employees regarding this competency in the scope of technological implementations and presence. So, this competency was also integred in Part IV of the questionnaire.

This questionnaire was, as previously refered, build in portuguese, using for that the Qualtrics Software, which allows respondents to answer the questionnaire online.

Population, Sample and Data Collection

Given the objectives of this study and the variables to be studied, the population was defined as portuguese individuals who have ever work. This was the only selection criteria, which conducts to a sample with a dimension hard to acess. In order to access these individuals, a non-probabilistic sampling, convenience sampling, which consists of selecting the subjects to integrate in the sample through a criterion of availability, ease and speed. This technique does not allow generalization to the population of the results obtained in the sample. However, given the temporal limitations of this study, the use of a probabilistic sampling technique was not feasible. In this sense, Hill (1998) refered:

> 'It appears that determining sample size for an e-survey is not a cut-and-dried procedure. Despite a large amount of literature on the topic, seemingly in all cases there is an element of arbitrary judgement and personal choice involved.' (Hill, 1998)

Furhermore, the initial goal was of 200 valid answers, to make able the representativeness of the population. Thus, the questionnaire was available for online filling for four weeks, between July and August of 2018. This sampling technique proved to be effective, since 368 responses were obtained, a number that exceeded researcher expectations.

After the questionnaire responses were collected, they were reviewed to decide whether they could be integrated into the sample or not. It was defined that for a response to be considered two conditions should be guarantee

1. to have answered to the Part IV of the questionnaire, ordering the six competencies presented;
2. to have answered at least one of the characterization questions socio-demographic (Part I)

With this procedure we excluded 44 responses of the initial 368, remaining a total of 324 valid answers to the questionnaire. After the responses were inserted into the database, a statistical treatment was performed, using SPSS software.

Sample Characterization

In this section, one intends to characterize the sample of this study, composed of 324 individuals, in what concerns to sociodemographic aspects.

In the sample of this research, 52.5% of the respondents are female and 47.5%.

Regarding the number of work years of the respondents, it were defined clusters to facilitate the analysis. For this question, the distribution is the presented in the Table 17. It can be observed that most represented respondents are the ones who have worked between 1 year and 5 years (28.4%).

Table 17 – Sample Characterization – Years of work

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Less than 1 year**	38	11.7	11.7	11.7
	1 year - 5 years	92	28.4	28.4	40.1
	6 years - 10 years	54	16.7	16.7	56.8
	11 years - 20 years	39	12.0	12.0	68.8
	21 years - 30 years	55	17.0	17.0	85.8
	More than 30 years	46	14.2	14.2	100.0
	Total	324	100.0	100.0	

In what concerns to the professional situation of the respondents, it was defined three options: dependent employee; independent worker and unemployed. For this question, the distribution is the presented in the Table 18. It can be observed that most represented respondents are the dependent employees (89.2%).

Table 18 – Sample Characterization – Professional Situation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Dependent Employee**	289	89.2	89.2	89.2
	Independent Worker	29	9.0	9.0	98.1
	Unemployed	6	1.9	1.9	100.0
	Total	324	100.0	100.0	

Regarding to the field of action of the respondents, it was defined twelve options, based on the INE Portuguese Classification of Profession (Instituto Nacional de Estatística, 2011), presented in the Table 19. For this question, the distribution is the presented as well in the Table 19. It can be observed that most represented respondents act in the Education field (19.4%), followed by the Consultancy field (14.8%) and the Transforming Industries / Energy Resources and Waste Management field (13.0%).

In respect of the education level of the respondents, it was defined seven options, based on the Portuguese National Education System, presented in the Table 20. For this question, the distribution is the presented as well in the Table 20. It can be observed that most represented respondents act in the Education field (19.4%), followed by the Consultancy field (14.8%) and the Transforming Industries / Energy Resources and Waste Management field (13.0%).

Table 19 – Sample Characterization – Field of Action

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Agriculture / Fishing / Extractive Industries / Construction**	8	2.5	2.5	2.5
	Transforming Industries / Energy Resources and Waste Management	42	13.0	13.0	15.4
	Wholesale and Retail / Transportation and Storage	45	13.9	13.9	29.3
	Accommodation and Restaurant	10	3.1	3.1	32.4
	Finance and Insurance	16	4.9	4.9	37.3
	Consulting	48	14.8	14.8	52.2
	Administrative	8	2.5	2.5	54.6
	Public Administration and National Defense	15	4.6	4.6	59.3
	Education	63	19.4	19.4	78.7
	Cheers	24	7.4	7.4	86.1
	Management	12	3.7	3.7	89.8
	Other	33	10.2	10.2	100.0
	Total	**324**	**100.0**	**100.0**	

Table 20 – Sample Characterization – Education Level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Basic Education - 6º Ano**	9	2.8	2.8	2.8
	Basic Education - 9º Ano	40	12.3	12.3	15.1
	High School - 12º Ano	57	17.6	17.6	32.7
	College Education- Bacharelato	10	3.1	3.1	35.8
	College Education - Licenciatura	116	35.8	35.8	71.6
	College Education - Mestrado	85	26.2	26.2	97.8
	College Education - Doutoramento	7	2.2	2.2	100.0
	Total	**324**	**100.0**	**100.0**	

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Regarding the goal of this research, all answers to Part V of the questionnaire were analysed and will be presented through the following paragraphs of this section.

Regarding the *Adaptability*, this competency was considered, as stated in table 21, as the most important competency by 33.0% of the respondents and as the third most important competency by 24.7% of the respondents. In the other hand, only 2.5% of the 324 answers are in the sense that Adaptability is the presented competency with less importance for a worker.

Table 21 – Adaptability – Importance for the worker – Employees' Perception

		Frequency	Percent	Cumulative Percent
Valid	**1st**	107	33.0	33.0
	2nd	58	17.9	50.9
	3rd	80	24.7	75.6
	4th	30	9.3	84.9
	5th	41	12.7	97.5
	6th	8	2.5	100.0
	Total	**324**	**100.0**	

In what concerns to *Proactivity*, this competency was considered, as stated in table 22, as the most important competency by only 13.0% of the respondents and as the fourth most important competency by 27.5% of the respondents. One can notice that there is not a predominant option for this competency by the worker inquired, which can be explained by the low level of importance the give to proactivity as a competency in their professional path.

Table 22 – Proactivity – Importance for the worker – Employees' Perception

		Frequency	Percent	Cumulative Percent
Valid	**1st**	42	13.0	13.0
	2nd	43	13.3	26.2
	3rd	54	16.7	42.9
	4th	89	27.5	70.4
	5th	57	17.6	88.0
	6th	39	12.0	100.0
	Total	324	100.0	

In what regards to *Learning Skills*, this competency was considered, as presented in table 23, as the most important competency by 20.4% of the respondents and as the second most important competency by 34.6% of the respondents. It is relevant to observe that 79.3% of the respondents considered Learning Skills as the first, second or third more important competency of the ones presented.

Table 23 – Learning Skills – Importance for the worker – Employees' Perception

		Frequency	Percent	Cumulative Percent
Valid	1st	66	20.4	20.4
	2nd	112	34.6	54.9
	3rd	79	24.4	79.3
	4th	40	12.3	91.7
	5th	20	6.2	97.8
	6th	7	2.2	100.0
	Total	324	100.0	

Concerning *Computer Competencies*, this was considered, as showed in table 24, as the most important competency by 27.2% of the respondents and as the second most important competency by 19.1% of the respondents. It is relevant to observe that only 56.8% of the respondents considered *Computer Competencies* as the first, second or third more important competency of the ones presented.

Table 24 – Computer Competencies – Importance for the worker – Employees' Perception

		Frequency	Percent	Cumulative Percent
Valid	1st	88	27.2	27.2
	2nd	62	19.1	46.3
	3rd	34	10.5	56.8
	4th	55	17.0	73.8
	5th	42	13.0	86.7
	6th	43	13.3	100.0
	Total	324	100.0	

Regarding *Resilience*, this was considered, as presented in table 25, as the most important competency only by 3.7% of the respondents, as the fifth most important competency by 29.9% of the respondents, and as the sixth most important competency by 21.9% of the respondents. It is relevant to observe that only 32.1% of the respondents considered *Resilience* as the first, second or third more important competency of the ones presented.

Table 25 – Resilience – Importance for the worker – Employees' Perception

		Frequency	Percent	Cumulative Percent
Valid	1st	12	3.7	3.7
	2nd	35	10.8	14.5
	3rd	57	17.6	32.1
	4th	52	16.0	48.1
	5th	97	29.9	78.1
	6th	71	21.9	100.0
	Total	324	100.0	

Last, when considered *Creativity*, this was considered, as in table 26, as the most important competency only by 2.8% of the respondents and as the sixth most important competency by 48.1% of the respondents. It is relevant to observe that only 13.3% of the respondents considered *Creativity* as the first, second or third more important competency of the ones presented.

Table 26 – Creativity – Importance for the worker – Employees' Perception

		Frequency	Percent	Cumulative Percent
Valid	1st	9	2.8	2.8
	2nd	14	4.3	7.1
	3rd	20	6.2	13.3
	4th	58	17.9	31.2
	5th	67	20.7	51.9
	6th	156	48.1	100.0
	Total	324	100.0	

Considering this results, it is possible to be concluded by the high importance given by employers to Learning Skills and Adaptability, which presents a cumulative percent (at the level of 3rd more important competency, which means it is considered the percentage of respondents who consider these competencies as the first, the second or the third most important competency for a worker to have a positive reaction to a technological or robotic

implementation or presence in the workplace) of 79.3% and 75.6 %, respectively. In the other hand, creativity only appears with a cumulative percent at the 3rd position of 13.3%.

IX. Conclusion

This research intends to understand which competencies are considered more valuable for an employee with technological or robotic presence in the workplace, from the perspective and perception of the employers (for what it was performed a Delphi Study) and the employees (for what it was conducted a questionnaire to a sample composed by Portuguese workers).

In this sense, this research examined both perceptions, so it can be able to compare it, stating differences and similarities. In order to perform this goal, it is important to understand results from both parties.

It is important to have clear that the perspective of the employees was studied starting from the perspective of the employers. This means that, because of the sample size needed to be representative, it was not given total freedom to employees to give their contribute to the research. All the options of competencies given to them resulted from the competencies most referred by the experts, or, even not the most referred, but also considered opportune to be studied.

From the perspective of the employers' perception, as shown in Table 27, the most referred as important competencies are *Adaptability*, *Creativity*, *Resilience* and *Learning Skills*, with a weighted averaged percentage of reference by the experts of 66.7%, 60.0%, 46.7% and 33.3%, respectively.

Informatic Competencies were also referred by experts within the Delphi Study, however with a low importance, representing a weighted average percentage of reference of only 26.7%.

To ordering the referred competencies by the importance given by the experts, it was used the criteria of the Weighted Averaged Percentage of Reference by Experts, as previously explained.

Table 27 – Employers' Perception of the most important competencies

	Ordering Criteria - Weighted Averaged Percentage of Reference by Experts
Adaptability	66.7
Creativity	60.0
Resilience	46.7
Learning Skills	33.3
Informatic Competencies	26.7

When faced with the competencies most referred by the employees, namely *Adaptability*, *Creativity*, *Resilience*, *Learning Skills,* as well as *Informatic Competencies* and *Proactivity* (used in the questionnaire to the population for reasons previously explained), the results are the shown in the Table 28.

Table 28 – Employees' Perception of the most important competencies

	Ordering Criteria - Cumulative Percentage at 3rd Position of Reference by Employees
Learning Skills	79.3
Adaptability	75.6
Informatic Competencies	56.8
Proactivity	42.9
Resilience	32.1
Creativity	13.3

For ordering the competencies considered as the most important for the sample of employees, it was considered the percentage of respondents who consider these competencies as the first, the second or the third most important competency for a worker to have a positive reaction to a technological or robotic implementation or presence in the workplace, as previously explained.

To proceed the analysis presented in the following paragraphs, it was omitted the presence of Proactivity in the employees' perspective and perception, because it appears as a personal interest of the researcher, which ends with no worth meaning for the research *per si.*

The major similarities between the perspective of the employees and the employers is the position of Adaptability: as it appears in first position regarding the importance for a worker from the perspective of employers, it appears in second position from the perspective of employees. Adaptability gathered the consensus within the competencies presented.

Regarding differences presented, there are significant ones, so one can conclude that the differences between both perspectives are relevant and worth mentioning.

Learning Skills and *Informatic Competencies* are considered highly important from the perspective of the employees. Even so, from the perspective of the employers, although these competencies are referred, they do not reach such importance like others do.

Creativity is presented by the employees as a less meaning competency in the scope of a technological implementation or presence in the workplace, having only 13.3% of the respondents classifying as firs, second or third position. In a very different way, employers considered creativity as the second most important competency in a worker who deal with technology or robot in his workplace.

Table 29 – Comparison – Employers vs Employees Perspective

	Employers Position	Employees Position
Adaptability	1st	2nd
Creativity	2nd	5th
Resilience	3rd	4th
Learning Skills	4th	1st
Informatic Competencies	5th	3rd

It can be concluded the perception of which competencies are more valuable for an employee with technological or robot presence in his workplace is very different between employers and employees.

While employers give most importance to competencies like adaptability, creativity or resilience, employees consider learning skills and informatic competencies. This difference can be a result of different expectations in what concerns to a worker's role within the company.

Employers expect to have a worker who use competencies, mostly transversal to other fields, in order to better know how to manage and handle with technological or robotic tools. In the other hand, the perception of employees is, given the results gathered, that they need to have technical competencies to handle informatic environments and the capacity to learn what the employee (or an external agent) will be teaching to them.

It is possible to observe a transfer of responsibility by both parties: workers consider employers will teach them to handle new robotic or technologic tools; employees expect to have workers who will try to understand and adapt themselves to the new needs of the company.

X. Limitations and Future Research

The initially stated overarching aim of this research was to identify competencies that employers and, after that, employees consider important for a worker to deal with a technological or robotic presence or implementation on his workplace.

While recognising the limitations of this research, it is possible to identify how critical is to identify a panel of experts to represent companies who employ workers to constantly deal with technology or robotic. Even so, the gathered panel for the Delphi Study pursued was highly satisfactory in terms of quality.

However, it can be identified as difficulty, the constantly feedback needed with the experts in order to maintain the number of participants in each round. Although there was a constant feedback and contact with experts, two of them eventually did not fulfil all rounds of the study. Regarding this limitation, it is worth it also to refer the need of time to have consistent participations from the experts: this consists in a limitation for the experts and, consequently, for the research.

In future research, the perception of the employees should be assessed through a Delphi Study with a bigger and more consistent panel. In this way, a reward, like positive public exposition of the company or even of the expert, can be defined and used as encouragement to the participation of experts. Given the characteristics of this research, a reward was not possible and all participations in the panel were done by the experts' interest and support to the academic research.

In what concerns to recognize limitations within the study of the general population or Portuguese workers, it is important to understand that all respondents are people who already lead with technology, so the data were collected through an online software. This is a relevant limitation in this research, which should be overcome by assessing a representative sample of the general population of Portuguese workers, and not a sample by convenience as it was performed in this research.

Recommendations for future research goes also through the importance to understand why this difference exists between the perception of the employees and the employers, in order to, after that understanding, define which competencies are really needed for workers who deal with technological or robotic implementations or presence. With this already defined and stated by the literature, it will be possible to develop consistent strategies to develop the more needed

competencies, in order to cope the challenges promoted by the presence of technology and robots in the current workplaces.

XI.   Bibliography

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XII. Annexes

Annex	Description
A	**Delphi Questionnaire**
B	**Report of the 1st Round - Delphi Study**
C	**Report of the 2nd Round - Delphi Study**
D	**Report of the 3rd Round - Delphi Study**
E	**Questionnaire applied to Portuguese Workers**

Annex A - Delphi Questionnaire

Competências de Trabalhadores que lidam com Tecnologia e Robótica no seu Local de Trabalho

Este questionário é desenvolvido no âmbito uma investigação realizada no contexto de uma tese do Mestrado em Consultoria Organizacional da ISCTE Business School.

Esta investigação, realizada através do Método Delphi, pretende identificar as competências que contribuem para uma reação positiva de um trabalhador à introdução de novas tecnologias ou à introdução de robótica no seu ambiente de trabalho. De acordo com Linstone e Turoff (2002), o Método Delphi é um método que estrutura a comunicação de um grupo de peritos, por forma a potenciar que esse grupo chegue a um consenso relativo a um determinado tópico. Este método é conduzido através da aplicação do mesmo questionário em diferentes rondas. No fim de cada ronda, o respondente receberá um relatório de feedback dos resultados recolhidos, podendo, na ronda seguinte, reformular (ou manter) as respostas dadas. Neste estudo, espera-se a realização de 3 rondas. Dadas as características do método em utilização, os resultados recolhidos neste estudo têm tanta qualidade quanto a qualidade do painel de peritos reunido.

Neste sentido, a sua participação revela-se de maior importância, sendo que lhe é reconhecido um nível de experiência e conhecimento que permite validar os resultados recolhidos na investigação.

Os seus dados e respostas são confidenciais e anónimos, apenas a investigadora terá acesso à sua identificação. Para tal, pedimos que se identifique apenas com o Número de Perito, atribuído pela investigadora, que pode encontrar no e-mail onde encontrou a ligação para este questionário.

Muito obrigada pela colaboração,

Inês Costa Faina

Qualquer questão que surja, por favor não hesite em contactar: ines.r.faina@gmail.com

Q5 Por favor preencha cada campo de acordo com a informação pedida.

○ Número de Perito - disponível no email recebido _____

○ Área de Atividade _____

○ Dimensão da Empresa - em número aproximado de trabalhadores _____

○ Anos de Experiência _____

Q4 Relativamente à presença de tecnologia ou robótica na sua empresa de trabalho ou na sua atividade profissional, por favor classifique as seguintes expressões. (Considere exemplos de robotização tais como a utilização de robots de apoio às linhas de produção. Considere exemplos de presença tecnológica na empresa como a utilização de computadores para preenchimento de horas de trabalho ou a utilização de ferramentas de índole tecnológica no dia-a-dia dos trabalhadores.)

	Discordo totalmente (1)	(2)	(3)	(4)	(5)	(6)	Concordo totalmente (7)
Na minha empresa, a robotização e/ou tecnologia está presente no ambiente de trabalho. (1)	○	○	○	○	○	○	○
Há implementações e/ou alterações tecnológicas estruturais na minha empresa todos os anos. (2)	○	○	○	○	○	○	○
Conheço a realidade dos trabalhadores que lidam diariamente com tecnologia e robotização. (3)	○	○	○	○	○	○	○
O meu trabalho implica a necessidade de percepção das necessidades atuais do mercado de trabalho. (4)	○	○	○	○	○	○	○

Q6 Breve descrição da função desempenhada, atualmente ou no passado, com contributo para a percepção do impacto da robótica e tecnologia nos trabalhadores.

_____
_____
_____

Parte II

Q7 De acordo com a sua experiência e conhecimento, classifique a importância das competências, propostas por Blásquez, Herrarte e Llorente-Heras (2018), para um trabalhador com presença de robotização ou tecnologia no seu ambiente de trabalho.

	Sem qualquer importância (1)	Ligeiramente importante (2)	Relativamen-te importante (3)	Muito importante (4)	Extremamen-te importante (5)
Disponibilidade para novas oportunidades (1)	○	○	○	○	○
Capacidade de propor novas ideias e soluções (2)	○	○	○	○	○
Capacidade de questionar as suas próprias ideias ou as dos outros (3)	○	○	○	○	○
Capacidade de escrita de relatórios, memoranduns ou documentos (4)	○	○	○	○	○
Pensamento analítico (5)	○	○	○	○	○
Capacidade para adquirir rapidamente novos conhecimentos (6)	○	○	○	○	○
Conhecimentos em outras áreas ou disciplinas (7)	○	○	○	○	○

Domínio da sua área ou disciplina (8)	○	○	○	○	○
Capacidade de utilização de computadores e internet (9)	○	○	○	○	○
Domínio escrito e falado de uma língua estrangeira (10)	○	○	○	○	○
Capacidade de mobilização das competências dos outros (11)	○	○	○	○	○
Clareza na comunicação (12)	○	○	○	○	○
Assertividade (13)	○	○	○	○	○
Negociação eficaz (14)	○	○	○	○	○
Capacidade de trabalho com qualidade sob pressão (15)	○	○	○	○	○
Capacidade de coordenação de atividades (16)	○	○	○	○	○
Utilização eficiente do tempo (17)	○	○	○	○	○
Capacidade de trabalho produtivo em equipa (18)	○	○	○	○	○
Capacidade de apresentação de produtos, ideias ou resultados a uma audiência (19)	○	○	○	○	○

End of Block: Parte II

Q9 Considere uma empresa na indústria de componentes automóvel. Vai haver uma alteração numa das linhas de produção que passará pela introdução de um robot que permitirá a solução de um problema previamente identificado nesta linha de produção. Este robot conduzirá a um aumento de produtividade da fábrica, aumentando o número de componentes produzidos por minuto, com a utilização dos mesmos recursos humanos. Considere o Trabalhador A e o Trabalhador B, ambos trabalhadores alocados a esta linha de produção e que sentirão o impacto do robot no seu ambiente de trabalho. Eles precisarão de aprender a utilizar o robot e a resolver possíveis problemas que possam ocorrer.

Os perfis pessoais e profissionais dos trabalhadores são os apresentados de seguida:

Trabalhador A – não concluiu o Ensino secundário; o seu primeiro trabalho foi na indústria de componentes automóvel; nunca mudou de trabalho nem de entidade empregadora; foi escuteiro durante 7 anos da sua vida, sendo responsável pela organização de alguns dos mais importantes eventos do grupo; usa o computador para interagir com a sua família e amigos; tem dois filhos que criou sozinho porque o outro progenitor faleceu precocemente; os seus filhos são jovens adultos felizes e realizados.

Trabalhador B – frequentou 3 disciplinas do ramo de artes no Ensino Secundário; concluiu o Ensino secundário com aproveitamento mediano; mudou de trabalho quatro vezes durante a sua vida profissional por se sentir insatisfeito nas suas funções; utiliza o computador com eficácia para apenas o necessário; as suas ocupações extraprofissionais são a pintura e a pastelaria; não tem filhos ou animais de estimação; frequenta, muitas vezes, oficinas e workshops das suas áreas de interesse.

Q10 Selecione o trabalhador que, na sua opinião, tem melhor adquiridas e/ou desenvolvidas cada uma das seguintes competências.

	Trabalhador A	Trabalhador B
Criatividade (1)	○	○
Conhecimento Informático (2)	○	○
Resiliência (3)	○	○
Capacidade técnica de trabalho com computadores (4)	○	○

Autonomia (5)	○	○
Autodesenvolvimento (6)	○	○
Outra: (7)	○	○
Outra: (8)	○	○

Q11 Na sua opinião, qual dos trabalhadores teria uma reação mais positiva à implementação deste robot?

○ Trabalhador A (1)

○ Trabalhador B (2)

Q12 Que outras competências pensa que estes trabalhadores poderiam ter ou desenvolver para que a sua reação à implementação deste robot fosse positiva ou mais positiva.

_____
_____
_____
_____
_____

End of Block: Parte III

Parte IV

Q13 Apresente, por ordem de importância - da mais importante (1) para a menos importante (6) - competências que considera importantes num trabalhador para que este tenha uma reação positiva à implementação de um robot ou de uma inovação tecnológica no seu ambiente de trabalho.

(Por favor preencha, de acordo com a sua experiência e com a reflexão realizada ao longo deste questionário, apenas os espaços que considerar necessários, num máximo de seis.)

○ 1 _____

○ 2 _____

○ 3 _____

○ 4 _____

○ 5 _____

○ 6 _____

Q14 No âmbito da experiência adquirida no seio da sua vida profissional, e depois da reflexão induzida pelo preenchimento deste questionário, escolha uma das competências referidas na questão anterior e explore o seu grau de importância em trabalhadores que entram em contacto com tecnologia e robótica no seu local de trabalho, dando exemplos ou referindo situações e casos já explorados.

_____
_____
_____
_____
_____
_____
_____

End of Block: Parte IV

ISCTE Business School
INSTITUTO UNIVERSITÁRIO DE LISBOA

Mestrado em Gestão de Recursos Humanos e Consultoria Organizacional

Ronda 1 – Resumo de Resultados Obtidos

Recolha dos dados: 07/06/2018 a 02/07/2018
Data de divulgação dos resultados: 03/07/2018
Número de Peritos: 6

Da 1ª Ronda de questionários aplicada no âmbito do presente estudo pelo Método de Delphi, cumpre salientar os seguintes pontos:

1. Foram recolhidas opiniões de um conjunto de **6 peritos** com **experiência compreendida entre 14 e 28 anos** em Gestão e Consultoria de Recursos Humanos e relevante para a perceção do impacto da robótica e da tecnologia nos trabalhadores.
2. Relativamente à importância das competências para um trabalhador com presença de robotização ou tecnologia no seu ambiente de trabalho, as seguintes respostas foram obtidas.

| Competência	Sem qualquer importância	Ligeiramente importante	Relativamente importante	Muito importante	Extremamente importante
Disponibilidade para novas oportunidades				4	2
Capacidade de propor novas ideias e soluções			2	2	2
Capacidade de questionar as suas próprias ideias ou as dos outros			2	3	1
Capacidade de escrita de relatórios, memoranduns ou documentos			3	1	1
Pensamento analítico			3	2	1
Capacidade para adquirir rapidamente novos conhecimentos				3	3
Conhecimentos em outras áreas ou disciplinas		1	2	1	2
Domínio da sua área ou disciplina		1	1	3	1
Capacidade de utilização de computadores e internet				3	3
Domínio escrito e falado de uma língua estrangeira			1	4	1
Capacidade de mobilização das competências dos outros			3	2	1
Clareza na comunicação			2	1	3
Assertividade			3	2	1
Negociação eficaz		2		3	1
Capacidade de trabalho com qualidade sob pressão			1	4	1
Capacidade de coordenação de atividades			3	2	1
Utilização eficiente do tempo			1	4	1
Capacidade de trabalho produtivo em equipa			1	4	1
Capacidade de apresentação de produtos, ideias ou resultados a uma audiência			2	3	1

1

Inês Costa Faina

Em suma, as **competências consideradas mais importantes e com maior consenso** foram:

– Capacidade para adquirir rapidamente novos conhecimentos;
– Disponibilidade para novas oportunidades; e
– Capacidade de utilização de computadores e internet.

As **competências menos valorizadas**, de uma forma global, pelos peritos foram:

– Negociação eficaz;
– Conhecimentos em outras áreas ou disciplinas; e
– Domínio da sua área ou disciplina.

3. Relativamente ao trabalhador que tem melhor adquiridas e/ou desenvolvidas cada uma das competências listadas, os resultados foram os apresentados no gráfico seguinte, havendo consenso apenas na Criatividade do Trabalhador B.
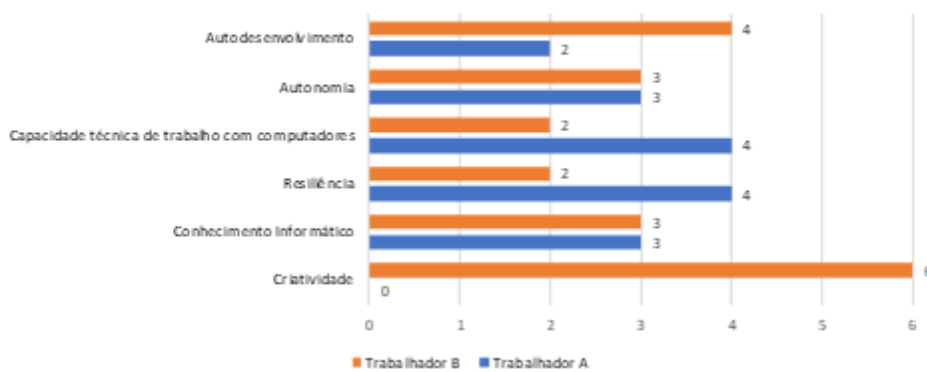
4. No que concerne ao trabalhador com uma reação mais positiva à implementação do robot (como figura para a implementação de uma inovação tecnológica) os resultados dividiram-se entre ambos os trabalhadores, não havendo consenso reunido (2 peritos optaram pelo trabalhador A e 4 peritos optaram pelo trabalhador B)
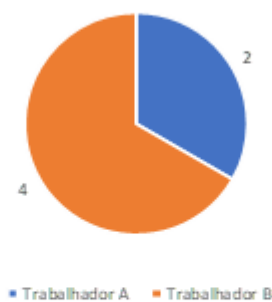
No âmbito desta primeira ronda, pode observar-se que os peritos que consideram que o Trabalhador A reagiria mais positivamente do que o Trabalhador B a uma implementação tecnológica são os que consideram que o Trabalhador A apresenta mais desenvolvidas a maioria das competências sobre as quais são questionados. Daí pode concluir-se que, na sua generalidade, os peritos chegaram a um consenso quanto às competências consideradas importantes, mas não quanto ao trabalhador (dado o perfil apresentado) que as tem mais desenvolvidas.

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5. Relativamente às competências importantes num trabalhador para que este tenha uma reação positiva à implementação de um robot ou de uma inovação tecnológica no seu ambiente de trabalho, as sugestões apresentadas foram as seguintes.

1ª	Capacidade de adaptação a novas situações	Proatividade	Capacidade para aprender continuamente	Capacidade de inovação e mudança	Capacidade de inovação	Flexibilidade
2ª	Capacidade de análise e de crítica	Comunicação	Trabalho em equipa	Criatividade	Abertura para a mudança	Adaptação à mudança/criatividade
3ª	Resiliência	Abertura a mudança	Adaptabilidade	Flexibilidade	Resiliência	Resiliência
4ª	Flexibilidade	Raciocínio lógico	Criatividade	Capacidade de trabalhar com meios informáticos	Autorreflexão	Capacidade de aprendizagem
5ª	Tomada de decisão	Capacidade analítica	Conhecimentos tecnológicos			Capacidade de análise
6ª	Resistência ao stress	Criatividade	Resiliência			Orientação para a melhoria contínua

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Ronda 2 – Resumo de Resultados Obtidos

Recolha dos dados: 03/07/2018 a 22/07/2018
Data de divulgação dos resultados: 23/07/2018
Número de Peritos Respondente: 5

Da 2ª Ronda de questionários aplicada no âmbito do presente estudo pelo Método de Delphi, cumpre salientar os seguintes pontos:

1. Foram recolhidas opiniões de um conjunto de **5 peritos** com **experiência compreendida entre 14 e 28 anos** em Gestão e Consultoria de Recursos Humanos e relevante para a perceção do impacto da robótica e da tecnologia nos trabalhadores.
2. Relativamente à importância das competências para um trabalhador com presença de robotização ou tecnologia no seu ambiente de trabalho, as seguintes respostas foram obtidas.

Competência	Sem qualquer importância	Ligeiramente importante	Relativamente importante	Muito importante	Extremamente importante
Disponibilidade para novas oportunidades				4	1
Capacidade de propor novas ideias e soluções				2	3
Capacidade de questionar as suas próprias ideias ou as dos outros				4	1
Capacidade de escrita de relatórios, memoranduns ou documentos		2		2	
Pensamento analítico			2	1	2
Capacidade para adquirir rapidamente novos conhecimentos				2	3
Conhecimentos em outras áreas ou disciplinas		1	1	2	1
Domínio da sua área ou disciplina			2	1	2
Capacidade de utilização de computadores e internet				2	3
Domínio escrito e falado de uma língua estrangeira			1	2	2
Capacidade de mobilização das competências dos outros			1	4	
Clareza na comunicação			2	2	1
Assertividade			3	1	1
Negociação eficaz		2	1	1	1
Capacidade de trabalho com qualidade sob pressão			2	2	1
Capacidade de coordenação de atividades			3	1	1
Utilização eficiente do tempo			1	2	2
Capacidade de trabalho produtivo em equipa		1		3	1
Capacidade de apresentação de produtos, ideias ou resultados a uma audiência		1	1	2	1

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Em suma, as **competências consideradas que reuniram maior consenso, sendo consideradas como Muito Importantes,** foram:
- Disponibilidade para novas oportunidades;
- Capacidade de questionar as suas próprias ideias ou as dos outros; e
- Capacidade de mobilização das competências dos outros.

As competências, na globalidade, **consideradas como mais importantes** (Muito Importante e Extremamente Importante) foram:

- Disponibilidade para novas oportunidades;
- Capacidade de propor novas ideias e soluções;
- Capacidade de questionar as suas próprias ideias ou as dos outros;
- Capacidade para adquirir rapidamente novos conhecimentos; e
- Capacidade de utilização de computadores e internet.

A **competência menos valorizada**, de uma forma global, pelos peritos foi a negociação eficaz.

3. Relativamente ao trabalhador que tem melhor adquiridas e/ou desenvolvidas cada uma das competências listadas, os resultados foram os apresentados no gráfico seguinte, havendo consenso apenas na Criatividade do Trabalhador B.
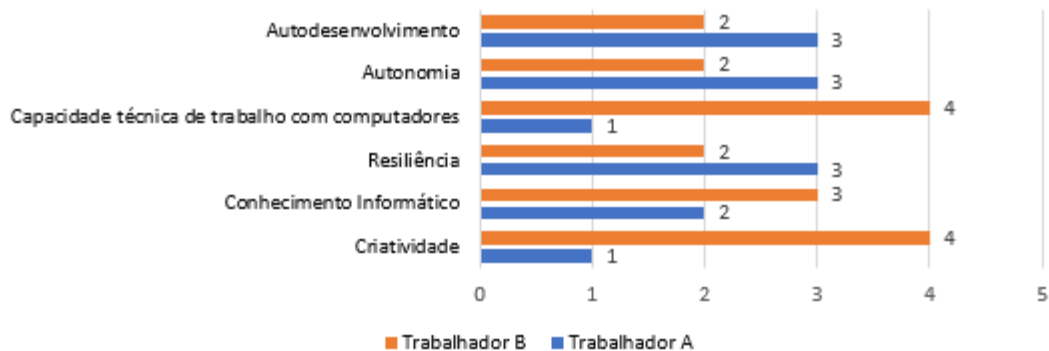
4. No que concerne ao trabalhador com uma reação mais positiva à implementação do robot (como figura para a implementação de uma inovação tecnológica) os resultados dividiram-se entre ambos os trabalhadores, não havendo consenso reunido (2 peritos optaram pelo trabalhador A e 3 peritos optaram pelo trabalhador B)

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■ Trabalhador A   ■ Trabalhador B
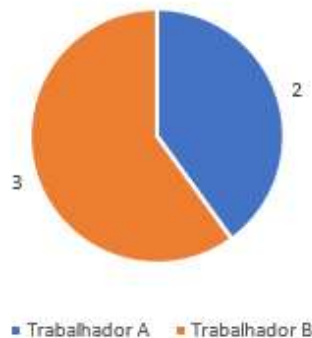
Assim como resultado da primeira ronda desta investigação, no âmbito desta segunda ronda, pode observar-se que os peritos que consideram que o Trabalhador A reagiria mais positivamente do que o Trabalhador B a uma implementação tecnológica são os que consideram que o Trabalhador A apresenta mais desenvolvidas a maioria das competências sobre as quais são questionados. Daí pode concluir-se que, na sua generalidade, os peritos chegaram a um consenso quanto às competências consideradas importantes, mas não quanto ao trabalhador (dado o perfil apresentado) que as tem mais desenvolvidas.

5. Relativamente às competências importantes num trabalhador para que este tenha uma reação positiva à implementação de um robot ou de uma inovação tecnológica no seu ambiente de trabalho, as sugestões apresentadas foram as seguintes.

1ª	Gestão da mudança	Abertura à mudança	Flexibilidade	Proatividade	Capacidade de inovação e mudança
2ª	Resiliência	Capacidade para aprender permanentemente	Adaptação à mudança	Comunicação	Criatividade
3ª	Resistência ao stress	Pensamento Analítico	Autoaprendizagem	Abertura a mudança	Flexibilidade
4ª	Boa organização do trabalho	Trabalho em equipa	Orientação para melhoria continua	Raciocinio lógico	Capacidade de trabalhar com meios informáticos
5ª	Boa gestão do tempo	Resiliência		Capacidade analitica	
6ª	Criatividade	"Positividade"		Criatividade	

Em suma e de uma forma geral, os peritos referem as seguintes competências como relevantes:

– Abertura à mudança;
– Resiliência;
– Criatividade;
– Capacidade de Aprendizagem; e
– Proatividade.

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Ronda 3 – Resumo de Resultados Obtidos

Recolha dos dados: 24/07/2018 a 10/08/2018
Número de Peritos Respondente: 4

Da 3ª Ronda de questionários aplicada no âmbito do presente estudo pelo Método de Delphi, cumpre salientar os seguintes pontos:

1. Foram recolhidas opiniões de um conjunto de **4 peritos** com **experiência compreendida entre 14 e 28 anos** em Gestão e Consultoria de Recursos Humanos e relevante para a perceção do impacto da robótica e da tecnologia nos trabalhadores.
2. Relativamente à importância das competências para um trabalhador com presença de robotização ou tecnologia no seu ambiente de trabalho, as seguintes respostas foram obtidas.

Competência	Sem qualquer importância	Ligeiramente importante	Relativamente importante	Muito importante	Extremamente importante
Disponibilidade para novas oportunidades		1		1	2
Capacidade de propor novas ideias e soluções				2	2
Capacidade de questionar as suas próprias ideias ou as dos outros				3	1
Capacidade de escrita de relatórios, memoranduns ou documentos		1	1	2	
Pensamento analítico				2	2
Capacidade para adquirir rapidamente novos conhecimentos				2	2
Conhecimentos em outras áreas ou disciplinas				4	
Domínio da sua área ou disciplina				1	3
Capacidade de utilização de computadores e internet				2	2
Domínio escrito e falado de uma língua estrangeira				3	1
Capacidade de mobilização das competências dos outros			1	3	
Clareza na comunicação				2	2
Assertividade				3	1
Negociação eficaz		1	1	2	
Capacidade de trabalho com qualidade sob pressão				4	
Capacidade de coordenação de atividades				4	
Utilização eficiente do tempo			1	2	1
Capacidade de trabalho produtivo em equipa		1		2	1
Capacidade de apresentação de produtos, ideias ou resultados a uma audiência			1	2	1

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Em suma, as **competências consideradas que reuniram maior consenso, sendo consideradas como Muito Importantes,** foram:
- Conhecimentos em outras áreas ou disciplinas;
- Capacidade de trabalho com qualidade sob pressão; e
- Capacidade de coordenação de atividades.

As competências, na globalidade, **consideradas como mais importantes** (Muito Importante e Extremamente Importante) foram:

- Capacidade de propor novas ideias e soluções;
- Capacidade de questionar as suas próprias ideias ou as dos outros;
- Pensamento analítico
- Capacidade para adquirir rapidamente novos conhecimentos;
- Conhecimentos em outras áreas ou disciplinas;
- Domínio da sua área ou disciplina;
- Capacidade de utilização de computadores e internet;
- Domínio escrito e falado de uma língua estrangeira;
- Clareza na comunicação;
- Assertividade;
- Capacidade de trabalho com qualidade sob pressão; e
- Capacidade de coordenação de atividades.

A **competência menos valorizada**, de uma forma global, pelos peritos foi a negociação eficaz.

3. Relativamente ao trabalhador que tem melhor adquiridas e/ou desenvolvidas cada uma das competências listadas, os resultados foram os apresentados no gráfico seguinte, havendo consenso apenas na Criatividade do Trabalhador B.
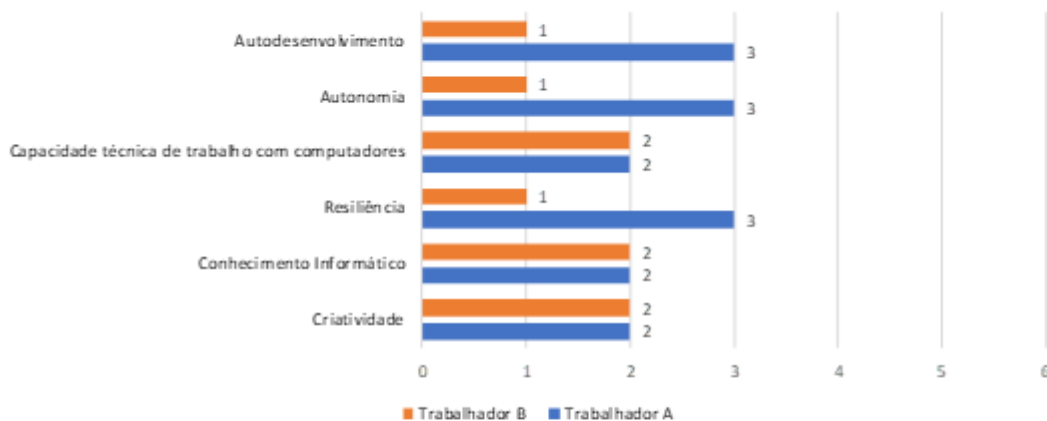
4. No que concerne ao trabalhador com uma reação mais positiva à implementação do robot (como figura para a implementação de uma inovação tecnológica) os resultados dividiram-se entre ambos os trabalhadores, não havendo consenso reunido (2 peritos optaram pelo trabalhador A e 2 peritos optaram pelo trabalhador B)

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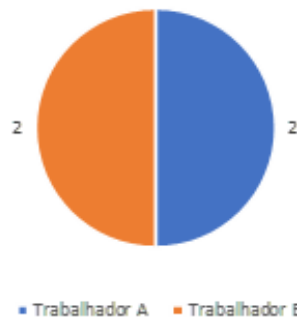
No·âmbito·desta·terceira·ronda,·pode·observar-se·que·os·peritos·que·consideram·que·o·Trabalhador·A·reagiria·mais·positivamente·do·que·o·Trabalhador·B·a·uma·implementação·tecnológica·são·os·que·consideram·que·o·Trabalhador·A·apresenta·mais·desenvolvidas·a·maioria·das·competências·sobre·as·quais·são·questionados.·Daí·pode·concluir-se·que,·na·sua·generalidade,·os·peritos·chegaram·a·um·consenso·quanto·às·competências·consideradas·importantes,·mas·não·quanto·ao·trabalhador·(dado·o·perfil·apresentado)·que·as·tem·mais·desenvolvidas.¶

5.→ Relativamente· às· competências· importantes· num· trabalhador· para· que· este· tenha· uma· reação· positiva· à· implementação· de· um· robot· ou· de· uma· inovação· tecnológica· no· seu· ambiente·de·trabalho,·as·sugestões·apresentadas·foram·as·seguintes.¶

1ª	Capacidade de adaptação a novas situações	Capacidade de adaptação à mudança	Proatividade	Capacidade de inovação e mudança
2ª	Flexibilidade	Flexibilidade	Comunicação	Criatividade
3ª	Resiliência	Autodesenvolvimento	Abertura a mudança	Flexibilidade
4ª	Capacidade de trabalho sob pressão	Resolução de problemas	Raciocínio lógico	Capacidade de trabalhar com meios informáticos
5ª	Auto estima e segurança pessoal	Capacidade analítica		
6ª	Gosto por novos desafios	Criatividade		

Em suma e de uma forma geral, os peritos referem as seguintes competências como relevantes:

– Abertura e adaptação à mudança;
– Resiliência;
– Criatividade;
– Capacidade de Aprendizagem; e
– Flexibilidade.

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Competências para uma reação positiva a tecnologia e robótica no local de trabalho

Este questionário é desenvolvido no âmbito de uma investigação realizada no contexto de uma tese do Mestrado em Consultoria Organizacional da ISCTE Business School.

Pretende-se entender a percepção dos trabalhadores relativamente às competências que lhes permitiriam uma melhor e mais positiva reação a uma intervenção tecnológica no seu ambiente de trabalho.

A sua participação revela-se de maior importância, no sentido de obter resultados consistentes e coerentes.

Os seus dados e respostas são confidenciais e anónimos.

Muito obrigada pela colaboração,

Inês Costa Faina

Qualquer questão que surja, por favor não hesite em contactar: ines.r.faina@gmail.com

End of Block: Início

Parte I - Caracterização do Respondente

Q15 Anos de Trabalho (no total, independentemente da área ou função exercida)

○ Menos de 1 ano (1)

○ 1 ano - 5 anos (2)

○ 6 anos - 10 anos (3)

○ 11 anos - 20 anos (4)

○ 21 anos - 30 anos (5)

○ Mais de 30 anos (6)

Q18 Sexo

○ Feminino (1)

○ Masculino (0)

Q5 Situação na profissão

◯ Trabalhador por conta de outrem (1)

◯ Trabalhador por conta própria (2)

◯ Desempregado (3)

Q16 Área de Atividade

◯ Agricultura / Pesca / Indústrias extractivas / Construção (1)

◯ Indústrias Transformadoras / Recursos Energéticos e Gestão de Resíduos (2)

◯ Comércio por Grosso e a Retalho / Transportes e Armazenagem (3)

◯ Alojamento e Restauração (4)

◯ Finanças e Seguros (5)

◯ Consultoria (6)

◯ Administrativo (7)

◯ Administração Pública e Defesa (8)

◯ Educação (9)

◯ Saúde (10)

◯ Artes e Espetáculos (11)

◯ Gestão (12)

◯ Outra (13)

Q17 Escolaridade completa

○ Ensino Primário - 1º Ciclo (1)

○ Ensino Básico - 6º Ano (2)

○ Ensino Básico - 9º Ano (3)

○ Ensino Secundário - 12º Ano (4)

○ Ensino Superior - Bacharelato (5)

○ Ensino Superior - Licenciatura (6)

○ Ensino Superior - Mestrado (7)

○ Ensino Superior - Doutoramento (8)

Q4 Relativamente à presença de tecnologia ou robótica na sua empresa de trabalho ou na sua atividade profissional, por favor classifique as seguintes expressões.

	Nunca (1)	Menos do que uma vez por semana (2)	Uma vez por semana (3)	2-3 vezes por semana (4)	Diariamente (5)	Não Sei/ Não Respondo (6)
Trabalho com computadores (1)	○	○	○	○	○	○
Trabalho com internet e ferramentas tais como email, clouds e outras semelhantes (2)	○	○	○	○	○	○
Utilizo linguagens de programação (3)	○	○	○	○	○	○

| Trabalho com máquinas robóticas (4) | ○ | ○ | ○ | ○ | ○ | ○ |

Q19 Face à sua percepção do mercado de trabalho e dos desafios atuais da tecnologia, classifique a exposição da sua atividade profissional a alterações tecnológicas.

○ Muito acima da média (7)

○ Relativamente acima da média (6)

○ Ligeiramente acima da média (5)

○ Média (4)

○ Ligeiramente abaixo da média (3)

○ Relativamente abaixo da média (2)

○ Muito abaixo da média (1)

End of Block: Parte I - Caracterização do Respondente

Parte II

Q7 Classifique cada uma das afirmações seguintes.

	Discordo totalmente (1)	Discordo parcialmente (2)	Nem concordo nem discordo (3)	Concordo parcialmente (4)	Concordo totalmente (5)
Considero-me uma pessoa criativa na abordagem de novas questões ou problemas (Q7_1)	○	○	○	○	○

Na presença de mudanças, facilmente me adapto. (Q7_2)

○ ○ ○ ○ ○

Procuro encontrar soluções para os problemas, mesmo antes de estas me serem pedidas (Q7_3)

○ ○ ○ ○ ○

Interesso-me pela minha e outras áreas de conhecimento (Q7_20)

○ ○ ○ ○ ○

Quando tenho de aprender algo novo, sinto que o faço com facilidade (Q7_21)

○ ○ ○ ○ ○

Utilizo frequentemente computadores e internet (Q7_22)

○ ○ ○ ○ ○

Tenho facilidade em utilizar a internet e o computador para a resolução de problemas (Q7_4)

○ ○ ○ ○ ○

Perante uma contrariedade, procuro encontrar sempre uma solução (Q7_23)

○ ○ ○ ○ ○

Quando tenho de ser criativo(a), sinto-me pouco produtivo(a) (Q7_6)

○ ○ ○ ○ ○

Numa situação de mudança, muitas vezes sinto-me impotente (Q7_7)

○ ○ ○ ○ ○

Sinto dificuldade em aprender diariamente no meu trabalho (Q7_8)

○ ○ ○ ○ ○

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	Discordo totalmente (1)	Discordo parcialmente (2)	Nem concordo nem discordo (3)	Concordo parcialmente (4)	Concordo totalmente (5)
Evito tentar resolver problemas com a utilização de computadores ou internet (Q7_24)	◯	◯	◯	◯	◯
Quando encontro uma dificuldade, facilmente desmotivo (Q7_10)	◯	◯	◯	◯	◯

Parte III

Q9 Imagine que, no seu ambiente de trabalho, vai ser integrada uma alteração tecnológica ou robótica. Esta intervenção vai impactar diretamente o seu local de trabalho e as suas tarefas diárias. Por favor classifique cada uma das seguintes frases.

	Discordo totalmente (1)	Discordo parcialmente (2)	Nem concordo nem discordo (3)	Concordo parcialmente (4)	Concordo totalmente (5)
Vou procurar conhecer a tecnologia que vai ser integrada antes mesmo de ser implementada. (Q9_4)	◯	◯	◯	◯	◯
Vou frequentar todas as formações e sessões de esclarecimento que a empresa disponibilize sobre a intervenção. (Q9_5)	◯	◯	◯	◯	◯
Quando os meus colegas sentirem dificuldades, vou esperar que a empresa os ajude a ultrapassar. (Q9_6)	◯	◯	◯	◯	◯

Vou aprender a lidar com a nova tecnologia de forma a conseguir aumentar a minha produtividade. (Q9_7)

○ ○ ○ ○ ○

É obrigação da empresa disponibilizar ajuda constante e formação intensiva quanto à utilização desta nova tecnologia. (Q9_8)

○ ○ ○ ○ ○

No caso de sentir alguma dificuldade, vou partilhá-la com as minhas chefias, sugerindo melhorias. (Q9_9)

○ ○ ○ ○ ○

Parte IV

Q13 Ordene - da mais importante (1) para a menos importante (6) - as competências que considera importantes num trabalhador para que este tenha uma reação positiva à implementação de um robot ou de uma inovação tecnológica no seu ambiente de trabalho.

_____ Adaptabilidade

_____ Proatividade

_____ Capacidade de Aquisição de Novos Conhecimentos

_____ Capacidade Utilização de Computadores e Internet

_____ Resiliência

_____ Criatividade