

**A STUDY OF THE EFFECT OF ROBOTIC PROCESS
AUTOMATION ON THE ROLE OF THE ACCOUNTANT AND
THE FINANCE PROFESSIONAL FROM THE PERSPECTIVE OF
THE POSTGRADUATE IN ACCOUNTING AND FINANCE IN THE
IRISH JOB MARKET**

Research dissertation presented in partial fulfilment of the requirements
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MSc in programme title here

Griffith College Irish

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29/05/2020

“If you want to stop a computer taking your job, you’ll have to hone your creative and social skills. Mercifully, it will be quite a while before the machines outpace us in that respect”.

(C. Frey and Osborne, 2013)

Candidate Declaration

Candidate Name: Tatiane dos Santos Costa

I certify that the dissertation entitled: A Study of the Effect of Robotic Process Automation on the Role of the Accountant and the Finance Professional from the Perspective of the Postgraduate in Accounting and Finance in the Irish Job Market,

Submitted for the degree of: **MSc in Accounting and Finance Management** is the result of the my own work and that where reference is made to the work of others, due acknowledgement is given.

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Date:

Dedication

“This research is entirely dedicated to my parents and to my lovely boyfriend for their love, endless support and encouragement. Thank you!”

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I am very grateful to God for the blessings and strength given me to achieve this research work.

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Abstract

The aim of this dissertation is to explore the competencies required to work with robotic process automation in the Irish job market (RPA). RPA is software that has been a trendy topic in the accounting/financial sector due to its ability to perform repetitive and rule-based processes with high efficiency and efficacy. This research work was based on a literature review and interviews made with two groups of professionals: postgraduates in accounting and finance based in Ireland and, experienced professionals in the accounting industry. The findings underscore that there is a foreseen change in the competencies required in the Irish job market (e.g. programming, mastered analytical thinking, SQL query, IT knowledge) for accounting and finance professionals; however, it is not here yet. The main conclusion to be formed from this work is that regardless of the stage that RPA adoption is in the Irish job market, professionals must prepare themselves to achieve a high level in technological, human, and any other competencies that are perceived as fundamental to remain relevant and build a sustainable and successful career in the RPA era.

Keywords: RPA, accounting industry, technological, exclusive human, analytical and technical competencies, upskilling, digital workforce.

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List of Relevant Definitions

Accounting Industry Sub-categories – “There are several types of accounting that range from auditing to the preparation of tax returns”. It can be divided into subcategories: “Financial, Public, Government, Forensic, Management, Taxation and Audit” (Accounting Tools, 2019)

Artificial Intelligence (AI) – “There are two main categories of AI: artificial general intelligence (AGI) and narrow artificial intelligence (NAI) ... AGI refers to a machine that, in simple terms, can think on its own like a human does. Such a machine would be capable of learning to solve any number of problems without human input and would be able to adapt and evolve on its own. NAI is in wide use today. As the name implies, NAI refers to machines created to handle a specific task or a limited range of tasks” (Patrick and Williams, 2020).

Automation – “A technology concerned with performing a process by means of programmed commands combined with automatic feedback control to ensure proper execution of the instructions. The resulting system is capable of operating without human intervention” (Groover, 2018).

Big Data – “Massive amounts of data from a wide variety of sources are being collected every second by businesses and organisations and analysed in near real time” (Ahmadi *et al.*, 2016).

Computerisation – “Refer to computerisation as job automation by means of computer-controlled equipment” (C. B. Frey and Osborne, 2013).

Cloud – “Method of running application software and storing related data in central computer systems and providing customers or other users access to them through the Internet” (Carr, 2019a).

Deep Learning – “Systems that specifically rely upon non-linear neural networks to build out machine learning systems, often relying upon using the machine learning to actually model the system doing the modelling. It is mostly a subset of machine learning with a specific emphasis on neural nets” (Cagle, 2019).

Digitalisation – “When things are digitalised, they can be stored and transferred at virtually no cost. The set of these things bring together is known as BIG DATA” (Frey, 2019)

Expert Systems – “Collections of rules programmed by a human in the form of if-then statements -are not part of AI since they lack the ability to learn automatically from external data” (Haenlein and Kaplan, 2019).

Enterprise Resource Planning (ERP) – “Enterprise resource planning are configurable information systems packages that integrate information and information-based process within and across functional areas in an organisation” (Kumar and Hillegersberg, 2000).

Image Recognition – “Refers to the application of AI to recognise an object based on what is seen and categorise that image” (Patrick and Williams, 2020).

Professional Competence – “Competence is defined as the ability to perform a work role to a defined standard with reference to working environments. To demonstrate competence in a role, a professional accountant must possess the necessary (a) professional knowledge, (b) professional skills, and (c) professional values, ethics, and attitudes” (International Federation of Accountants (IFAC), 2019).

Professional Knowledge – “Those topics that make up the subject of accountancy as well as other business disciplines that, together, constitute the essential body of knowledge for professional accountants” (International Federation of Accountants (IFAC), 2019).

Professional Skills – “The various types of abilities required to apply professional knowledge, and professional values, ethics, and attitudes appropriately and effectively in a professional context. (...) including technical and functional skills, organisational and business management skills, personal skills, interpersonal and communication skills, a variety of intellectual skills, and skills in forming professional judgments (International Federation of Accountants (IFAC), 2019).

Professional Values, Ethics and Attitudes – “The professional behavior and characteristics that identify professional accountants as members of a profession. They include the principles of conduct (i.e., ethical principles) generally associated with and considered essential in defining the distinctive characteristics of, professional behavior” (International Federation of Accountants (IFAC), 2019).

Machine Learning – “A sub-set of artificial intelligence (AI). “It is generally understood as the ability of the system to make predictions or draw conclusions based on the analysis of a large historical data set” (ACCA Global, 2019b).

Natural Language Processing (NLP) – “Also known as computational linguistics, is the combination of AI and linguistics that allows us to talk to machines as if they were human. NLP powers predictive word suggestions on our mobile devices and voice-activated assistants like Siri, Bixby and Google’s voice search” (Zhang, 2018).

IoT – “ Intended to provide network connectivity to devices so that they can communicate with other devices. Robotics involves creating autonomous physical agents capable of movement. In

that both of these may end up managing their own state, relies upon AI-based systems for identifying signals and determining response, they use AI, but aren't directly AI" (Cagle, 2019).

Industry 4.0 – “Stands for the fourth industrial revolution which is defined as a new level of organisation and control over the entire value chain of the life cycle of products” (Vaidya et al., 2018)

Robotic Process Automation (RPA) – “Ranges from a simple to a very complex computer program that is able to automate the input, processing, and/or output of data across computer applications or systems without altering a firm’s existing infrastructure. RPA software mimics the actions of a human and can therefore be used to complete a variety of tasks, including manipulating data, processing business transactions, generating responses, and communicating with humans (e.g., via email) or other digital systems” (Cooper *et al.*, 2019).

Speech Recognition – “Also known as name voice recognition – refers to the translation from speech into words in a machine-readable format” (Dey, 2019, p.2).

SQL - “Standardised query language for requesting information from a database. Originally known as SEQUEL (Structured English Query Language)” (ACCA Global, 2020a).

1 Introduction

1.1 Overview

Robots are transforming the accounting industry through Robotic Process Automation (RPA) since it has become popular. Technology crossed accountancy about 2000 years ago, when a system named abacus was used by Mesopotamians to make additions calculation. Much later on, in 1980 another technology impacted accountancy by reducing the need for “handwriting accountants” and enabling major access to information. This was the punch, Herman Hollerith, and James Power developed a machine which would read data stamped mechanically in a paper (CPAJ, 2017). Since then, technology has changed accountancy, easing tasks and enabling professionals to perform efficiently and effectively, but also bringing concerns whether it can turn accounting roles obsolete.

Arguably this duality between benefits and threats that innovation caused in the accounting sector may be a reason for many related studies. Many of them focus on professionals and the need for them to reconsidered and adapted their skills to meet the technological demands.

For instance, a study released in 1960 by the American Bureau of Labor Statistics predicted that as advancement in automation helps to increase the speed of services delivered and assembly output, this would cause a reduction in the demand for human labour consequently, thus impacting employment. With regard to the accountancy industry, it foresaw automation replacing activities such as keypunching, bookkeeping and those involving routine clerical work due to the automation of data administrative processes and enhancement of computers sizes, which would require fewer employees on these tasks (Goldberg 1961). A posterior study entitled *How CPAs Can Adapt to the Computer* discusses the introduction of computer and transformation triggered in accountancy, further it exposes the duality of technology in the accountancy offices, that while innovation would force professionals and companies to update their knowledge to be able to remain competitive in the industry, it also would support them to enhance performance (Lennox, 1965). Controversy, Boyle, (1966) argues that introduction of computer in the accounting offices made routines such as bookkeeping and machine operator redundant due to the speed of computers in processing data and calculating figures in comparison to time consumed by human professionals to operate a “reprocessing cards” machine.

Technology continually is affecting the accounting industry. At the beginning of the 90s, the advent and evolution of enterprise resource planning in accounting (ERP) enabled companies to integrate into a single database departments related to the manufacturing department such as inventory control, but then it extended to other departments for example, “purchasing, warehouse management, financial and managerial accounting” through automation (Kumar and Hillegersberg,

2000) and, consequently decreasing the numbers of clerical professionals needed, but increasing a demand for professionals able to apply their accounting expertise to the implementation, complexity and maintenance of ERP. Therefore, while some functions became redundant others have emerged, but with a need for technological knowledge. An example of a redundant function would be a manual collection of data which became electronic, and eliminated the need of workers for this activity (Vasarhelyi *et al.*, 2015). On the other hand, ERP's limitations such as recording operations immediately into the ledger accounting and in data analysis would increase the need for accounting expertise to deal with those poor functionalities (Snapp, 2018). ERP has been seen as complex and expensive software to implement plus costly maintenance which entails IT, experts, not only in the implementation but also in any updating process needed (Cooper *et al.*, 2019). Earlier, Kanellou and Spathis (2012) outline some benefits that ERP would bring to accounting, such as improvement of information time, reliability of accounting data and accuracy of reports. Arguably, Jongkyum *et al.* (2013) point out that ERP implementation's complexity would impact directly in accounting control and audit report, producing delay and damage to firms' reputation. Besides, by implanting ERP, the organisation should re-structure their whole application "to fit around applications such as Oracle® E-Business Suite, SAP®, Oracle®JD Edwards EnterpriseOne, and Oracle® PeopleSoft Applications".

Back to now, innovations such as automation, artificial intelligence (AI) and robotic accounting processes (RPA) are in the spotlight among studies around the technological impacts on industries, including accountancy. And one of researchers' persistent concerns is the probability of machines replacing humans in the labour market.

Researches in the accountancy field agree that technology would threaten some accounting activities, such as bookkeeping and payroll administrator, besides other changes in the industry. But they concur that opportunities might emerge. They base that idea on past events, such as the advent of computer and internet that eliminated clerical jobs such as punch-card operator but on the other hand created other roles, for example, an advisor job in the accounting field (Carlson, 1957; Keenoy, 1958; Boyle, 1966; Walton, 2000; Armed Forces Comptroller, 2008; Richins *et al.*, 2017; Yedavalli, 2018; Dahlin, 2019; Haenlein and Kaplan M., 2019). Researchers highlight that some accounting roles would be more sensitive to innovations, but whether it would be a threat or an opportunity to the accounting profession may depend on the perception of the profession in relation to smart machines, such RPA and others that are yet to come. These facts will be subject of investigation later in this research.

Therefore, automation, AI and RPA differences can be illustrated as follows:

Table 1: Difference Between Automation, RPA and AI

	Automation	RPA	AI
Features	It allows machinery to perform tasks and it is built at the infrastructure level and is typically associated with a lengthy implementation process. It also requires substantial input from IT professionals and software developers	Is the application of technology which enables computer software configuration to partially or fully automate human activities which are manual, repetitive and rule-based. It has been maturing quietly over the last decade and is now used for enterprise-scale deployments, very quickly and at very low cost.	Aims to mimic human behaviour such as perceiving, gathering evidence and reasoning, and is therefore the best fit for processes which involve unstructured data from non-standard sources. It is enabled by cognitive technologies, nascent, but with huge transformative potential in the near future.
Reference	(B2BNN, 2020)	(Deloitte, 2016)	(Deloitte, 2016)

Source: Author

Thus, while a traditional automation approach relates to using software to automate tasks with human power needed; RPA goes further by mimicking human actions and therefore, doing by itself tasks that a human would do in a structured and rule-based environment; AI, in turn, goes further as it is able to perform reasonable tasks in an unstructured environment.

1.2 Research Purpose

RPA has become popular software in the accounting industry; therefore awareness about how RPA and innovation would impact professional's career path is essential to create strategies to preserve their value to business and make themselves ready for the new requirements. This author highlights that this industry is composed of professionals involved in different areas such as accounting, management accounting control, auditing, taxation, etc. However, this study will focus, mainly, on roles related to accounting departments, for instance, bookkeeping, payroll and accounts payables/receivables executives. It does not mean that other roles will not be mentioned, but they are not the direct subject of this study.

This study aims to advance an understating the effects of RPA in the Irish job market from the perception of postgraduates in accounting and finance and whether RPA is reshaping this profession in the Irish job market.

In order to reach this aim, an examination of the past and actual trends of technological fears in the accounting field, with a deeper insight into the main technological trend at the moment; i.e. RPA, was made to provide a better understanding of the theoretical aspects surrounding the purpose of this research. This research will provide an insight into different literature sources, embracing journals, reports, books. Illustrations of these comprise Harvard Business Review Digital Articles; CPA Journal; Journal of Emerging Technologies in Accounting; and ACCA Global's reports.

The principal issues that surround this trend will drive this study through the following research question:

a) What are the skills, competencies (knowledge plus skills) that accounting and finance professionals should acquire and expand in order to work together with RPA and its digital workforce in the Irish accounting industry?

The data will be gathered applying semi-structured interview approach which questions are designed in an open-ended format to promote meaningful answers (Patton, 2014). In order to enrich this study, it will also involve interviews with experienced professionals in the accounting industry.

The conjunction of both interviews and literature review will contribute to understanding whether or not there is a difference between conceptual and real work life. From this, an illustration of the impact of RPA on the workplace for accountant and finance postgraduate should arise.

1.3 Significance of the Study

As a recent postgraduate in accounting and finance, this author was interested in investigating the main trends in the accounting industry. This author realised that technological developments are a subject in evidence in various industries as well in accounting. From preliminary readings, RPA appears as the most popular in the accounting industry at this time. Additionally, this caught this author's attention as it linked to the robotisation of some accounting roles which seem to be the ones most available in the Irish job market, such as accounts payable, receivable and payroll administrator.

Through examining how RPA has been and will be causing change, this author will explore the literature review to support and drive the correct methodology for the primary data collection in order to answer the core questions of this research, presented in the previous section 1.2. Furthermore, this author aims to outline to the readers' principal points of RPA transformation in accountancy and provide a guideline aiming to prepare professionals for the obstacles that may arise in this new transformational era.

1.4 Research Objective

Willing to keep their knowledge up to date has always been a prerequisite for whoever wanted to become an accounting professional, but it relates to updating expertise, to develop the accounting knowledge, in order to be relevant to the job market. Through history, it is shown that the demand for plurality in abilities becomes each year more important for the maintenance of professional relevance (ACCA Global, 2016; Matthews, 2019).

Technology is redesigning the accounting industry's requirement, as it evolves. Therefore, professionals in this field are being required to expand the range of skills and capabilities to accompany these changes and be able to deal with innovation (Yedavalli, 2018). RPA is one innovation that has reshaped this industry and one of the trends that promise to become more popular and consequently impact roles which meet its constraint to be automated (Mazars, 2019; Cooper *et al.*, 2019; AICPA, 2020).

Hence, surrounded by the context of RPA innovation in the accounting industry, the objectives of this study are to:

- 1) Investigate which accounting and finance roles that are most susceptible to RPA.
- 2) Explore the researchers' assessments regarding the actual and foreseen RPA's impacts on the accountancy profession.
- 3) Determine the necessary competencies (knowledge plus skills) that accountants and finance professionals must acquire to face RPA in the accounting industry.
- 4) Explore accounting professionals views and actions regarding RPA and innovation effects in their career path.
- 5) Devise recommendations on professional upskilling matters.

1.5 Structure of the Study

This research is structured into five chapters, as follows:

- The first chapter presents an introduction based on a preliminary literature review; research purposes and significance of this study.
- The second chapter introduces an investigation of the literature relevant to the objectives of this study, presented in the section above; this chapter also presents the conceptual framework that aims to guide the methodology of this study and the collection of primary data.
- The third chapter describes the chosen research methodology believed to be the most appropriate to accomplish and achieve the answer for this study research question.
- The fourth chapter presents the findings from the collection and analysis of primary data aiming to answer the proposed research question; besides, to confront findings within the literature review and provide an insight on the objectives of this study presented in the above section.
- The fifth and last chapter presents the conclusions, contributions, and limitations of this research plus recommendations for future research related to the subject of this study.

2 Literature Review

2.1 Overview – Historical Introduction

Since the beginning of the 20th century, when technology came to be associated designed machines and tools aimed at improving performance in industries (Buchanan, 2016), it has developed with increasing efficiency and effectiveness. However, in the last two decades, innovation was enhanced as never before within a short period, and it promises to fast-forward the transformation of traditional skills to those requires by technological advancements. These technological factors promise change in the workforce worldwide and encourage professionals to progress and adapt their abilities (Bughin *et al.*, 2018).

Therefore, this chapter will provide a critical review of the relevant literature as a foundation for the construction of this research. Its aim is to ensure that the work delivers a good grasp to the reader of prior research and trends concerning three of the widely discussed innovations at this moment: **Automation, Artificial Intelligence (AI) and Robotic Process Automation (RPA)**. The objective is to identify the impacts of these innovations in the accounting industry and on the professional accounting path.

Table 2: Automation, AI, RPA - Concepts Preferred in this Research (Not Deemed as Absolute True)

	Automation	AI	RPA
Definition	It is understood as machines used for "repetitive and mindless" activities, supporting human beings to surpass their limitations and increasing economic company's performance.	It can be categorised as a higher level of advancement in automation that would be able to perform human work related to cognitive knowledge, rather than only manual work.	Robotic process automation (RPA) is the application of technology that allows employees in a company to configure computer software or a "robot" to capture and interpret existing applications for processing a transaction, manipulating data, triggering responses and communicating with other digital systems.
Reference	(Brynjolfsson and McAfee, 2014)	(Davenport and Kirby 2015)	(IRPAAI, 2019)

Source: Author

Additionally, a theoretical framework related to this research will be presented in the 2.5 sub-chapter in order to assist in the preparation of the conceptual model. This will be applied to the script for conducting interviews. It will also scrutinise how the professionals subject of this study perceive their readiness for the transformation of RPA in accounting, along with the main difficulties encountered by them in this field.

Hence, the literature review that substantiates this research is assembled as follows:

First, it presents a general view of automation, artificial intelligence and robotic process automation and its evolution and impacts in the industry.

Subsequently, it presents these innovations in the accounting field and their effects on companies and professionals in this industry.

Ultimately, it presents a deeper insight into RPA as this seems to be the trend which is affecting the accounting and finance industry in the foreseeable future.

2.2 Defining Relevant Technologies – Historical Context

2.2.1 Automation

Automation is considered a peripheral layer in innovation which refers to transference from manual to mechanisation of activities (Clair and Kirkwood, 2019). Historically, automation phenomenon was initiated over two hundred years ago when James Watt and his companions boosted a remarkable technological change by creating the steam engine. Then, their innovation would be considered an essential factor in the advent of the Industrial Revolution and the beginning of transcendence the human being’s constraints to the machine’s strength resulting in increase production massively (Brynjolfsson and McAfee, 2014). Since then, automation has been developed from steam machines to highly sophisticated machines in the present time (ACCA Global, 2019a). Accordingly, Davenport and Kirby (2015) delineate that automation has three main historical stages (figure 1) and that each of those stages demonstrates an enhancement leap. These enhancements concur with assertion of the benefits that automation has delivered to industries, such as accounting, speed production, administrative processes, improvement of performance and cost-saving (Xu *et al.*, 2018).

Figure 1: Three Eras of Automation

ERA ONE 19TH CENTURY	ERA TWO 20TH CENTURY	ERA THREE 21ST CENTURY
Machines take away the dirty and dangerous - industrial equipment, from looms to the cotton gin, relieves human of onerous manual labour.	Machines take away the dull - automated interfaces, from airlines kiosks to call centers, relieve humans of routine service transactions and clerical chores.	Machines take away decisions - intelligent systems, from airfare pricing to IBM's Watson, make better choices than humans, reliably and fast.

Source: Assembled by the author based on *Beyond Automation* (Davenport and Kirby 2015)

At the new digital era, in general speaking, automation is surrounded by two main trends; i.e. IoT that is “worldwide network of interconnected and uniform addressed objects that communicate via standard protocols.”; and Cybersecurity and Cyber-Physical Systems (CPS) which is characterised as integration between systems made by human and computation, communication and control

systems. Automation continues with similar purpose described above, that is to improve overall performance in industries (Vaidya *et al.*, 2018).

It is evident that all the revolutions have brought compelling advancements and innovation worldwide. Notwithstanding, novelty also brings challenges; in the case of the new technological age, the major challenge may relate to the lack of autonomy of machines in making decisions. This element seems to be a uniquely human skill, and therefore, machines may be far away from reaching this ability (Vaidya *et al.*, 2018; Daugherty and Wilson, 2018).

Additionally, throughout automation advancements, one aspect that always emerged was the impact of this on the workforce; and how companies would deal with training and qualification of their personnel to meet the need that would have arisen at each revolutionary stage in the different industries. For instance, Acemoglu and Restrepo (2018) claim that automation would result in the substitution of humans in the labour market by machines. The authors believe that it would lead to joblessness in tasks that can be automated. This matches with predictions made by scholars such as Keynes (1930) and years later by Frey and Osborne (2013).

Table 3: Automation Definitions

Definition	Reference	Field
It is deemed as use of machine to improve the speed of industrial processes and compilation of data in offices. Consequently, it would reduce the requirement for manpower in those processes.	(Goldberg, 1961)	Business and Law
It is the conversion of a work process, a procedure, or equipment to automatic rather than human operation or control.	(Gerovitch, 2003)	Scientific History
It is a technology used to automate manual and repetitive tasks in different sectors, resulting in disruption and reshaping of the workforce.	(Frey and Osborne, 2013)	Economy and History; Technology
It is understood as machines used for "repetitive and mindless" activities, supporting human beings to surpass their limitations and increasing economic company's performance.	(Brynjolfsson and McAfee, 2014)	Business and Technology; Science and
Processes being performed by machines rather than by humans. Machines can perform some repetitive processes, to a consistent standard, quickly and without errors, so are often better at performing these tasks than the human.	(ACCA Global, 2018)	Accounting Body
It is the use of machines and computers to replace human work in a various types of industries processes.	(Acemoglu and Restrepo, 2018)	Economy and Technology
A technology concerned with performing a process by means of programmed commands combined with automatic feedback control to ensure proper execution of the instructions. The resulting system is capable of operating without human intervention.	(Groover, 2018)	Industry and Technology
It would be related to development of machines that boosted industries performance through history.	(M. Xu et al., 2018).	Science and Technology
It is a developed technology that uses computers to automate processes and its main collaborator is the human that can maintain its progress toward the future.	(Janssen et al., 2019)	Psychology, Technology and Engineering

Source: Author

From the above definitions it appears that automation has a direct relationship with human labour, however, while some authors understand automation as allied to human improvement performance,

others argue that automation would disturb workforce and culminate in unemployment, mainly for workers considered low-skilled or without computer knowledge (Kokina and Davenport, 2017; Osborne and Frey, 2018; Clair and Kirkwood, 2019).

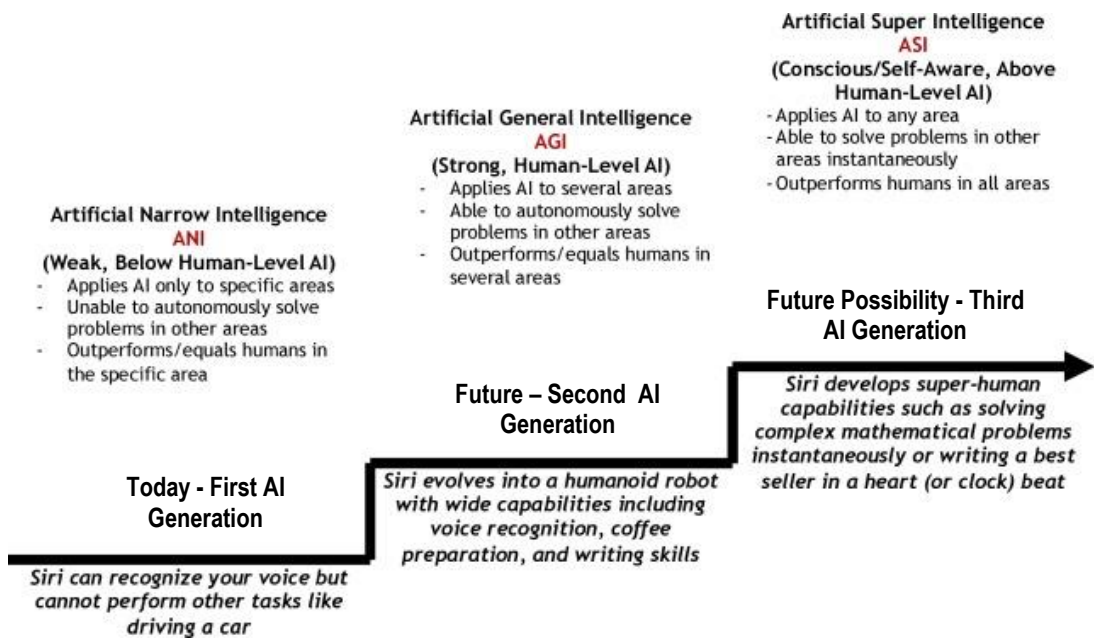
2.2.2 Artificial Intelligence (AI)

AI is an increasingly common wording in discussions about how far robots can reach in relation to human intellectual capacity. Further, if intelligent machines can reach all the humankind capability and their uniqueness (Kurzweil, 2005). The expression Artificial Intelligence emerged in 1956 from the first meeting in history to discuss whether the machine would learn or if there would be a day it in which it could reflect human capabilities. The group in this conference were composed by John McCarthy, Claude Shannon, Marvin Minsk and others who were computer scientists (Daugherty and Wilson, 2018). Since then, many predictions were made on how long it would take AI to equal humans in all their features, and a huge improvement has been seen in its territory (Haenlein and Kaplan, 2019).

The definitions of AI (Table 4) range follow the researchers' perspective, the study field and the period of time that is defined due to the speed of its development. A common understanding may be that AI can not imitate the soft human skills, such as empathy and deeper analysis, and to work appropriately, the machines need a human behind them. AI also may be seen as a co-worker which would enable humans to employ their unique skills to have a greater insight into business situations (Davenport and Kirby, 2015). Likewise Daugherty and Wilson (2018) also define collaborative work between humans and machines; the author alleges that machines might be seen an extension of human cerebral abilities, such as learning and responding, which would result in extra time for humans to solve complex problems while machines would do those tasks that are time-consuming such as data collection and analysis of primary data.

Arguably, Tegmark (2017) claims that AI can be defined as machines with the capability of demonstrating human beings' skills such as learning, problem-solving, and multiple analyses in a high level of data in a very short period of time, this makes AI as a great human competitor in relation to the power of bringing business to a higher performance, due to its velocity in processing information. In approaching the subject of machine supremacy, Haenlein and Kaplan M. (2019) assert that AI is in a first stage out of three and although it is as yet able only to mimic some mankind actions it may achieve exclusive human skills in a possible forthcoming third stage.

Figure 2: Stages of Artificial Intelligence (AI)



Source: (Haenlein and Kaplan M., 2019)

A part of AI's efficiency and efficacy in performance, also brings concerns related to business security due to its upcoming autonomy. As AI still in its infancy stage there is a need for more comprehension on how to make IT safer, as it may be vulnerable to cyber-attacks. Another concern that emerges is more apocalyptic and related to AI is the extension of humanity by smart robots in the unpredicted future, and the possibility of human intelligence being superseded by smart machines, although it would be ages away from now, it is believed to be a possibility (Clair, 2019).

Table 4: AI Definitions

Definition	Reference	Field
It is a range of systems that can be programmed to think and act rationally like humans.	(Kok et al., 2002)	Computer Science
It can be categorised as a higher level of advancement in automation that would be able to perform human work related to cognitive knowledge, rather than only manual work.	(Davenport and Kirby 2015)	Technology and Business
It is composed by a set of innovation such as machine learning and deep learning to deal with a large number of data, structured or not to provide a deep insight of information.	(ACCA, 2017)	Accounting Body
It refers to machines capable to perform tasks that would commonly require human intellect, such as planning, reasoning and learning.	(Duin and Bakhshi, 2017)	Accounting Industry
Machines capable of demonstrating the skills of human beings, such as learning, problem-solving and multiple analyses on a high level of data in a very short period of time.	(Tegmark, 2017).	Technology
AI refers to the development of computer systems (IT/Data Science-based set of technologies) able to perform tasks normally requiring human intelligence where judgement is applied beyond simple decision trees, such as visual perception, chat and messaging dialog, reading emails, speech recognition, decision making and translation between languages.	(Ernst Young, 2018)	(Ernst Young, 2018)
It is a range of technologies with sub-domains capable to deal with diverse situations and act, think and sensing like as human.	(Ernst Young, 2019)	Accounting Industry
it is an evolution of automation where machines are programmed to have the ability to learn tasks from information or experience and do jobs previously done exclusively by humans.	(Frey, 2019, pp.327–328)	Economy
It is understood as a machine that has the ability to achieve specific objectives by the application of high precision data analysis and the acquisition of knowledge from data and employment of those knowledge to attain these specific objectives through adaptation of means.	(Haenlein and Kaplan M., 2019)	Digital World and Big Data
It concerns the automation of tasks that request human intellect, for example, uncovering fraud and maintenance of physical assets.	(PwC, 2019)	Accounting Industry
It refers to computers capable of carrying out activities commonly linked to exclusive human intelligence.	(Copeland, 2020)	Philosophy and History
It is a technology composed of two categories: "general", related to machines that can acquire knowledge to solve problems without human intervention; and "narrow", which refers to machines capable of performing specific tasks and making decisions with autonomy, with the possibility of surpassing the human in their specific area.	(Patrick and Williams, 2020)	Accounting and Technology

Source: Author

Therefore, comprehension of AI appears to modify over time and at the same speed as its advancements, but it also appears that the goal of reaching whole human capability is maintained in the core of the majority of definitions, even if it seems that is far away from actual time (Kok *et al.*, 2002). Another factor that appears to be an agreement among researchers is that AI is the head composed of innovations subheads that are categorised as: Machine learning, deep learning, speech recognition, neural language processing, image recognition, robots which together empower AI (Kok *et al.*, 2002; ACCA, 2017; Cagle, 2019; Patrick and Williams, 2020).

2.2.3 Robotic Process Automation (RPA)

All of the technological advancement discussed up to here, back to twenty years ago seemed to be possible only in sci-fi movies. Thus, it has become a reality, and the disruptions of this maybe has

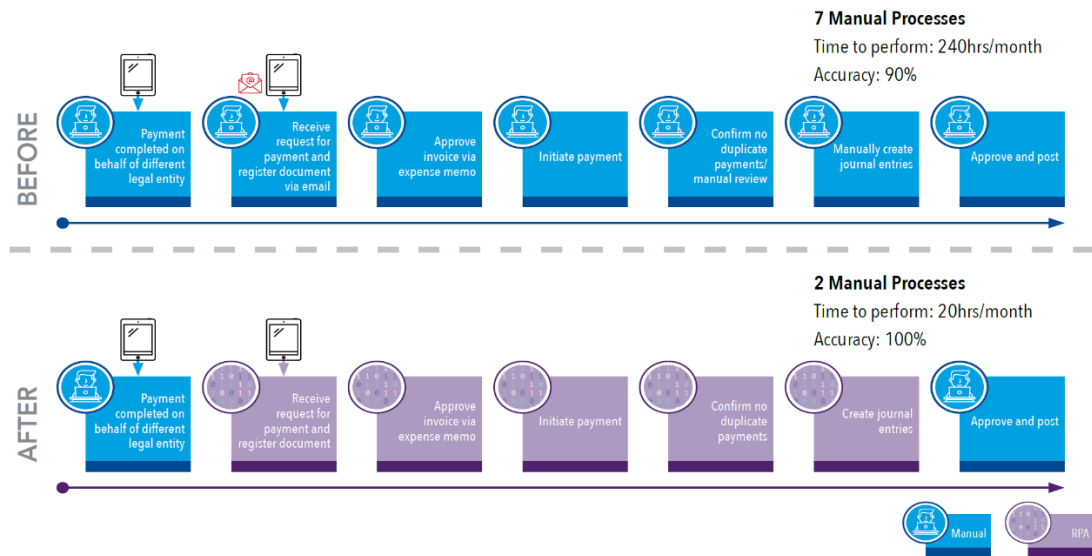
made people reflect on how it could impact on industries organisations and the job in the industries, organisation and job market.

RPA nomenclature emerged in earlier 2000s and has been disseminated by three main developers, UiPathInc., Blue Prism Group PLC, and Automation Anywhere Inc. (Santos *et al.*, 2019); however it derives from the traditional automation. This technology promises to increase businesses' efficiency process at a lower cost than conventional software without disturbing a company structural IT (Yedavalli, 2018); it also recognised as an innovation which can use AI together to process and provide fast information (Forrester Research, 2020). In a similar thought, Cho *et al.* (2019) in agreement with Cooper *et al.* (2019) conclude that RPA is a software programmed, that can be added AI, to replicate humans works and then perform these works in a large amount without IT or any employee intervention multiple and large bases-rule tasks in an environment with structured information. The main RPA's attributes include: codification of computer using a software, programs mimicking human interface with applications, cross-functional application, digital workforce operate by operators, non-invasive and rapid implementation, works harmonically with legacy systems and governance (Deloitte UK, 2020).

The RPA can be deployed into two different ways: firstly by setting robots with a rule-based and structured process; the implementation is done through a detailed map of all steps of a process and then recording each step which RPA can mimic in a diary basis. The second way, is to deploy intelligent robots that are combined with AI able to analyse past and actual information. The robots will mimic each click, action, open screens as a human would do. After certain time, when robots acquire enough data analyses in its memory, it will perform all processes, including unstructured ones, that they have been trained for (ACCA Global, 2017; Hawkins, 2018).

Among RPA capabilities are the ability to perform automatically administrative tasks that have a repetitive and consistent process much faster than human (Lin, 2018). Figure 3 illustrates a comparison between RPA versus human in handle an intercompany chargeback process. The time that RPA processes all the steps to complete this tasks is 12 times less (1200%) hours than humans. However, the most significant difference would be the data accuracy of information provided by RPA of 100%, which are essential for the quality of services delivered (ACCA Global and KPMG, 2018).

Figure 3: Application of RPA in the Record to Report process



Source: (ACCA Global and KPMG, 2018)

From these features, RPA appeared to have the potential to modify a workplace as it would be able to handle a large workload and process required information within hours rather than taking weeks by a human employee. This scenario of changes in the workplace has been discussed among researchers. A study made by Forrester Consulting on behalf of UiPath, that is a vendor of RPA, identifies employees anxiety in relation to this innovation and the future skills requirements upon to automation (Forrester Research, 2020). This will be discussed later in the section 2.5.1. However, Fersht (2019) argues that RPA has not yet reached a level of engagement at which it could affect the reduction in the number of employees.

Table 5: RPA Definitions

Definition	Reference	Field
It is a type of software that mimics the activity of a human being in carrying out a task within a process. It can do repetitive stuff more quickly, accurately, and tirelessly than humans, freeing them to do other tasks requiring human strengths such as emotional intelligence, reasoning, judgment, and interaction with the customer.	(McKinsey Global Institute, 2016)	Researcher Company
RPA tool use automation software to perform tasks such as processing sales and financial transactions, managing data, communicating between different systems, and access management, as well as monitoring and reporting.	(Seasongood, 2016)	Finance and Performance management
It is as the name would suggest a way to automate processes through the use of robots. These kinds of processes are typically performed within a back-office function and can often be characterized as being one or a combination of; (1) Repetitive (2) Prone to error (3) Rules based (3) Involve digital data and (4) Time critical and seasonal	(ACCA Global, 2018)	Accounting Body
It leverages user-friendly applications to configure software robots that can be quickly trained and deployed to automate manual tasks across various business processes spanning multiple systems.	(Ernst Young, 2018)	Accounting Industry
RPA is the use of computer software “robots” to handle repetitive, rule-based digital tasks, interacting with applications and information sources the same way humans do now.	(Kaelble, 2018, p.6)	Communication
RPA uses computer software to automate rule-based business processes that are routinely performed by office workers. They mimic what human employees do, and can generally be implemented without the need of IT infrastructure upgrades.	(Lin, 2018)	Finance
It involves the use of software that <i>mimics</i> human actions while interacting with applications in a computer and accomplishing <i>rule-based tasks</i> .	(Tripathi, 2018, p.26)	Technology
It is the technology that allows anyone today to configure computer software, or a “robot” to emulate and integrate the actions of a human interacting within digital systems to execute a business process. RPA robots utilize the user interface to capture data and manipulate applications just like humans do. They interpret, trigger responses and communicate with other systems in order to perform on a vast variety of repetitive tasks. Only substantially better: an RPA software robot never sleeps and makes zero mistakes.	(UiPath, 2018)	RPA Developer and Vendor
Ranges from a simple to a very complex computer program that is able to automate the input, processing, and/or output of data across computer applications or systems without altering a firm’s existing infrastructure. RPA software mimics the actions of a human.	(Cooper et al. 2019)	Accounting and Technology
Unassisted automation, (...) self-triggered (bots pass tasks to humans) and centered on increased process efficiency.	(Fersht 2019)	Researcher Company
It is an emerging technology that enables the automation of rules-based business processes and tasks through the use of software bots.	(Kokina and Blanchette, 2019)	Accounting
RPA is the application of technology that allows employees in a company to configure computer software or a “robot” to capture and interpret existing applications for processing a transaction, manipulating data, triggering responses and communicating with other digital systems.	(IRPAAI, 2019)	Institute of RPA and AI studies
It is a way of automating high-volume, low-complexity, routine processes so that recurring and manual digital work is done by software robots, or bots.	(Automation Anywhere, 2020)	RPA Developer and Vendor

Source: Author

Researchers concur (Table 5) that the main feature of RPA is that it has the ability to increase the speed and accuracy of routine back-office processes and, consequently, decrease the demand for hours to complete activities that would take days, such as preparing a tax return or payslips. What also appeared to be in agreement among the scholars is that robots need professionals’ expertise to teach them in order to do processes correctly. Nevertheless, it seems that an issue with this innovation is that it works only with rule-based processes, which means that the company, that decides to deploy it needs to plan carefully and evaluate how the existing processes are structured.

For, fearing that RPA only mimics the actions of its coaches, its limitation is that it does not detect procedural errors; thus processes must be 100% correct. Additionally, Fersht (2019) claims that RPA definition has been misapplied as most of “RPA” deployed are not processes automation, but “desktop apps, screen scrapes and doc management” rather than “unassisted automation, (...) self-triggered (bots pass tasks to humans) and centered on increased process efficiency” (Fersht, 2019). Therefore, perhaps this issue of lack of clarity and understanding in the RPA concept is the reason for the slow scalability of RPA in the accounting industry.

2.3 Technology in Accountancy

This chapter will investigate the effects of technology on the accounting industry overall. However, a deeper insight into the literature will only concern RPA, as the technology object of this study.

As mentioned earlier, in the introduction, from abacus to RPA (Table 6), technology has always played a significant role in the accountancy history. This has made easier the routine and augmented precision, efficiency and efficacy of professionals which may result in increased credibility in these professionals (Pepe, 2011).

Table 6: Technology in Accountancy - Time Line

≈Time Period	Link	Technology in Accounting	Use in Accounting	Reference
2000 years ago	Automation	The Abacus	<ul style="list-style-type: none"> It is deemed to be the first machine used by Mesopotamians to make calculation up to ten items. 	(Previts <i>et al.</i> , 1990)
1890	Automation	The punch card	<ul style="list-style-type: none"> It was created by the engineer Herman Hollerith, initially to speed the count of US census' figures. 	(IBM, 2003; IBM, 2012)
1934			<ul style="list-style-type: none"> Introduction IBM 405 alphabetic bookkeeping and accounting machine (support in adding, subtracting and printing in the back-office) 	
1944	Automation – First step towards AI	Automatic Sequence Controlled Calculator (ASCC) – A big computer	<ul style="list-style-type: none"> First “thinking machine” developed by IBM to make faster calculation. It helped to ease bookkeeping process 	(Saxby, 1990)
1960s – 1980s	Automation – First steps towards AI	Small computers – Offices introduction	<ul style="list-style-type: none"> Replacement of accounting machines by data-processing Accountants were replaced by computer skilled professionals 	(Chatfield and Vangermeersch, 2014)
1985>	Automation	Excel - Spreadsheets	<ul style="list-style-type: none"> System which helped professionals organise and manipulate data Performance of accurate calculation Helps professionals to analyse, compile and relate information 	(Encyclopaedia Britannica, 2019)
1990'	Automation	ERP advent – Software (SAP, SAGE, Oracle, Workday, etc.)	<ul style="list-style-type: none"> Integration among accounting and other company's department Real-time information, increased information flexibility and quality Generation of information for decision-making 	(Kanellou and Spathis, 2012)
1956 >	AI	AI-based technology	<ul style="list-style-type: none"> Processing unstructured data Invoice management (Payables/Receivables) Supporting audit to perceive processual fraud Outputs extremely accurate 	(Daugherty and Wilson, 2018; ICAEW <i>et al.</i> , 2018)
Earlier 2000s	Automation - Robotics	RPA – Software	<ul style="list-style-type: none"> Accurate results Supports compliance Performance of routine tasks in a short time Robots mimics human actions 	(Ernst Young, 2017; van der Aalst <i>et al.</i> , 2018)

Source: Author

In addition to an augment of trust in the accounting industry and its professionals, technological developments seem to have brought flexibility and freedom from mundane tasks as they can dedicate their time in deep analysis and navigate beyond the core and traditional knowledge of accounting matters, such as mathematical calculation, manual recording transactions in paper books, manual copy of information (Kruglinski, 2009; Surendar and Rathnakar, 2019). Other benefits that technology has provided to accountancy relates to the speed to access information through internet, accounting software eliminating the need for bookkeeping, physical records (Pepe, 2011). Regarding the need for physical and hardware space for document storage, cloud computing solves the issue as this technology and allows accounting organisation to have digital files (Carr, 2019b).

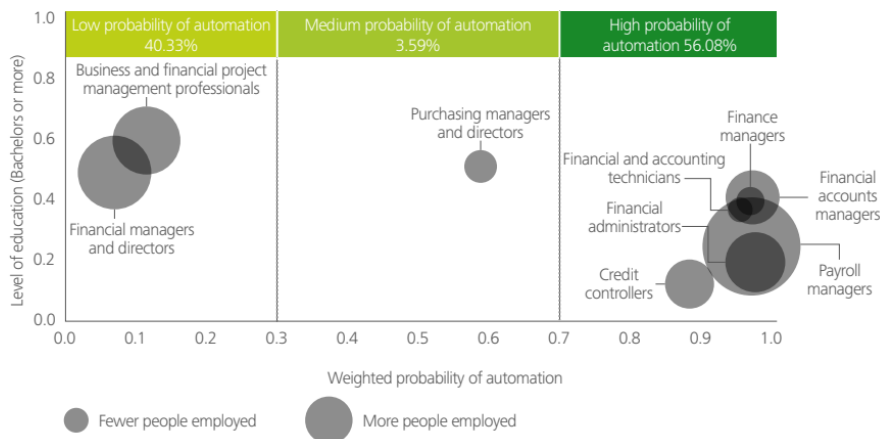
Unquestionably, technology can also present some problems and monetary loss for the accounting and finance sectors, especially in relation to the protection of confidential data against cyber attacks. David Adams, an expert in Cloud and data security, states there are no 100% efficiency tactics against these attacks; Nevertheless, the author outlines procedures that would increase organisations self-defence, such as making professionals aware of sensitive data security, investment in security systems, anti-virus and, mainly maintenance and updating of software and technologies deployed in the organisation as it would “prevent attacks on vulnerability known” (Adams, 2019). Accounting service and advisor providers are essential for planning to prevent these risks, as are those professionals who are able to assess business risks and create a strategy to protect information (ICAEW, 2019a).

2.3.1 Automation in the Accounting Industry

There are some concerns about the distress that automation development can cause in industry, and the accounting industry is not exempt (ACCA Global, 2019a). Notwithstanding, this matter appears historically relevant when a new automation wave arises. Back at the end of the 1950s, during automation wave Era Two (Davenport and Kirby 2015), the attention given to the development of technologies in data processing filled back-office professionals with dread and uncertainty regarding their career path and apprehension about overcoming or dealing with computers’ smartness (Keenoy, 1958). Keenoy’s (1958) assumptions on automation and computerisation impacts on routine accounting tasks, such as reduction or roles eliminations and business cost saving would return to be very relevant years later in the automation wave Era Three (Davenport and Kirby 2015). Despite Keenoy’s (1958) highlighting that automation could displace accounting professionals, the author also points out the limitation of machines in comparison to human, such as making judgements and decisions to aggregate value to firms’ clients. This limitation would boost the need for thinking beings to bridge the gap that machines would leave behind, which may continue to be a relevant factor in the current time.

Other studies reveal Keenoy (1958) prediction’s relevance, by indicating all automation waves have impacted the job market, either positively and negatively, as discussed in the course of chapter 2.2; i.e. in a contra-balance way of making some tasks obsolete but also creating new job opportunities (Autor et al., 2003; Frey and Osborne, 2013; Osborne and Frey, Carl Benedikt, 2018). A study *The future of employment: How susceptible are jobs to computerisation?*, done by Frey and Osborne (2013) concurs with the idea that roles framed as a repetitive-based tasks would be more susceptible to be done by machines due to those being easy codified. Further, the authors outline some accounting roles (Figure 4) which would match these criteria.

Figure 4: Profitability of Automation by Finance Functional Roles



Source: (Frey and Osborne, 2013, pp.57–72)

Despite the possible displacement that automation can cause, as pointed earlier by Keenoy (1958), it also can create multiple opportunities and consequently new type of jobs at the same time that others will fade (The Economist, 2014). It may differ from role to role as to how professionals are ready to perform activities that will demand more strategic thought and multiple-knowledge skills rather than manual tasks (Deloitte UK, 2015). ACCA Global (2018) also believes that automation can be a way to increase the accounting professional prestige in a company rather than lessening it. McGhee (2018) likewise Akhter and Sultana (2018) express similar thoughts around the accounting profession, as the authors emphasise that once professionals are highly skilled they would increase opportunities to assume strategic functions which are ethical-judgement based and value business adding.

Therefore, although automation could threaten some accounting roles, it also could provide opportunities to professionals and organisations by supporting the creation of value to businesses and professionals. Counterweight, those involved in the accounting industry should go after understanding the developments in automation, to plan and adapt themselves to be ready to adopt innovation.

2.3.2 Artificial Intelligence in the Accounting Industry

As previously discussed, AI is a range of technologies that together form “smart machines” with the aim to solve complex problems in a rational manner, but in a much shorter time. One of those in AI’s range that looks to be the one most adopted by accountancy is machine learning, which has been used in the accounting industry to codify processes and enhance data accuracy, improve

processes automation, detect and prevent fraudulent actions and collect and assess unstructured data, for instance, emails and contracts (Muwandi, 2020). The foreseen future seems to be even more promising, as machine learning would be able to cross-reference information and to reconcile bank statements with ledgers without any human intervention, (Duffy, 2018).

Related studies seem to concur with the above authors, as many have outlined several advantages of AI to the accounting industry. For instance, Tegmark (2017) ascertains that the use of AI in the audit fieldwork stage, has freed auditors from days of a substantial quantity of data analysis to apply their time in analytical analysis and strategy planning, consequently enhancing audit quality and opinion. Audit data compilation also has also benefited from AI deployment, as it makes more efficient and accurate audit data analysis, besides shortening their projects' deadlines (Brennan *et al.*, 2017).

AI is deemed to be a machine in an early stage and far from reaching exclusive human abilities, such as social and emotional ones. Thus, AI's capabilities would be restricted to cognitive humans ability, reinforcing the idea that smart machines are an ally for professionals and would help them to overcome the human limitation, such as speed in processing and analysing a large amount of information (Haenlein and Kaplan M., 2019). With the support of a machine to complete routine activities, a human would use their unique skills in a more efficient way to deliver higher performance.

Although it seems that there is no common belief that "smart machines" would supersede human beings, researchers draw attention to the probability of AI disruptions in the accounting industry as it tends year by year, once it is implemented, to decrease the company's cost due to its ability to produce more data or perform activities much faster than humans, consequently accounting services which require complex analysis such as consulting and financial services are those which may be heavily affected by this innovation (ACCA Global, 2017; PwC UK, 2018; Boobier, 2018; Haenlein and Kaplan M., 2019; ACCA Global, 2019a; Deloitte, 2020).

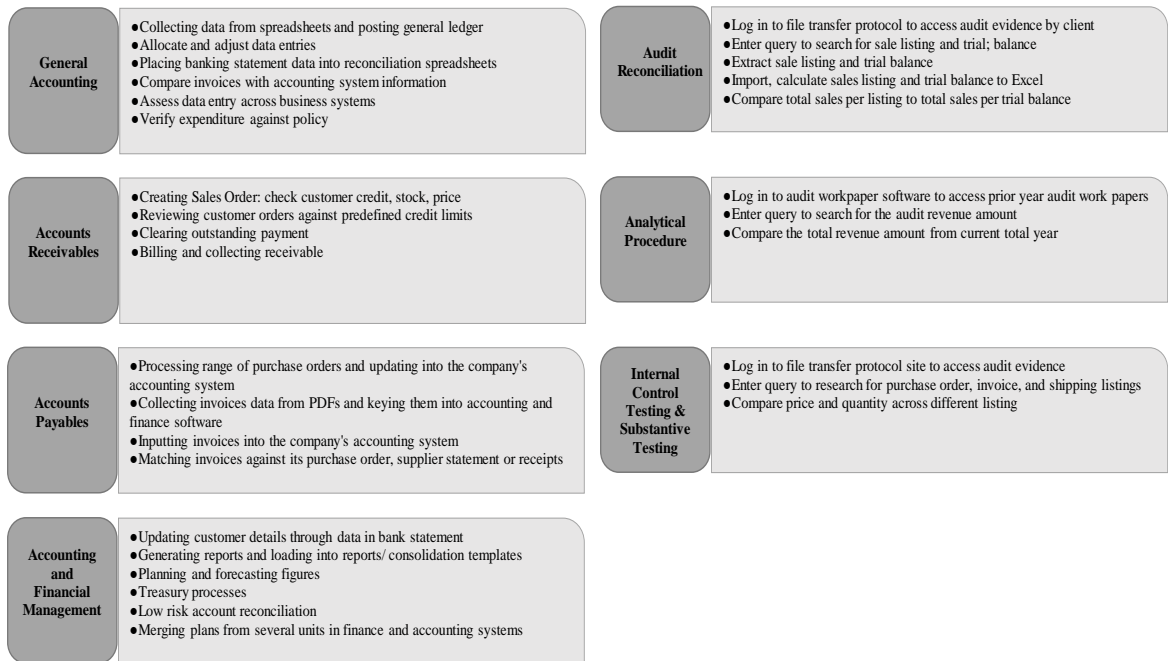
To diminish these disturbances, researchers call professionals and organisations attention to the need to be able to adapt quickly, to understand and then control machines responses. For that, it is required to apply resilience, flexibility, adopt a philosophy of continuous learning, be compliant with the technological changes and be apt to acquire new skills in accordance with AI enhancement (ACCA Global, 2016; Haenlein and Kaplan M., 2019; ACCA and PwC, 2019).

Therefore, AI is regarded as more than a tool to be used in order to facilitate daily professionals tasks; it could be seen as a co-worker. Despite the fact that AI requires professionals knowledge beyond numbers and constant learning, it helps employees and employers to keep competitiveness in the accounting industry and enables them to provide a much higher quality service.

2.3.3 RPA in the Accounting Industry

In an increasingly regulated and competitive environment, RPA promises to improve compliance, data accuracy, process quality with low and rapid return of investment (Deloitte UK, 2015). RPA core is the automation of repetitive and rule-based tasks. It has helped the accounting industry to comply with legislation and perform efficiently in a shorter time than humans in these types of activities (Figure 5).

Figure 5: RPA Effectively Use - Accounting, Finance and Audit



Source: Assembled by the author based on the literature review (Ernst Young, 2016b; Rozario and Vasarhelyi, 2018; ACCA Global and KPMG, 2018; Kokina and Blanchette, 2019).

RPA is an entirely new technology that has become very popular in the accounting industry, and its adoption is believed to escalate in the next five years. A survey carried by Ernst Young (2016) confirms this trend as it reveals that 65% of global participants see the automatising of processes in order to enhance performance and excellence in services provided is a priority for financial affairs. Despite this willingness to deploy RPA, studies show that implementation is mostly done by large finance accounting companies and those still in an infancy stage. Many companies are reluctant to deploy this innovation reasoning lack of knowledge of RPA operation and employees resistance (ACCA Global and KPMG, 2018). Further, a big challenge is related to the complexity in designing all processes relevant to automation at a very detailed level, in order to detect any legacy issue in the processes (Kokina and Blanchette, 2019).

Indisputably, RPA's deployment may modify and disrupt the organisation's structure, which can impact directly on human workforce, since they are dealing with transactional tasks which are those that RPA performs in a much faster, more accurate and efficient way (ACCA Global, 2017). However, unlike earlier scholars who linked replacement of humans by machines as a potential disruption in the market place (Keenoy, 1958; Goldberg, 1961; C. B. Frey and Osborne, 2013), recent researchers argue that RPA and its digital workforce would not substitute humans, but would become an ally to professionals to improve their performance, once it takes over mundane tasks (ACCA Global, 2016; Tripathi, 2018; Cooper *et al.*, 2019; Stoudt-Hansen and Karamouzis, 2019; AICPA, 2020). Nevertheless, to mitigate the fears surrounding RPA, employers must manage the changes sensitively, and develop a strategic plan prior to implementation to make sure that employees will be able to embrace robots and new functions (ACCA Global, 2018b).

Another point that emerges is the possibility of success or failure of the RPA implementation. Although RPA can provide various advantages to business after its implementation, such as the preparation of tax returns through a calculation of figures from the trial balance, crossing tax data and assessment, researchers claim that failure deployment rate ranges around 30% to 60% in the accounting industry (McKinsey Global Institute, 2019; Mezzio *et al.*, 2019; Deloitte UK, 2020) due to support failure and incorrect mindset of business about its implementation, since the project must be led by the business as a whole (Silva, 2018). In order to mitigate this, it is essential to understand the solutions offered in RPA market and analyse whether it can successfully be implemented (Table 7) in the business procedures (Santos *et al.*, 2019).

Table 7: RPA Deployment Success Factors

Success Factors	Reference
Apply a business-led initiative rather than just IT-led.	(Ernst Young, 2016)
Start at the early stage of the IT security commitment.	
Establish a centre of excellence in RPA to manage and improve the digital workforce, while increasing awareness of governance, IT and employees about the need to understand robot operations.	(Anagnoste, 2018)
Have a financial and accounting team with strong experience, analytical and digital skills and ensure that there are no defective processes.	(ACCA Global and KPMG, 2018)
Effective and continuous communication from the moment the RPA implementation begins.	
Have a financial and accounting team with strong experience, analytical and digital skills and ensure that there are no defective processes.	(BlackLine Magazine, 2019)
Look for a correct RPA solution according to business processes and understand how that solution can affect the business structure after and before implementation.	
Employ a robust business case before deployment to guide the RPA project.	(Chartered Accountants Worldwide, 2019)
Select processes that fit with RPA capabilities, such as ruled-based and well structured.	(Santos et al., 2019)

Source: Author

Further, research *Embracing Robotic Automation* conducted by ACCA Global and KPMG (2018) identifies a roadmap (Figure 6) based on successful deployment in companies worldwide which matches with the success factor in the above outline for some other researchers.

Figure 6: Assessment steps for RPA feasibility

MOBILISATION	DATA COLLECTION AND ANALYSIS	EVALUATION	RECOMMENDATION
<ul style="list-style-type: none"> ● Mobilise a joint team including programme governance ● Assess current opportunities against RPA best practice ● Run centre/process led briefings ● Develop an assessment criteria definition 	<ul style="list-style-type: none"> ● Run workshops with function teams to map processes for potential impact of automation ● Conduct analysis of process steps with sufficient automation potential ● Identify processes for further deep-dive assessment 	<ul style="list-style-type: none"> ● Evaluate process automation potential ● Develop the business case and implementation plan ● Aggregate benefit to determine holistic automation potential for benefits case ● Work through follow-up questions with process leads 	<ul style="list-style-type: none"> ● Review outputs and key findings ● Identify common process themes across sites ● Prioritise opportunities ● Validate RPA solution feasibility ● Prepare the business case

Source: (ACCA Global and KPMG, 2018).

Therefore, RPA seems to be a useful tool in the accounting sector, as it has great potential to improve performance and quality of service, since it further increases the motivation of

professionals and the time to work in activities that would add value to the business. However, RPA bring some obstacles, since its implementation requires professionals with varied skills, deep understanding of their company routine procedures and competence in operating and working with digital force.

2.3.3.1 Benefits of RPA

Researchers outline numerous paybacks that RPA could bring (Table 8), not only for an organisation but also for professionals who would be freed from up to 70% of routine activities and; consequently an increase of effectiveness, efficacy and time to perform activities that could add value to their company (Kaelble, 2018). Likewise, studies show that companies would reduce dependency on outsourcing their cost by up 70% (ACCA Global and KPMG, 2018) which may contribute to benefits that emerge in full-time research papers (FTE) labour cost savings and reduction of out of date information and proneness to error (Gerogiannis *et al.*, 2017) which results in leveraging data accuracy (Seasongood, 2016; ACCA Global, 2017; Lin, 2018; Mazars, 2019; Cooper *et al.*, 2019; Deloitte, 2020). Besides that, the fact that robots can work 24h/7day/12monthths and can be scaled according to demand (Yedavalli, 2018; ACCA Global and KPMG, 2018; Chartered Accountants Ireland, 2020) thus, substitute between three and four employees at a low maintenance cost [\$8,000–\$9,000] yearly (Financial Times, 2018) would also contribute to measure cost-benefits and savings due to RPA deployment (Medium, 2019).

Another significant benefit from RPA is its “lightweight integration implemented by professionals that know good business approach” because deploying robots does not need to change business IT governance and structure (Fersht and Slaby, 2012), as mentioned in section 2.3.3. As a result of this straightforward implementation, professionals, who are RPA trainers, in the finance and accounting department would be able to monitor robots action at real-time and rapidly detect any issue that could threaten processes optimisation (ACCA Global and KPMG, 2018; Forrester Research, 2020). Due to this necessary engagement of accounting and professionals in the RPA deployment and monitoring, opportunities are emerging for the workers (Silva, 2018; Chartered Accountants Ireland, 2020) rather than generating mass unemployment, as some predictions mentioned earlier in this study. In the accounting firms, for example, professionals are being reallocated to tasks which require higher knowledge, judgement, analytical analysis, customer engagement to support the creation of value to the business (Cooper *et al.*, 2019).

Table 8: The Main RPA’s Benefits Based on the Critical Literature Review

Benefits	Reference
Allows professionals to have a deeper insight in added-value tasks and growth of efficiency and effectiveness / Improve executive decision-making	(Manyika et al., 2017), (Alberth and Mattern, 2017), (Deloitte, 2018), (Lin, 2018)
Communicates with legacy software and work autonomously	(Forrester Research, 2020), (van der Aalst et al., 2018), (ACCA Global and KPMG, 2018), (Gotthardt et al., 2019), (Kokina and Blanchette, 2019)
24-7 operational capability	(Lacity and Willcocks, 2016), (Seasongood, 2016), (ACCA Global, 2017), (Ernst Young, 2017), (Lin, 2018), (Mazars, 2019), (Cooper et al., 2019), (Deloitte, 2020)
Full time equivalent (FTE) labour cost savings/ Reduction of outsourcing dependency	(Ernst Young, 2016), (Ernst Young, 2017), (Gerogiannis et al., 2017, pp.81–94), (ACCA Global and KPMG, 2018), (Deloitte, 2018)
Increase speed of processes and flexibility to scale/ Increased capacity without long build-up phase	(ACCA Global and KPMG, 2018), (Santos et al., 2019), (Cooper et al., 2019), (Chartered Accountants Ireland, 2020)
Improvement of data accuracy/ Increase quality by avoiding human error	(Seasongood, 2016), (ACCA Global, 2018b), (Deloitte, 2018), (Cooper et al., 2019), (Stoudt-Hansen and Karamouzis, 2019)
Quicker Return of Investment (RoI)	(ACCA Global and KPMG, 2018), (Ernst Young, 2017), (Lin, 2018)
Ease and prompt assessment of robots work	(Fersht and Slaby, 2012), (Santos et al., 2019)
Easy Implementation and user interface	(Ernst Young, 2018b), (Thome and Rodriguez, 2018), (Syed et al., 2020)
Straightforward Implementation by business whole team	(ACCA Global and KPMG, 2018), (Forrester Research, 2020)
Professional Opportunities	(ACCA Global, 2017), (McGhee, 2018), Lyon, 2020)
Flexibility engage with human users	(ACCA Global and KPMG, 2018), (Forrester Research, 2020)

Source: Author

Despite all of the benefits found in the literature review and outlined in this section, like any technological change, perhaps some drawbacks and challenges emerge from the adoption of RPA. This will be investigated in the next section.

2.3.3.2 RPA’s Drawbacks and Business Risks

Despite the many benefits found in this literature review in and discussed in the previous section, the deployment of RPA, like any technological change, is challenging and raises concerns about business risks (Deloitte, 2018; ACCA Global and KPMG, 2018; Cooper *et al.*, 2019).

Contrary to some advantages outline by researchers; some RPA benefits also can be found to be a drawback, for example, one of the RPA core could turn to be one of its weaknesses; i.e. to be suitable only for tasks based-rules (Mazars, 2019; Santos *et al.*, 2019) and be unable deal with Unstructured information, such as “scanned documents” (Gotthardt et al., 2019). Additionally, robots are incapable of handling an unexpected situation and exercise judgement when there is need. This is perhaps a major factor that highlights the unique abilities of humans in relation to robots (Davenport and Kirby, 2015; Kokina and Davenport, 2017). Another benefit that has two facets is the implementation factor; while it is deemed to be more comfortable, faster and independent by IT experts, the researcher argues that one of the factors that has created delay and

drops in RPA projects is the level of difficulty linked to the need to thoroughly scan each step of the chosen task to be automated. This duality between advantages and disadvantages also affects one of the most relevant aspects highlighted by the vendors of RPA – cost-savings. Cooper et al. (2019) reveals that participants concern about whether disclosing the use of RPA can impact positively or negatively on their profitability as perhaps clients would claim a fee reduction since project hours would lessen dramatically. Indeed, there is no agreement among this industry whether RPA would be considered an advantage by using a smart tool to deliver a better service or a disadvantage as clients may link it to a low work cost.

Specifically with regard to accounting and finance professionals, RPA, as other technologies in different moments of history, threatens accounting and finance functions which are related to rules and compliance. RPA may cause distress in the labour force as it eliminates potentially some roles which have a relationship with mundane ones, revealing a duality between benefits and limits (ACCA Global, 2019a; Cooper *et al.*, 2019; Team, 2020; Deloitte UK, 2020). In addition, a lack of digital skills may also impact these professionals as they are the people who would manage robots during and after implementation (Kokina and Blanchette, 2019).

In Business RPA introduces new risks, for example, its facility to use and speed up the process can turn into hazards if inherited issues are not identified at the implementation, which could lead to thousands of transactional errors (Trefler, 2018; PWC and ACCA, 2019). Another significant risk relates to a company concentrating only on automation of processes and overlooking the impacts of these processual modifications on internal controls over financial statements and IT structure; this may result in financial loss (Deloitte, 2018). RPA can also increase a company's vulnerability to cyberattacks. Ernest Young in its report *How do you protect the robots from cyber attack*, list four possible risk to data security with the implementation of RPA – “ Abuse of privileged access” which relates to a user who would take advantage to train a robot in order to get or give access to confidential information; “Disclosure of sensitive data”, this may occur by human error in training robots inappropriately to get access in an opened website, or by the trainer leading maliciously to private outflow information; “Security vulnerabilities”, this is due to robots having easier “remote access” to sensitive data and also training robots to manipulate information but wrongly securing this when downloading or uploading it in a digital environment; and “Denial of service”, this may occur if robots are trained without taking on consideration scalability, leading them to collapse (Ernst Young, 2018).

Table 9: The Main RPA’s Drawbacks and Business Risks

Drawbacks and Challenges	References
Distress in workforce due to the automation of repetitive tasks	(Deloitte UK, 2020), (Brynjolfsson and McAfee, 2014), (Daugherty and Wilson, 2018), (ACCA Global, 2019), (Cooper et al., 2019), (Team, 2020)
Erroneous setup affecting thousands of transactions. Possibility to carry heritage issues	(Trefler, 2018), (PWC and ACCA, 2019)
Incapable to provide judgement and decision-making / Incapable of handling an unexpected	(Davenport and Kirby, 2015), (Kokina and Davenport, 2017)
High number of dropping or delay in deployment	(Trefler, 2018), (Santos et al., 2019), (Cooper et al., 2019)
Lack of professional with digital and program skills	(Kokina and Blanchette, 2019).
Needed for employees training prior implementation	(McKinsey Global Institute, 2018), (Cooper et al., 2019)
Possibility to cut-fees due to reduced hours to complete tasks	(Cooper et al., 2019)
Unsuitable for non-rule-based tasks / Inability to processes unstructured processes/ Unsuitable to	(Ernst Young, 2018), (Trefler, 2018), (Gotthardt et al., 2019), (Santos et al., 2019)
Vulnerable to cyberattack and misleading training	(Deloitte, 2018), (Ernst Young, 2018)

Source: Author

Therefore, to mitigate the drawbacks and business risks presented in this section and others that may arise during and after RPA deployment, researchers suggest that companies must draw a granular plan, optimise priority processes, find processes that match with RPA feasibilities, find an appropriate supplier, build a business case, set up a robotic process automation centre of excellence (Appendix K), ensure that the finance and accounting team, as well as all involved in the processes subject to automation are engaged in the project and understand RPA operations and put in place an appropriate governance policy for it and business (ACCA Global and KPMG, 2018; Deloitte, 2018; Cooper *et al.*, 2019; Kokina and Blanchette, 2019).

2.4 The Susceptibility of Accounting and Finance roles to RPA

This chapter will present the direct effects of RPA on professionals working in the accounting sector. The rise of RPA has developed the need for professionals to go beyond number and Excel formulas and spreadsheets; to look at the trends that surround tasks and roles that would be more susceptible to RPA in the near future. According to the predictions of Deloitte UK (2015) and PwC (2015) accountants payables, bookkeeping, business expenses and payroll are the tasks ahead of the RPA implementation. There is already RPA for end-to-end payroll, and its vendors emphasise that this is possible due to the repetition characteristics and rules that involve these activities (Cloudpay, 2018). Kokina and Blanchette (2019) assert that professionals should be aware that tasks involving repetition, high-level of data, rules-based are some of those processes that are most eligible to automation. A research made with Big4’s companies assesses (Cooper *et al.*, 2019)

functions and processes that would be most sensitive to RPA deployment and the percentual of automation in each of these processes.

Table 10: Automation Potential of Various Functions and Sub-Processes

Function	Sub-Process	Automation Potential (Percent)
Order to Cash	1. Customer Master Data Management	25–30%
	2. Credit Management	25–30%
	3. Customer Service Support	25–30%
	4. Account Receivables Management	25–30%
	5. Incoming Payments	0–5%
	6. Deductions and Disputes Management	25–30%
Human Resources	1. HR General Services	25–30%
	2. Expat Management	10–15%
Source to Pay	1. Source-to-Purchase	25–30%
	2. Purchase-to-Pay	25–30%
	3. Projects Support	10–15%
Supply Chain	1. Supply Chain Planning	10%–15%
	2. Transport Planning	10%–15%
	3. Supply Planning	10%–15%
	4. Project Management	10–15%
	5. General Supply Chain Services	10–15%
General Accounting	1. Fixed Assets/FMM/Closing and Reporting	25–30%
	2. Local Tax Accounting	10–15%
Controlling	1. Product Costing	5–10%
	2. CO Operation/Reporting	10–15%
	3. Business Controlling Support	5–10%
	4. BI and Systems	10–15%
	5. Group Financial Controlling	5–10%
Finance Other	1. Intercompany	25–30%
	2. Account and Bank Reconciliations	15–20%
	3. Financial Planning and Analysis	25–50%
	4. Tax	40–60%

Source: (Cooper *et al.*, 2019)

For example, RPA would impact payroll roles as it can be utilised used to extract specifics data that are needed from handwritten timesheets and compute the payslips from employees stipulated contracts and pay them through bank transactions, without human intervention and take 46 seconds instead of 4 hours, if done by humans further 100% of accuracy (McDaniel, 2020). Another

example, RPA can be used to automate accounts payable and receivable's reconciliation (Appendix L) with high accuracy and speed.

Although RPA may be perceived as a threat to accounting and finance people, many studies argue that this innovation will create opportunities for professionals to apply their knowledge, competencies and skills to add value to the business and RPA would not replace them. However, professionals should upskill in order to maintain value to their organisation (ACCA Global, 2016; Murphy and Quinn, 2018; Surendar and Rathnakar, 2019; Pullinger, 2019). This will be addressed in section 2.5.1 in detail.

2.4.1 RPA Barriers to the Accounting Profession

Back to the Third Industrial Revolution, where internet, computerisation and enhancement of automation software become the centre of attention, there was not yet a call to the accounting professionals to program or understand how ERP was coded, for example. However, it seems that in the new digital era, there is a need for that. Understanding how RPA is codified, how it works maybe a significant difficulty as there is no obligation to include in a syllabus RPA or programming in the accounting under-graduation course or even in higher level (Lin, 2018). As far as this author knows, in the case of Ireland, there is no coding or innovation program in any level of accounting graduation, which would be requested by industries.

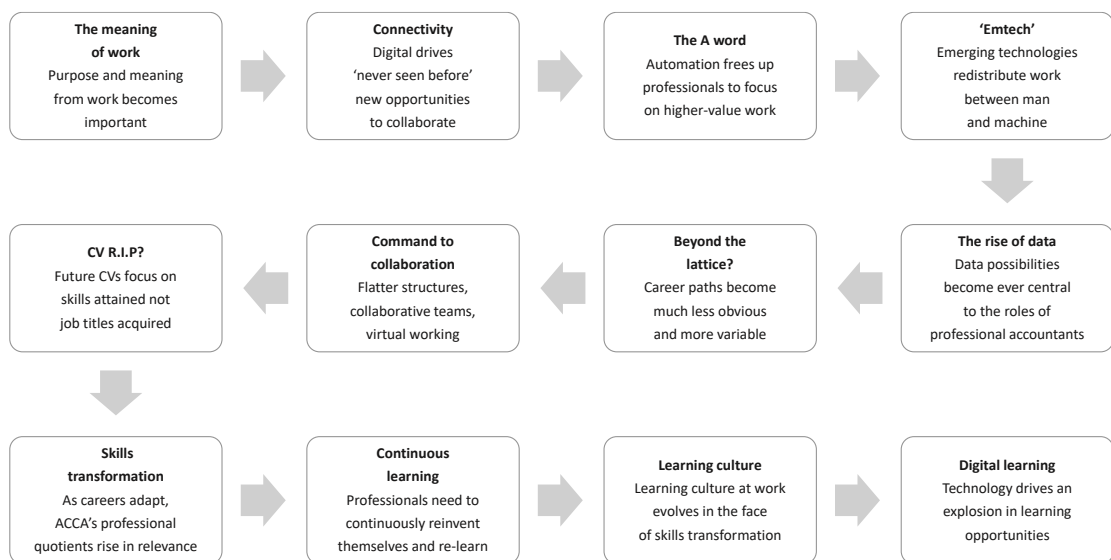
Therefore, to break this barrier, the accounting professionals should go beyond the knowledge that is offered at colleges, do some courses related to innovations and look for any training that would benefit them in this matter; i.e. the professionals should guide themselves in looking for qualification in innovation (Zhang *et al.*, 2018). Thus, it seems that main barriers against the professionals in dealing with RPA would be the lack of knowledge and the need of re-educating themselves. The study carried out in the public accounting firms identifies RPA's effects on the industry, reveals that these organisations are looking for talents with more than accounting and audit knowledge (Cooper *et al.*, 2019). Thus, flexibility in the career path, awareness of constant changes and necessity of following these transformations can be the key to eliminate barriers and maintain relevance in this industry and readiness to face the growth of competition, mainly with the so-called "digital natives" who would have some advantages on innovation matters (Lyon, 2020).

2.4.2 Opportunities from RPA to a New Digital Accounting Era

Researchers assert that RPA is positively yielding opportunities for accounting and finance professionals to go beyond number and Excel formulas and spreadsheets; to look at the trends that surround tasks that would be more susceptible to RPA and other future innovations that are yet to come. The key, therefore, would be to develop their skills, competence and knowledge regarding activities that enhance value-add to business, robotic software advancement, particular analysis, for example, (ACCA Global and KPMG, 2018; Pullinger, 2019; Kokina and Blanchette, 2019) in order to be able to work alongside robots and seize the robots potency (Lin, 2018).

Researchers suggest that professionals should monitor technological trends and scrutinise possible effects on their careers so that it will be possible to take advantage of the opportunities offered by this (Kokina and Davenport, 2017; Kokina and Blanchette, 2019; Lyon, 2020).

Figure 7: Technological Trends and Foreseen Opportunities



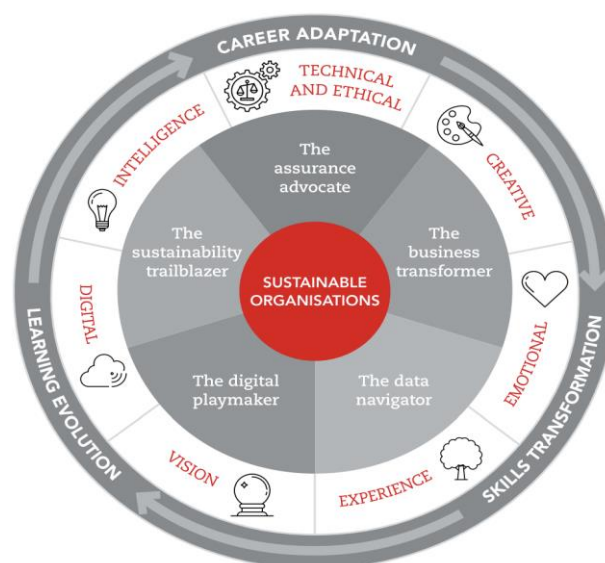
Source: Assembled by the author based on *Future Careers Accountancy 2020s* (Lyon, 2020, p.18)

Kokina *et al.* (2019) propose roles opportunities that rise along with RPA to accountants. These are appointed as “identifier role” who would be able to use their accounting expertise to detect processes prone to RPA and consequently help their company to increase performance; “explainer role” would fit those who have knowledge of their business and can describe precisely each step of a company process to RPA developers, such as invoices issuance; but also acquire appropriate familiarity with RPA workings; “trainer role” would be suitable for professionals who have a high level of experience in the determined procedure as they will teach the robot to perform a whole process, and also a robust IT background; “analyser role” would apply to whoever has the

capability of investigating any problem that would arise after deploying RPA or any other procedural problem that may occur and then make a suggestion as to any necessary change based on their findings. Syed *et al.* (2020) point out other roles that are emerging from the RPA trend, which have mostly related to administration of data and robots itself. The authors give some example of these roles, such as management of “RPA centre of excellence”, “robot management, consulting and data analysis”.

In a late report (*Future ready: accountancy careers in the 2020*, Lyon, 2020), ACCA presents a developed framework derived from its previous one (*Professional quotients for success (PQ)*, ACCA Global, 2016). This suggests that besides PQ, represented in the white layer of figure 8, there are five main “career zones”, represented in the grey middle layer of figure 8, which the professional should explore to become more aware of what the new age requires from them. The proposed future roles involve - “the assurance advocate” related to auditing and business risk assessment through digital tools which would require a much higher level of integrity and reliability; “the business transformer” regarded to be a driver of changes towards digital accountancy in a smaller organisation; “the data navigator” connects to the responsibility of looking for digital scopes to improve company’s data analysis and decision-making; “the digital playmaker” refers to foreseen technologies that can maintain a company’s competitiveness; “the sustainability trailblazer” is connected to the management of performance and would be a crucial role in an organisation as its responsibility is to aggregate value to a company through collection and assessment of information on capital and then report those to the stakeholder in a plain format (Lyon, 2020).

Figure 8: The five ‘zones’ of future career opportunity in accountancy

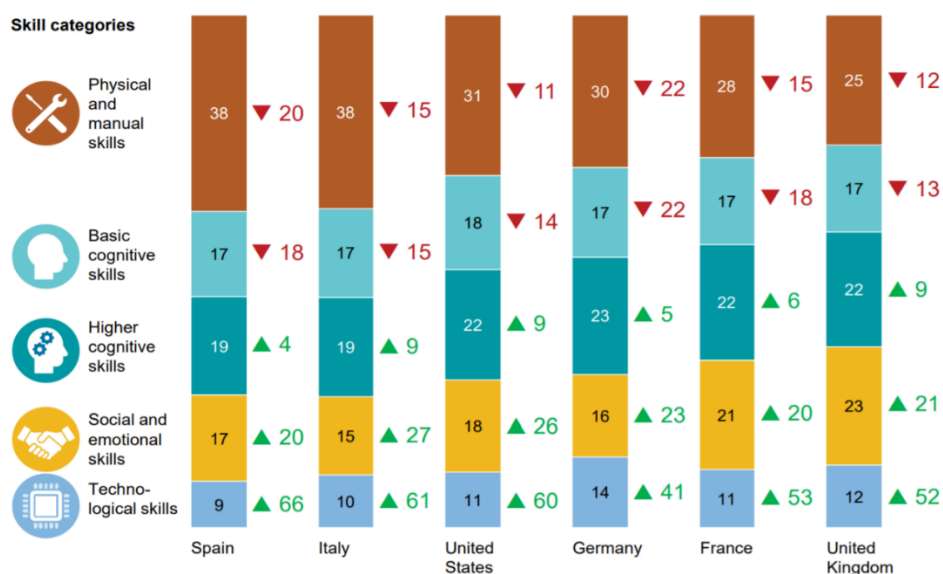


Source: (Lyon, 2020)

Other roles in finance and accounting that may emerge from innovation are those related to compliance and business risk-assessment as companies may have difficulty in constructing reliable and sustainable values (Lyon, 2020). Therefore, it seems that the opportunities that RPA and innovation are creating push to constant skills, competence and knowledge renovation. Professionals should be willing to adapt their mindset to be more resilient, flexible and aware of the necessity to see RPA, innovation and the upcoming future as pronounced opportunities to play more relevant roles in their organisation. Competencies, knowledge and skills that give eligibility to professionals in this new digital era will be subject of the next section.

In the accounting industry, acquiring knowledge and learning skills have always been the essential foundation for professionals to develop competencies required in this field. Traditionally, the technical accounting competencies required were linked to bringing value to stewardship, performing financial reports, complying with regulations, forecasting the future based on past events, collecting and recording data (Kruglinski, 2009). However, according to market's predictions, this is changing due to the technological advancements; thus the career path is no longer linear, and even though constant skills recycling has always been essential to career success, nowadays it is beyond this as the labour market expects that professionals have a range of combined and flexible skills (ACCA Global, 2016; ACCA Global, 2018a). A study carried by McKinsey Global Institute (Figure 9), illustrates the transformation of competencies (knowledge plus skills) and a growth in the demand for digital and soft skills (communication and social) contrarily a decrease in the requirement for skills that robots are able to performance (cognitive, manual and physical skills).

Figure 9: Change in hours worked 2016–2030, % Time



Source: (Bughin *et al.*, 2018)

The report *Professionals Accountants the Future* (ACCA Global, 2016) predicts that by 2020 all the professionals in the accounting industry should start combining capabilities upward. Though, to plan a future successful career path, may not be easy as it appears that there is no certainty about how accounting professionals' roles would look like due to continuous technological advancement.

Therefore, the demand for transformation in skills appears as the centre of the wheel in the accounting and finance career, in order to maintain relevance and value in this job market. In the following subsection, this will be explored based on previous research. However, it is essential to highlight the accounting core, such as ethical and integral professional behaviour (Lyon, 2020), remains essential towards a future successful career.

2.4.2.1 Required Technological Competencies

RPA and innovation, in general, have been challenging professionals in the accounting sector, which is probably the reason that knowledge about technological trends is above all competencies deemed to have a significant lacuna regarding digital skills required in this new digital era (ACCA Global, 2016). According to ACCA Global (2017), there is already a shortage of accounting and finance professionals proficient in dealing with RPA, whilst they are considered essentials at the forefront during and after RPA implementation. As a consequence of this, researchers urge that these professionals must fill this gap and strengthen these competencies (ACCA Global, 2017; Bahador and Haider, 2018; Kokina *et al.*, 2019; Cooper *et al.*, 2019; Kokina and Blanchette, 2019).

Digital skill is recognised as the ability to understand and develop innovations (Chatfield and Vangermeersch, 2014; Bughin *et al.*, 2018). Further, innovator thinking seems to demand digital skills; a professional should be able to assess the outputs of RPA and from data demonstrate creativity in the management of this and in linking unrelated data (Kokina *et al.*, 2019). Other digital skills considered relevant are the capability to manage large data amounts efficiently, communicate with digital workforce and interpret its outcomes, comprehension of innovations and ability to deploy them aiming to enhance corporate governance and identify, manage and lessen potential business risks associated with technological implementation on a reasonable basis (Kokina *et al.*, 2019; Cooper *et al.*, 2019).

Additional to technological competence, programming skills such as building RPA's also appears as very significant in the near future (Bughin *et al.*, 2018). Nevertheless, not only building would be enough for professionals to remain relevant; they need to be able to translate data and deliver acumens as well as (ACCA Global, 2017). These factors request a set of technological and IT structure knowledge along with accounting expertise, so to acquire knowledge on this innovation

and understand the implications of it in the industry may be one of the main steps for professionals being seen as an aggregator in their organisation (Cooper et al., 2019). Besides, professionals should be familiar with security protocols, robots' procedures and be ready to deal promptly with any issue that may arise. It is primordial to ensure that robots are working in a digital safety environment to maintain the confidentiality of clients data (Kokina et al., 2019). Other underlying skills are the capability of assessing and applying scepticism on the robots outputs, ability to use this assessment as a drive-data to make decisions, competence in data management and a deeper comprehension of figures meaning which would help to understand how robots work in the digital place (Ernst Young, 2018; ICAEW, 2020).

2.4.2.2 Exclusive Human Competencies

Researchers claim that exclusive human competencies are those which differentiate, mainly, human being and smart machines, and would be the x-factor in the current and future jobs requirement. These are composed of a set of soft skills, interpersonal, self-confidence and self-control, adaptability, determination, resilience, which relates to particular characteristics or habits that influence how a professional behaves in the work environment (ACCA Global, 2019b). Further, the professional with these skills would be able to lead, to judge and to use responsiveness, among others, to add value to a company (Farrar, 2019). Communication skills are also considered to be one of the most significant of the new era, as this would allow the professional to deliver a clear message, a vision and share commitments what would be essential to make the company's client believe in a company's ideas; however, researchers see a gap to be filled by accounting professionals. Furthermore, strong communication ability would be essential to support professionals explanation regarding technological outcomes (ACCA Global and KPMG, 2016; Cooper *et al.*, 2019; Kokina and Blanchette, 2019).

Another skill that also appears relevant is the aptitude in working in a team; where a professional can show off this skill, they may be seen as a valuable employee who helps their colleagues to welcome RPA and see it as significant software which can help to improve their performance in the company (Thome and Rodriguez, 2018). A good leadership spirit, would also strengthen the ability to teamwork, as a professional who has this trait can motivate co-workers to take advantage of innovation to show their ability to negotiate and create value to their position and to their path in the organisation (Mason *et al.*, 2018).

Additionally, researchers find proactiveness, challenging and inquisitive thinking are attributes which would contribute to the professionals' skills set construction to the transformational era (Zhang et al., 2018). The concept of emotional intelligence, in its turn, is also emergent as exclusive

human capability to apply in a digital environment alongside robots outputs. It is defined as a human ability to recognise, monitor and to understand their own and others's feelings and apply them to drive attitudes in an environmental work (Kokina *et al.*, 2019; ACCA Global, 2019b).

Therefore, towards a time of transformation, the exclusive skills of the human being are those that would help organisations to remain sustainable in the increasingly competitive digital world as those are who have them will be required to handle business' relationship with clients, gain and keep trustability and reliability (ACCA Global, 2016; Santos *et al.*, 2019).

2.4.2.3 Analytical Competencies

In the era of RPA and the rise of innovation in the accounting sector, analytical competencies are among those essential for professionals to remain relevant and valuable, but in an improved format. Considering that RPA and its workforce will perform ordinary activities, analytical competence will enable professionals to apply a strategic view to solve problems and make an appropriate, effective and valuable decision to business (Lawson *et al.*, 2013; CGMA, 2014).

In developing analytical skills accounting and finance people should be able to exercise problem solving and critical analytical thinking to analyse and understand reports, apply breakdown to explore whether there is room to optimise digital workforce, and apply strategies to gain an in-depth view of customers' Business (Lawson *et al.*, 2013; ACCA Global, 2016). In addition, Mason *et al.* (2018) asserts that a professional must demonstrate an ability to manage business strategically by assessing market threats, comparing digital forecasting to real-world predictions, applying results from RPA or other innovation to make decisions and most significantly, must be able to assess business risks and vulnerability that technological changes can bring to a business. The required analytical competence would also include the ability to bring novelty and brightness to the workplace, so fulfilling value-added objectives that are always cited among researchers (ACCA Global, 2017; Yedavalli, 2018; Cooper *et al.*, 2019; Deloitte UK, 2020). Besides that Kokina *et al.* (2019), emphasise that “the ability to ask the right questions, utilize logical thinking and to quickly identify trends” are essential skills to succeed and supersede robots in this new era as well as being able to “use more predictive and prescriptive analytics”.

2.4.2.3.1 RPA's Competencies, Knowledge and Skills – Conclusion

This sub-section has explored studies on RPA and innovation impacts on competencies, knowledge and skills in the accounting industry. It was evident that RPA, but also actual innovation, is

reshaping accounting and finance careers. Therefore, it is essential for professionals to upskill their competencies (Table 11) in accordance with the market requirements in this new digital age.

Table 11: Competencies Transformation in the Digital Era

	Competencies (Knowledge + Skills)	References
Required Technological Competencies (Digital Knowledge + Digital Skills)	Ability to understand, develop, deploy and maintain a new technology	(ACCA Global, 2017), (Cooper et al., 2019), (Kokina et al., 2019)
	Ability to operate accountants digital workforce; to understand and develop innovations	(Chatfield and Vangermeersch, 2014), (Bughin et al., 2018).
	Cybersecurity surround smart machines; Apply scepticism on machines outputs; Ability to use outputs to make decision	(Ernst Young, 2018), (ICAEW, 2020)
	Capability to manage and analyse a large number of data output from integrated systems; Expertise in accounting tasks.	(Kanellou and Spathis, 2012)
	Information System Knowledge; Understanding programming language; Data Intercommunication	(Bahador and Haider, 2018)
	Data management; Coding understanding; Tech Savvy	(Kokina et al., 2019)
	Innovator Thinking; Ability to manage and analyse robots outputs	(Kokina et al., 2019), (Cooper et al., 2019)
Exclusive Human Competence	Ability do apply interpersonal and social skills; Be a good storytelling	(ACCA Global and KPMG, 2016), (Cooper et al., 2019)
	Ability to employ proactiveness, are challenging and inquisitiveness thinking	(Kokina et al., 2019), (ACCA Global, 2019).
	Ability to self-awareness to develop continually self-confidence and self-control, adaptability, determination, resilience	(ACCA Global, 2019).
	Aptitude in working in a team	(Thome and Rodriguez, 2018)
	Strong ability to communicate and to persuade	(Kokina and Blanchette, 2019)
	Strong leadership spirit; Ability to negotiate	(Mason et al., 2018)
Analytical Competencies	Ability to apply critical thinking; Understanding robots outcomes; Explore rooms for processes optimisation	(ACCA Global, 2016)
	Ability to bring novelty and brightness to the workplace	(ACCA Global, 2017; Yedavalli, 2018; Cooper et al., 2019; Deloitte UK, 2020)
	Ability to exercise strategic management; Read digital and real-word forecasting; Be able to thinking critically on digital results prior decision -making	(Mason et al., 2018)
	Employ an analytical mindset (ask the right questions, logical reasoning skills)	(Kokina et al., 2019)

Source: Author

Although not many research papers have been found discussing the relationship between RPA and technical competencies; i.e., theoretical knowledge and skills, some researchers underline that accounting and finance expertise remains relevant (Pincus *et al.*, 2017; Kokina *et al.*, 2019). As discussed previously in this literature review, and added to these new found features, Alongside RPA and innovation yet to come, these competencies support professionals in creating a successful career. In addition, the core professional principle appears much more relevant in the new digital age as it is the basis for them to continue adding value to their companies (ACCA Global, 2020b).

2.5 Conceptual Framework (CF)

This chapter will be dedicated to the design of a CF based on the literature review and on concepts surrounding the effects of RPA on the accounting and finance profession, mainly in relation to competencies necessary to overcome eventual RPA drawbacks, but also to seize the opportunities that RPA may provide.

A CF as a strategy for connecting logically relevant concepts, assumptions and beliefs to provide a better understanding of the subjects of a study. This is to deliver to readers of a study the author's philosophical perspective; besides helping to address the research's aim and objectives, determine an appropriate methodology and to design research to collect primary data efficiently in order to answer the research question satisfactorily (Miles and Huberman, 1994; Camp, 2001; Jabareen, 2009). Moreover, the CF is understood as a significant part of the research process, as its purpose is to address the research objectives and aims, provide a guided study path and investigate different variates surround the research (Grant and Osanloo, 2014).

Thus, in the next section, the concepts based on the literature review of this study that make up the CF will be presented; followed by the designed CF which will lead the research towards the answers to the research question.

2.5.1 Delineating Concepts

This section aims to provide a better understanding of the concepts that are important for this research and are the foundation for the development of the CF in the next section; besides, provide readers with a clear explanation and facilitate their understanding.

2.5.1.1 Professional Competencies

This concept is essential because it is formed by skills, knowledge, in addition to the ethical and integrity values that are the core of the expected behaviour of professionals working in the accounting sector (Pincus *et al.*, 2017). This means that, in addition to traditional accounting and finance competencies (analytical and technical skills), professionals must acquire and develop exclusive human and technological competencies, as this will enable them to perform their duties effectively and efficiently in a work environment. (International Federation of Accountants (IFAC), 2019). In the CF it will be presented in 5 spheres as follow:

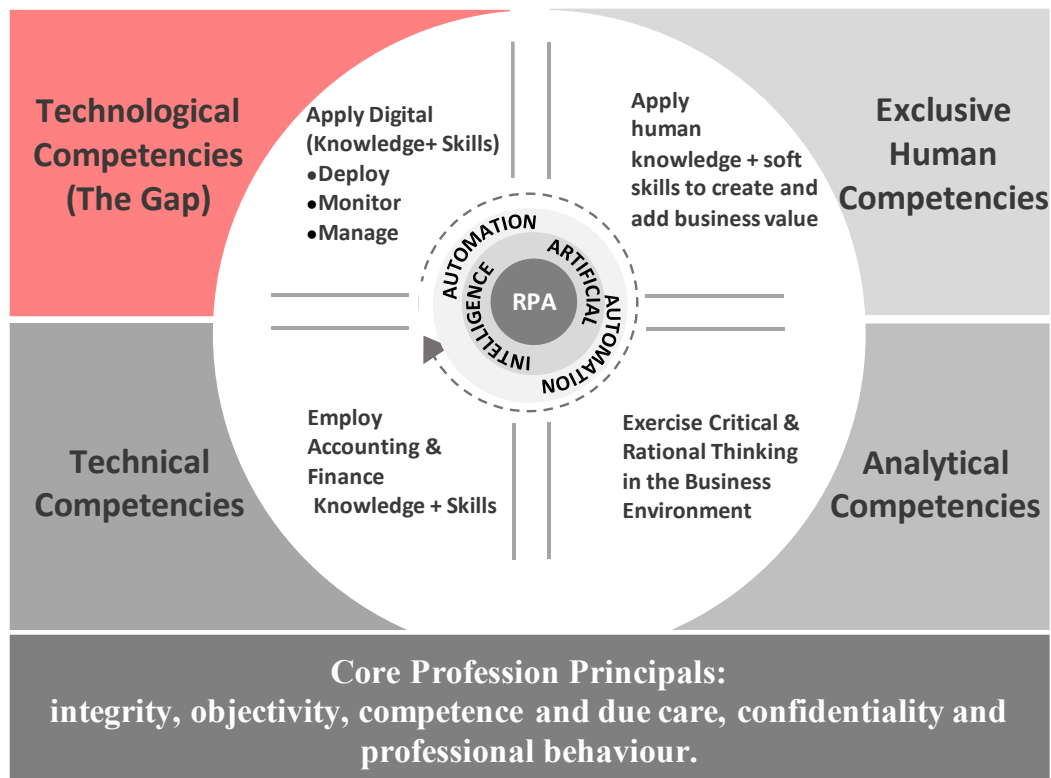
- **Technological Competencies:** Many authors consider that professionals in the accounting field should upskill digitally through acquiring programming and implementation of RPA and other innovation in order to supply this industry demand (ACCA Global, 2017; Bahador and Haider, 2018; Kokina *et al.*, 2019; Cooper *et al.*, 2019; Kokina and Blanchette, 2019). Additionally, researchers affirm that professionals must develop those skills, such as understanding robots outcomes, RPA and innovation structure and security, data processes, programming language, data intercommunication, coding understanding and tech-savvy (Pincus *et al.*, 2017; Bahador and Haider, 2018; Kokina *et al.*, 2019) to be able to work with the new era digital workforce, and also to create value to their workplace.
- **Exclusive Human Competencies:** Is a range of skillsets based on the best of human conduct and interpersonal actions, such as emotional intelligence, teamwork, communication, organisational abilities (Bahador and Haider, 2018). This exclusive human competence is considered essential for professionals who wish to pursue a sustainable and successful career in the age of robots (Farrar, 2019; ACCA Global, 2019b).
- **Analytical Competencies:** This sphere refers to the ability of a professional to use knowledge to develop skills that will enable them to solve problems and apply critical thinking to assess information, pieces of evidence, and considered the effects of options prior to making a decision (Lawson *et al.*, 2013). In RPA and innovation era, professionals must improve this competence by acquiring knowledge and upskill that will help them to understand and analyse data in order to add value to business decisions and strategies (Cooper *et al.*, 2019).
- **Technical competencies:** This sphere is the core of accounting and financial knowledge (intellectual content) and skills (ability to employ technical knowledge), which enable professionals to apply knowledge in the field to perform tasks in a manner consistent with professional standards. Some examples of technical knowledge in accounting are the understanding of tax laws and the accounting and financial standards followed by an organisation as in its governance policy; Technical skills include, for example, gathering and processing information and preparation of financial statements (CGMA, 2014; Pincus *et al.*, 2017; Kokina *et al.*, 2019).
- **Integrity, objectivity, competence and due care, confidentiality and professional behaviour:** these fundamental competencies are the base for accounting and finance professionals' conduct (ICAEW, 2019b). However, robots and innovations have brought new challenges in these core principles, such as applying a more significant professional

scepticism in relation to RPA and other innovation outcomes, applying these principles when setting up (“training”) a new digital workforce (Lawson, 2019). It is essential that accounting and finance professionals apply these core principles in the use of RPA and innovation, since question overbid of ethics code and threats to this and to the professional behaviour may arise from the fact that professionals would not be involved only in the processes of information, but also in the deployment, training and management of this new digital workforce (ICAEW, 2019c). Despite the stress on the need for technological competencies, accountability, ethics and integrity cannot be overlooked (ACCA Global, 2020b). On the contrary, they should be mastered and form a basis for all that RPA and innovation demand from professionals in the accounting industry.

2.5.2 The Conceptual Framework

This CF (Figure 10) concentrates on the competencies unearthed through the examination of the theoretical and contextual studies; therefore, it represents the foundation of this study and relates to identifying the most suitable methodology. It will also guide the primary data collection to find the answers for the research question subject of this study: *“What are the skills, competencies (knowledge plus skills) that accounting and finance professionals should acquire and expand in order to work together with RPA and its digital workforce in the Irish accounting industry?”*.

Figure 10: Conceptual Framework - Competencies Transformation in the RPA Era



Source: Author

This author highlights that the conceptual framework presented was developed based on *CGMA® Competence Framework* (CGMA, 2014).

2.6 Conclusion

This literature review aimed to investigate the main technological trends in the accounting industry in the last years, with a deeper insight into RPA innovation, but also how these trends have been developed since automation gained relevance with the advent of First Industrial Revolution. It is evident, from this literature review, that since then, innovation has continuously impacted industries, included the accounting one.

Specifically, in the accounting industry, technology has positive and negative impacts in history. For example, when computers came to be part of the accountant's desks, opportunities for new roles emerged; however, it displaced professionals who did not have computer skills. Recycling and updating skills were already essential to accounting professionals to maintain significance in the job market. Thus, it remains crucial, but as distinct from previous innovation waves, today's

professionals need to go further acquiring technical and some computer knowledge (Bughin *et al.*, 2018). As technology is improving at a speed as never before, professionals should follow it and keep informed about the trends and probable market job requirement in the near future (Kokina and Blanchette, 2019). The literature investigation showed that RPA is currently the strongest trend in the accounting industry and as its processor, has pros and cons for professionals and companies that desire to maintain competitiveness in the next five or ten years. Most of the researchers understood that RPA has various positive factors, but there are some who point negative ones.

3 Methodology and Research Design

3.1 Overview

This empirical research is endorsed by the main question “*What are the skills, competencies (knowledge plus skills) that accounting and finance professionals should acquire and expand in order to work together with RPA and its digital workforce in the Irish accounting industry?*”, besides the research objectives of this study that are:

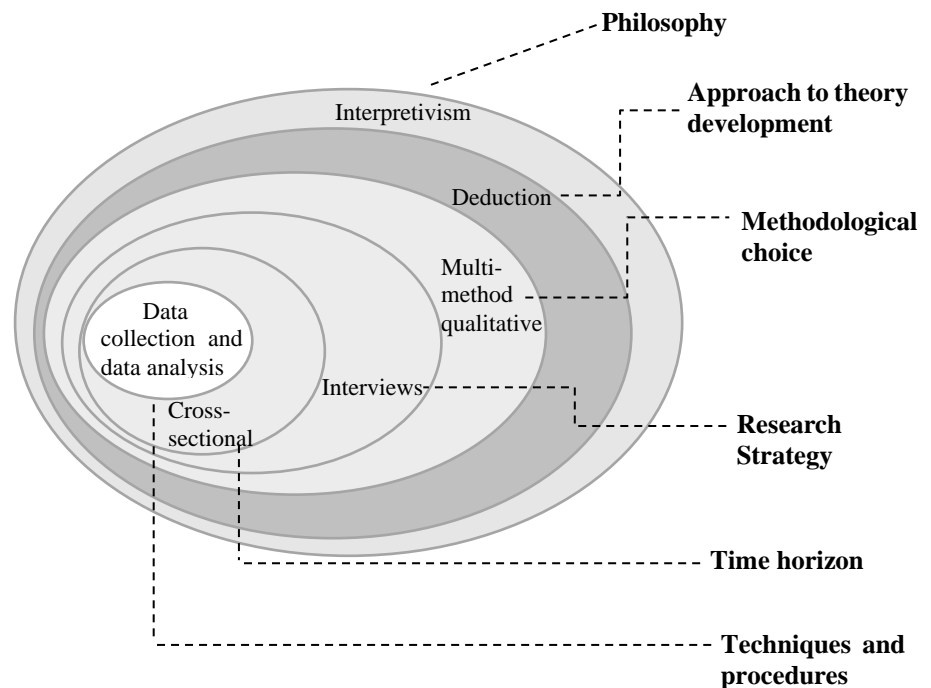
- 1) Investigate which accounting and finance roles that are most susceptible to RPA.
- 2) Explore the researchers’ assessments regarding the actual and foreseen RPA’s impacts on the accountancy profession.
- 3) Determine the necessary competencies (knowledge plus skills) that accountants and finance professionals must acquire to face RPA in the accounting industry.
- 4) Explore accounting professionals views and actions regarding RPA and innovation effects in their career path.
- 5) Devise recommendations on professional upskilling matters.

A significant factor to this study addresses three objectives in the subsection 2.4.3: to create a professional strategy in order to remain valuable in the job market and build a sustainable career, although many discussions, whether skills foreseen today will be relevant in the near future. The need, therefore, is to follow the actual trends and increase awareness over the essential market competencies required, in order to be ready for upcoming changes in the accounting industry.

Objectives 1 to 2 were at first approached throughout the section 2.4. The collection and assessment of the empirical data was obtained from graduate professionals in accounting and financial (Group A). In order to enrich this study, primary data was also gathered from experienced professionals in the accounting and finance industry, lecturers in accountancy, a member of an accounting body, an RPA salesman and a recruiter specialised in accounting and finance roles (Group B). Panel 1 and 2 (Appendix E) provides an overview of the interviewees who participated in this research. From these, this author aimed to understand their views on apparent innovation drivers through a successful career and which would be the foreseen as opportunities or a barrier to reach such success, thus to provide an insight how deep is the impact of RPA and innovations on the Irish accountancy market. Then, comparing the literature review and Irish job market reality, this research will achieve a greater comprehension of matters regarding RPA and its entrance into this industry. Besides that, to provide a contribution for professionals concerning RPA effects in the accounting industry and consequently in their profession.

This chapter will furnish the details of the methods (Figure 11) used to address the matters discussed above, through the collection of primary data and its assessment, including samples, besides the evaluation methodology to be implemented. Thus, the presentation will be, initially, the description of research philosophy and approach; then the research strategy where the research questions will delineate the objectives and scope of the study; followed by details of the research methodology that was utilised and the reasons for choosing it. Additionally, are presented the criteria applied for selecting postgraduate professionals in accounting and finance in the Irish market as the main subject of this research. Then, the criterion and process of data collection will be explained and how they were analysed; finally, the limitations of the research method will be shown.

Figure 11: Summary of this Research Design



Source: Assembled by the author based on Saunders *et al.* (2019, p.174).

3.2 Research Philosophy and Approach

3.2.1 Understanding the Research Paradigms

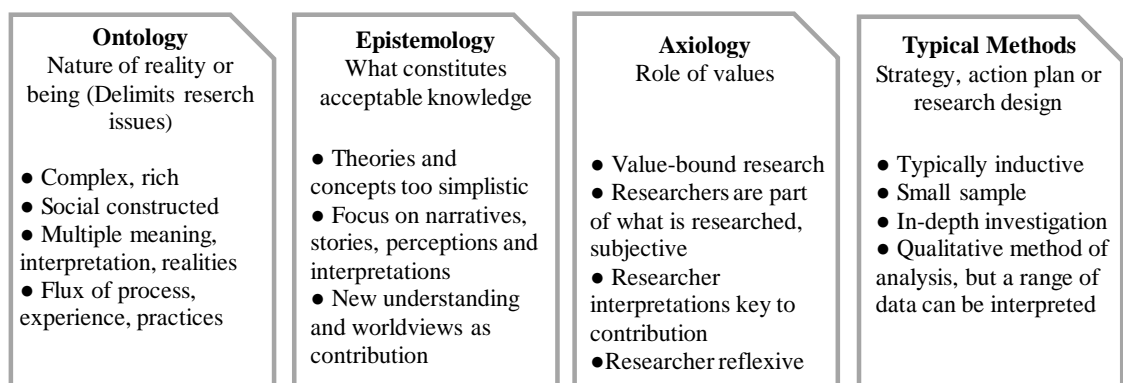
In this chapter will be presented the research philosophy that was applied in this paperwork and an explanation of this. The research philosophy aims to provide to readers the foundations of knowledge and assertions; further, it will support, in a clear way, the findings of this research

(O’Gorman and MacIntosh, 2014). Therefore, prior to defining the research methodology, it is important to understand the different research philosophies or the research paradigms which are well-known, in order to frame a method that will allow a better approach for the this study scenario (Creswell and Creswell, 2018). Paradigm can be deemed as a philosophical order that will apprise the research method (Crotty, 1998). A research paradigm is related to a group of “beliefs and assumptions” that an author has; additionally, it is based on a construction of knowledge (Saunders *et al.*, 2019, p.130). Assumptions, in turn, are significant in the study, as the author will interconnect the findings surrounding the research with their own set of values (Crotty, 1998).

Saunders et al. (2019 p.134) categorise three types assumption (Figure 12): ontology, which relates to assumptions of authors’ relationship with their comprehension of how things are in reality; Epistemology, which relates to authors’ assumption about how knowledge is constructed and how to share this knowledge and; Axiology, which relates to morals, values and ethics surrounding a study and the authors’ vision in relation to the impacts of their values, beliefs, morality on their works. Additionally, the type of assumptions can be distinguished through multidimensional objectivism and subjectivism.; the first sees social reality as the part of a person in society; while the other perceives social reality formation from how an individual understands and acts in their society. Thus, beliefs and assumptions types can be objective or subjective and this may result in the paradigm that moulds the formulation of research questions and drives the methodology applied and how the conclusions were reached (Sacol, 2009).

Therefore, after the insight above, this author believes that the most suitable research philosophy to apply on this research was interpretivism. Figure 12 demonstrates the relationship between assumptions and the paradigm (philosophy) chosen.

Figure 12: Relationship Between Assumptions and Interpretivism Research Paradigms (Philosophy)



Source: Assembled by the author based on *Research Methods for Business Students* (Saunders *et al.*, 2019, p.135)

3.2.2 This Research Philosophy – Interpretivism

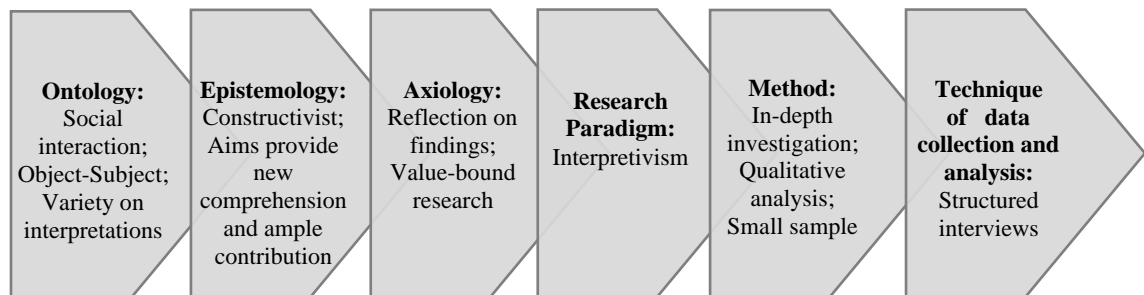
Interpretivism philosophy is intrinsic to the object-subject interaction ontologically as its view relates to subjectivism and social context in the way a person builds and rebuilds a reality surrounding them. Although inductive logic is normally applied in an interpretive philosophy (Sacol, 2009), does not prevent an author from applying deductive logic (Saunders *et al.*, 2019). The objective of this philosophical train is to produce “new, richer, understanding and interpretations of social world and contexts” (Saunders *et al.*, 2019, p.149). Therefore, through in-depth interviews with professionals in the accounting industry, analysis was made to produce a richer theory on their perceptions regarding RPA and innovation in the Irish labour market. This author highlights that there is not a theory developed in the Irish context.

In addition, in order to provide a rich qualitative research, the following criteria were applied in this study:

- Hermeneuticists – Relates to an understanding of a whole picture from individual perceptions and their correlations (Sacol, 2009).
- Phenomenologists – Regarding an investigation of life and researches knowledge (Saunders *et al.*, 2019).
- Contextualisation – The social and historical context of the participant plays a fundamental role, as it is believed that these factors are in constant adjustment (Pozzebon, 2004).
- Authenticity – The research should have a plentiful interaction with a researchee and secondary data, such a whitepapers on the study matter, what can allow the research to have an insight in the context of their subject of study (Pozzebon, 2004).
- Interaction – The research pre-knowledge and values are significant factors for the research outcomes (Sacol, 2009).

Thus, figure 13 illustrates the foundation of this research methodology and design:

Figure 13: Research Definition Model - Subjectivism Dimension Assumptions - Interpretivism Research Philosophy



Source: Assembled by the author based on Saccol (2009) and Saunders *et al.* (2019, p.145).

3.2.2.1 Rationale the Chosen Research Philosophy

In order to understand the option for the interpretivism as management philosophy of this research, it is important to explore the ontology and epistemology's subjectivist views related to this philosophy. The ontology assumption is inherent to nominalism, which considers that social players, such as researchers, would establish the sequence and construction of a "social phenomenon due to the individual's perception and experience of reality" (Saunders *et al.*, 2019, p.146). Regarding an epistemologically assumption, subjectivism aims to construct an understanding from different perspectives and social context; it assumes that knowledge about what surrounds us depends on the human performances (Saccol, 2009). While axiology assumption subjectivist reckons that a researcher looks to gathering different thoughts which would reflect their social context; besides that, a research which applies a subjectivism view is aware that their own beliefs and values cannot but include a part of themselves and can influence the research, this awareness would enable an open reflection on their own values (Saunders *et al.*, 2019).

Therefore, the reason to apply the interpretivism research philosophy in this study is due to its features. It considers different individual perspectives and their relationship with the subject of a study, besides allowing the researcher to seek a deep comprehension of trends and circumstances of the phenomenon studied in a particular context (Paterson and Leung, 2016). Evidently that the research question fits the philosophical characteristics of interpretivism, as this author looks to answer what are the impacts of RPA (trends/circumstances) can provoke on accounting and finance profession skillset requirement (phenomenon studied).

3.3 Research Strategy

This research strategy aimed to collect data efficiently, in order to provide answers to the research questions and provide an understanding to the objectives proposed in chapter 1 and reinforced in chapter 3, section 3.1, by linking these with the philosophy and paradigms of interpretivism. Thus, in this study a subjective approach was applied, as mentioned earlier, on a semi-structured interview.

The meaning of a semi-structured interview and its suitability for this research can be portrayed through the Saunders, Lewis and Thornhill as:

In **semi-structured interviews**, you start with a predetermined list of themes, and possibly some key questions related to these themes, to guide the conduct of each interview. How you use this predetermined list of themes will depend on philosophical assumptions. (...) In case you use a more structured and consistent approach to conduct semi-structured interviews in which you systematically explore each theme

with every participant. This will allow you to compare your participants' responses to each theme to identify the underpinning reality that you seek to reveal.

(Saunders *et al.*, 2019, p.470).

Therefore, as the interpretivism approach was applied, the semi-structured interview strategy was found the most appropriate to this study as it aimed to collect data from the main participants but also from teachers in the accounting field and professionals with experience in RPA who work in Irish and other countries. The aim was to enrich this work and find an answer to the research question, to discover the impacts on accounting and finance professionals in the Irish market regarding competencies required. It can also provide a guide so that readers can strategize towards a sustainable and successful career. From the literature review, it is clear that these impacts have been felt by companies worldwide, mainly big companies, but still unclear if the professionals have felt the same. It is much vaguer when it is related to Irish markets, since there is not a robust study on these values.

Thus, the semi-structured interviews were conducted in a consistent, one to one basis in two formats:

- 1) **Internet-mediate synchronous** – The semi-structured interviews were conducted in real-time, through Zoom app, to enable this research to compare the findings from the literature review examination with the outcomes from the primary data collection (Saunders *et al.*, 2019).
- 2) **Internet-mediate asynchronous** – Due to the busy schedule of some participants, certain interviews were conducted through exchanges by e-mail with open questions. In some cases, extra questions were sent later to clarify some points about RPA and the understanding of these professionals about the impacts of this innovation in the accounting and financial profession (Saunders *et al.*, 2019).

All the interviews made via Zoom were recorded with prior agreement of the participants and from these were transcribed all parts of the record, by listening and typing participant answers and researcher questions, observing the intonation in each answer given and the gestures presented by the participants, for them be codified and analysed. All the exchange email forwarded to conduct the asynchronous interviews were stored to be analysed. All of them will be destroyed soon as this study gets approval.

As the conferences were done with two different groups of professional, the questions to drive the semi-structured interview were prepared as:

- Firstly, predetermined subjects to be addressed in the interviews were listed – RPA; Accounting industry transformation by digital era; Transformation of accounting and finance professionals required competencies (skills plus knowledge); RPA challenges and opportunities to professionals in the area; RPA future and foreseen disturbances in the accounting industry.
- Secondly, one script was designed to drive the interview with professional postgraduates in accounting and finance based in Ireland and another to guide the interviews with a group of professionals composed of an accounting lecturer, a recruiter specialised in accounting and finance roles, a member of an accounting body, experienced professionals based in Ireland and an expert in RPA development based in Germany; both open-ended questions.
- Thirdly, in order to endorse credibility and seriousness, prior to interview, via email, participants were sent an ethical form complying with Griffith College’s Ethics Committee guidelines. In addition, relevant information on the topics and the purpose of this research were attached in the same email.
- Ultimately, the themes were addressed in accordance with the flow of conversation; some were not addressed; others were modified in the pre-designed questions. Additionally, other themes arose from responses and were adopted for the next interviews.

This author understood that the use of semi-structured interviews could cause some concern about data quality in relation to reliability and bias issues due to its lack of standardisation. In order to overcome these issues, it justified the choice of research designed, strategy methods applied in this study and the approach to contact participants. Moreover, all the interviews were managed in with ethics, and professionalism, besides it followed the research process proposed with strictness (Paterson and Leung, 2016; Saunders *et al.*, 2019).

3.4 Research Methodology

The methodology applied in this study was qualitative research design, as it enforced the philosophical interpretivism, in a subjective and deductive approach, chosen as a drive of this research (Saunders *et al.*, 2019). It is highlighted that due to this study’s qualitative characteristics, non-probability as a sampling technique, as it looked to translate words from participants rather than numbers (Saunders *et al.*, 2019). Additionally, it was considered a multi-method qualitative study (Saunders *et al.*, 2019) as it used two strategies (semi-structured interview through Zoom and email exchanges).

Therefore, the characteristics of this qualitative study, based on Saunders *et al.* (2019, p.180) are:

- Participants are postgraduates in accounting and finance as a main subject of this study plus lecturers in the accounting field and professionals experienced in RPA.
- Script designed as the drive to the semi-structured interviews in order to capture the participants understanding and relationship, where it exists, with RPA.
- Used a non-probability as sampling method.
- Founded on connotations stated through conversation and text emails.
- Internet-intermediate semi-structured interview applied as a strategy to collect data.
- Outcomes from data collection were codified into categories.
- Data analysis conducted through the conceptualisation of information.

Finally, although, this author is conscious that to achieve generalisation is difficult as this study has a deadline limitation which makes it unable to sample all the postgraduate accounting professionals represented in the Irish market. Through the chosen research methodology and strategy, this author aimed to provide a valid empirical research. Another objective stated by this author was to deliver a reliable and unbiased empirical study; therefore details about this research were placed in Appendices E to I, in order to give evidence of its reliability.

In addition, this exploratory research was conducted in two phases. The first phase was to probe previous research and literature to obtain an insight over the set of objectives of this study, in order to build a solid foundation which would achieve the interest of comparing the results from primary data with discoveries from the literature review concerning the effects of innovation in the accounting industry, broadly speaking. In the second stage, this author used interviews with professionals applying a qualitative methodology to collect primary data with the objective for the main research question of this study.

3.5 Collection Primary Data

The data collection was conducted using firstly the deductive approach, as the themes in the semi-structured interviews originated from the literature review.

This author highlights that the semi-structured interview, even though it sought to provide a representative view, did not propose to be an all-inclusive investigation of all impacts of RPA present and future on the accounting industry and its professionals based in the Irish market. ACCA Global (2016) highlights that due to the constant and rapid technological advancement it is hard to

ascertain all of the impacts that are forthcoming, although it is already possible to see some effects at the current time (Cooper *et al.*, 2019). Therefore, the concerns found in the literature regarding the effects of RPA and innovation on accountancy and professionals related to this area were from secondary sources. Choosing a sample-based on recent postgraduate professionals or in those in the final stage of study in Irish plus lecturers in the accounting field and professionals experienced in RPA offered a significant means to gather data on whether or not these professionals have perceived these impacts on the Irish market and how this may affect their career path and their preparation regarding upskilling themselves for the near future.

This author established contacts through a college network, LinkedIn and an accounting and finance WhatsApp group. The interview scripts were added in Appendices C and D (an overview of the participants are in the Appendix E – Panel 1 and 2).

This research objective is to obtain a qualitative picture of RPA matters in the accounting field. The examination of pertinent literature showed that innovation and mainly RPA is an item that has been gaining attention in academic research and bodies involved in this field; thus the outcomes of this research would be an object of attention in the wider accounting industry and mainly for postgraduate professionals. The time horizon applied in this research was the cross-sectional (Saunders *et al.*, 2007), as this research looks at the impacts of RPA and innovation on accountancy at the current time and a foreseen future.

3.5.1 Sources

The primary source of data was prepared semi-structured interviews based on subjects relevant for this research with open-ended questions. The participants were interviewed between 25th of April 12th of May 2020. Zoom interviews last an average of 30 minutes. And the interviews made by email have two messages exchanges on average. The prior information about the topic of this research helped participants understand its purpose and demonstrate this author's knowledge of RPA, aiming to increase the credibility of this research.

The interviews scripts and the open-ended questions that conducted this study were added in the Appendices C and D as a complementary information to explore and understand which are the professional accounting skills required with the advent of RPA in the Irish market.

Secondary sources, such as jobseekers websites and newspapers were analysed to verify whether the Irish market has already been affected by innovation concerning accounting roles and skills. The utilisation of more than one fount was planned to perform triangulation of data among literature review, interviews, and these secondary sources to give a substantial reliability to this work.

3.5.2 Access and Ethical Issues

As part of the accounting industry, this author aimed to conduct this research with integrity, objectivity, professional competence and due care, confidentiality and professional behaviour; it is in accordance with code of ethics that are considered to be vital for professionals in the sector established by International Ethics Standards Board of Accountants (IFAC, 2011 Section 100.5) in addition to Griffith College's ethical form.

As mentioned earlier, a semi-structured interview was used as a research strategy to collect data; therefore, to obtain access to accounting postgraduates located in Irish region and lecturers in the accounting field and experienced professional on RPA, internet-mediated access was selected as it allows the use of technological means, such as email, WhatsApp and LinkedIn. These gave participants a clear statement prior to interviews to make sure they were conscious of this study's purpose and were clear about what was expected from them. This author is aware of issues correlated to this type of access, for instance, the accessibility to appropriate participants to reach the objectives of this research and; also the possibility of the emergence of ethical issues such as lack of commitment or a proper management of private data, email or phone number (Saunders *et al.*, 2019). Therefore, to mitigate any ethical matter that may arise, the Griffith College Ethics Committee Guiding Principles were applied in the whole research process as guidance for this author's behaviour to the rights of participants in this research or of anyone who was touched by it.

Prior to initiating the data collection, the researcher prepared a checklist with a code of ethics and good conduct practice and, the same was followed after the collection. Some of these ethical procedure considered during the research process were:

- Seeking for ethical approval from Griffith College's Ethics Committee prior data collection.
- Commitment to abide by the highest ethical principles established by Griffith College's Ethics Committee related such as data protection, explanation of the objectives of this research to participants and the reason for the research proposal.
- Documentation of all consent forms gathered electronically prior to the semi-structured interviews.
- Assurance, through the consent forms, that all participants were aware of their voluntary participation and that they could withdraw anytime and without any harm to them.

Besides the compliance with Griffith College's Ethics Committee guidelines, this author also conducted this study with integrity, impartiality, deference to participants, prevention of damage to others, as it is also consistent with Griffith College terms of proper ethical behaviour.

3.6 Approach to Data Analysis

The qualitative methodology applied in this research gave the opportunity to develop a deep analysis of the findings, as it permits a relationship between the research's objectives, the environment and subjects arisen from analysis. Moreover, the primary data collection was codified and organised into classes to facilitate its analysis. During the transcription processes of data collected through Zoom was taken into consideration not only words, but also the way that participants expressed themselves when answering. In order to maintain the confidentiality of participants, interviews were filed separately with a code of identification. Likewise, the interviews made via email exchange were appropriately saved separately by coding-participants. This author wrote an interim summary of data headway (Saunders *et al.*, 2019) with associated interviews in order to enhance data collection and ease the data analysis processes.

Thus, the appropriate approach found to analyse this study was thematic analysis as its characteristics rest on theoretical flexibility and data interpretation; i.e. this approach helped this author to reflect on the purpose of this study and produce assumptions from the supporting literature review. This helped to codify the data collected from analyses, and identified themes and patterns for advance examination, related to this study research question (Braun and Clarke, 2013). Further, this approach supports the development of conclusions of this research from crossing its related data. As a deductive approach was adopted in this study, the subjects investigated emerged from the literature review in chapter 3 and preliminary readings.

The framework followed to assess data through Thematic Analysis, was based on Braun and Clarke (*Thematic Analysis - An Introduction*, 2018) and Saunders *et al.* (2019, p.648) were:

- 1) Becoming familiar with data collected through the transcription and reading actively, analytically and critically the interviews to understand the meaning behind each answer. This was done by making notes during the whole process of data collection.
- 2) Creating semantic (capture the superficial meanings) and latent (capture the assumptions behind) codes that attempt to capture and label the most significant subjects in the data collected for data with similar significant patterns categorising each element within a data item with a code that summarised the data extraction. The codes helped this study to cluster the most significant arguments to generate the themes.
- 3) Creating and mapping potential patterned themes from the generated codes, then associating them with data collected. Themes, in turn, are defined as “an abstract entity that brings meaning and identity to a recurrent experience and its variant manifestations” (DeSantis and Ugarriza, 2000).

- 4) Revising and polishing themes by looking back at data collected to see if they represent the themes generated or if they needed to be altered.
- 5) Delineating and labelling the themes generated to help this study to provide a clear analysis of the collected data.
- 6) Final procedure, to write the analysis report in accordance with the most relevant generated themes aiming to present readers with the most relevant and affluent narrative from the collected data. To illustrate each theme generated, some compiled quotes from participants in this study were used.

Therefore, by applying the above framework, this author looked to engage with data collected in an active manner, founded on knowledge acquired before this research and during the literature review processes (Braun and Clarke, *Thematic Analysis - An Introduction*, 2018). From that, this researcher produced the themes that could be associated with the data collection with the aim to display the overall objective of this study, further to reflect the main themes which arose during the investigation of the literature review: *Innovation impacts on workforce, RPA effects in the accounting industry, the accounting profession transformation due to innovation, the demand for multiple skills for accountants and finance professionals*. This author emphasizes that these themes are correlated and are under one roof: *Future of accounting professional career due to RPA and innovation*. For instance, queries to professionals on necessity and motivation to continuously upskill themselves, their involvement in areas out of their expertise and their concern over their future in their industry. The themes were placed to help this researcher concentrate and also to support the analysis.

3.7 Method Limitations

As reported by Braun and Clarke (2013, p.14) the limitation related to semi-structured interviews would be the time taken to prepare and produce data collection, lack of extensiveness due to the sample extent, privation of total privacy. In relation to this, Saunders *et al.*, 2019 (p.447) point out another limitation of this methodology would be related to “reliability/dependability; forms of bias; cultural differences; generalisability/transferability; validity/credibility”. The author suggests that to overcome these limitations, the author should explain well all the research process and structure rigorously the data collection and research methodology in order to produce reliable and credible data.

Therefore, it is a highlight that this study presents limitations, as well as issues related to finding participants suitable to the research question. One of the reasons is that the outcomes of this research cannot be a comprehensive communal research due to the number of participants. Indeed, the outcome cannot comprehensively represent the whole accounting and finance class based in Irish; despite key professionals having been interviewed. This author applied a deductive approach to test theory, attempting to achieve relative results rather than comprehensive. Additionally, to avoid any of the limitations of the chosen methods, during the interviews, this author looked to let the participants feel free as possible to reply to the questions by establishing an informal conversation.

3.8 Conclusion

This chapter aimed to provide the justification and processes details of the methodology and research design of this study. In addition, the limitation of this research strategy was presented and the approach to overcome these. By adopting the detailed methodology and research design, this study looked to finding satisfactory results from the interviews in order to answer the main question (*“What are the skills, competencies (knowledge plus skills) that accounting and finance professionals should acquire and expand in order to work together with RPA and its digital workforce in the Irish accounting industry?”*) and to develop a credible and reliable report. These findings will be presented in the next chapter, initially to display an overview of the findings followed by then a discussion and analyses of the outcomes from the semi-structured interviews.

4 Presentation and Discussion of the Findings

4.1 Overview

This chapter will discuss the findings of this research. The study focuses on postgraduate perception in relation to RPA, however, to have a greater insight, the findings will include insights from two types of participants (Appendix E): postgraduates in accounting and finance based in Ireland (**Group A**) and professionals composed by accountancy lecturers, a member of an accounting body, a recruiter specialised in accounting and finance roles, experienced professionals based in Ireland and an expert in RPA development based in German (**Group B**). Following (Braun and Clarke, 2013) to analyse data a complete coding approach was applied, then MAXQDA program was used to create themes from identified codes and patterns in the data. Therefore, this chapter's purpose is to gather the items that are most relevant and evocative in the data collected for answering this study research question: "*What are the skills, competencies (knowledge plus skills) that accounting and finance professionals should acquire and expand in order to work together with RPA and its digital workforce in the Irish accounting industry?*". It also has the purpose to compare the findings with the literature review to obtain a supportive analysis in relation to the objectives of this study which are:

- 1) Investigate which accounting and finance roles are most susceptible to RPA.
- 2) Explore the researchers' assessments regarding the actual and foreseen RPA's impacts on the accountancy profession.
- 3) Determine the necessary competencies (knowledge plus skills) that accountants and finance professionals must acquire to face RPA in the accounting industry.
- 4) Explore accounting professionals views and actions regarding RPA and innovation effects in their career path.
- 5) Devise recommendations on professional upskilling matters.

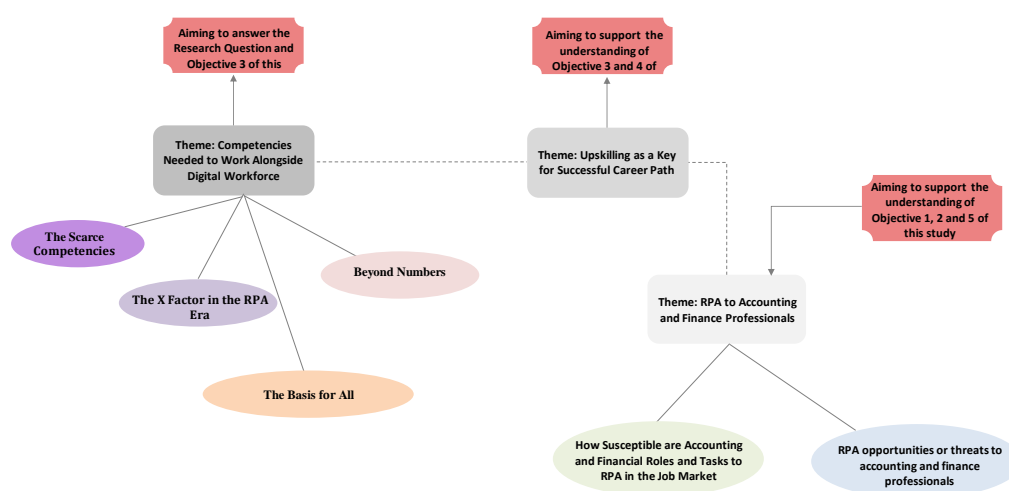
4.2 Findings and Discussions

The findings are included in both group, A and B, perspectives about competencies that need to be acquired in order to be able to succeed in the RPA era in the Irish job market. In order to provide reliability and validity to the findings, some sample quotes were placed in Appendices F, G, H and J. Hence, from data analyses were identified theme and sub-themes to answer the main question and support the objectives above. The first theme, *Competencies Needed to Work Alongside Digital Workforce (RPA)*, and its sub-themes identified in the data analyses main points for responding to the main question of this research from the perspectives of postgraduates in accounting and finance

based in the Irish job market. Additionally, perspectives from experienced professionals in different accounting and finance sectors were evaluated to enrich the answers for the main research question.

The other themes: *Upskilling as a Key for Successful Career Path* and *RPA to Accounting and Finance Professionals* – aimed to present the findings to support the answer to the main research question but also to underpin the literature review and cross them with the objectives of this study. Based on that, data analysis are presented thematically as follows:

Figure 14: The Thematic Map from Data Analysis



Source: Author

4.2.1 Competencies Needed to Work Alongside Digital Workforce (RPA)

An overarching theme enlightens competencies that accounting and finance professionals need as a consequence of RPA popularity in the accounting industry. Gardner (2019) predicts that 80% of the organisations worldwide will recognise that RPA and advanced automation will be vital to their sustainability in the market by 2030. Due to that, RPA adoption will increase exponentially as the need for multi-skilled professionals. In this line, Stoudt-Hansen and Karamouzis (2019), underscore that professionals in the accounting industry must widen the range to face the transformational age. Aligned with this, in the literature review, a group B participant when queried about the competencies needed by a professional be valuable in this new digital era, points out:

“All professional accountants will need to balance their professional quotients (PQ to fit their role and stage of career. Each accountant's PQ will reflect their competency and skill across seven constituent areas (...) Technical skills and ethics (...) Creative (...) Digital (...) Emotional Intelligence (...) Experience (...) Vision (...)”.

(Q24 AB)

The above extract demonstrates the range of different competencies that will be required for accounting and finance professionals (Murray, 2019) to work with RPA. Although these skills and knowledge have always been critical to professionals to acquire, develop and upgrade them to date (Pepe, 2011), in the past the most important abilities were linked to numerical skills and theoretical knowledge. Thus, due to the relevance of this theme for the research, it is addressed into the following subthemes: *The Scarce Competence* (technological competencies), *the X Factor in the RPA Era* (exclusive human competencies), *Beyond Numbers* (analytical competencies), *The Basis for All* (technical skills).

4.2.1.1 The Scarce Competencies

This sub-theme refers to technological competencies that professionals in the accounting industry should acquire to maintain value in the RPA era. Cooper *et al.* (2019) affirm that these competencies are deemed to be a big gap among finance and accounting professionals' competencies, and they must to overcome that to keep their relevance in the job market. Thus, whether professionals in accounting and finance roles have competencies required to engage with RPA, for example, a group B participant alerts:

“There is a lot of demand for people who are skilled in robotics at the moment (...), but there is no supply. So organisations are fighting for people who are skilled in analysing the potential for robotics and setting up a robotics landscape. So that's a very scarce skill at the moment”.

(Z16 SP)

This observation sheds light on one of the categories of competencies needed for professionals to be able to play an important role at a time when there is an increase in the adoption of RPA by companies in the accounting and financial sector. Lyon (2020) also urges that the technological competencies are those which represents one of the masters among professionals in the accounting industry. During the assessment of data collected, it was observed that group A participants recognise that there is a lacuna regarding technology competencies. A group A participant made a comment on this matter:

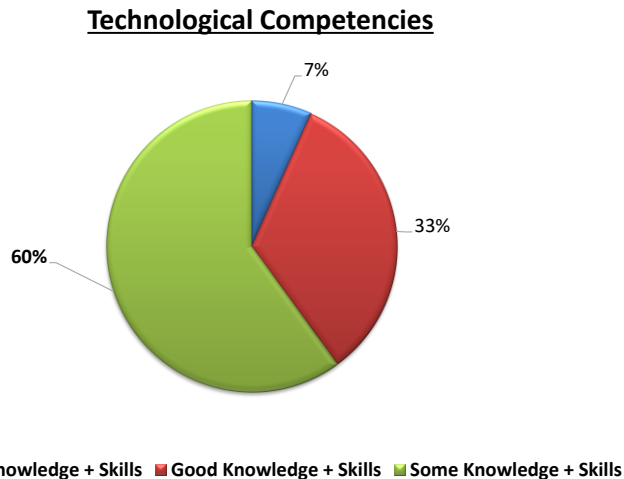
“(...) I should be more familiar with latest trend/improvements in technology and must know how to operate them since most companies now require that you have knowledge and experience of certain technology in assessing whether you're qualified for the job or not”.

(Q8 PG)

ACCA Global and KPMG (2018) underline this lack of technological competencies and suggests that professionals must upskill themselves to be ready for the digital era. This corroborates with the findings in the data collected, the graph below (Figure 15), illustrates the self-assessment made by

group A participants about how they would rate their knowledge and skills regarding technological competencies:

Figure 15: Respondents Self-Assessment - Technological Competencies (E.g. Programming, SQL, Implementation, IT Knowledge)



Source: Author (Data collection and analysis in the period between Apr and May 2020)

Thus, from the above analysis, it can be observed that the majority of postgraduate respondents reckon that their technological competencies need to be improved to remain competitive in the job market. Although the majority of these participants recognise that there is a gap in these competencies, some of them suggest that the postgraduate courses in accounting and finance should be better to prepare them for the market place. On this matter, a group A participant points out:

“The syllabus in the postgraduate course is not directed towards the use of new technologies. The student finishes the course with no idea how to operate an Accountancy software”.

(Q7 PG)

This extract highlights the power of innovation, such as RPA to disrupt accounting education, contributing to widening the gap related to digital transformation. Pincus et al. (2017) underpins that there is an urgency for change in the higher accounting courses syllabus due to technological advancement. Here again, this disruption is pointed by a group A participant:

“I don't think so [that Irish postgraduate course in accounting and finance prepares professionals to RPA era]. I had in this semester one subject called "digital business", which opened our mind about the new digital era, however, it was focused in digital marketing, it would be more interesting to have a finance perspective instead”.

(Q11 PG)

The above quote meets with a previous argument as it highlights the lack of discipline focused on the new digital age and also meets with Parkin (2020) understanding that alleges that this lack contributes to the gap in technological competencies in the RPA era among accounting and finance professionals. In contrast, another group A participant states:

"I don't think the educational system has a role in incorporating these teachings into school curricula (...) it is a role of your firm or organisation to train you according to their needs".

(Z13 PG)

From the perspective of the group B of participants, an accounting lecturer recognised that postgraduate courses in accounting and finance are lacking in preparing the postgrads:

"(...) courses should have a greater focus on technology and related tools for accountants to leverage in their future careers".

(Q21 LP)

Such comment provides an example that the gap existent among professionals in the accounting industry could be diminished if the actual postgraduate courses give more attention to digital transformational era and its impact on the professional's technological competencies. During the literature exploration such duality of arguments was not found, since most of the investigated paperwork only emphasised the need of professionals in the accounting industry to improve themselves digitally (Kokina and Davenport, 2017; Kokina *et al.*, 2019; Cooper *et al.*, 2019) in order to be considered valuable in the job market. Appendix F presents some quotes originating from data analysis which expose the acknowledgement of participants in relation to the deficiency of technological training.

4.2.1.2 The X Factor in the RPA Era

This sub-theme captures exclusive human competencies to deal with RPA as a technological advancement. Daugherty and Wilson (2018) consider exclusive humans skills and knowledge are those which differentiate human labour from digital workforce. From data analysis was noted that participants also have this perception. For instance, a group B participant states:

“There are for sure, standard processes which can be automated and can be fully executed by a robot. But there is still a lot of human judgment. (...) Human judgment will always be required to perform all those duties in the correct way (...) There is an advancement that we will see it that we will experience, but we will at the same time have to ensure that we preserve that human judgment component when we attribute the accountancy role to a robot”.

(Z15 EP)

This statement meets with ACCA Global (2019) understanding that exclusively human competencies are the ones that accounting and financial professionals must develop in order to continue to be relevant in the RPA era. Thus, ‘judgment human ability’ becomes a key ingredient to work with RPA and its digital workforce, and to use it to boost these exclusive human competencies. Along the same line of the relevance of judgment and its human distinctiveness ability, another group B participant concludes:

“The ability to anticipate future trends accurately by extrapolating existing trends and facts, and filling the gaps by thinking innovatively. This is exclusively human capacity”.

(Q24 AB)

This extract reveals a set of skills that are linked to the ability to judge creatively, which results in adding value to an organisation. The comprehension that exclusive human competencies are needed in this time of transformation, since this is an X factor for overcoming the power of RPA and its robots, extends to postgraduate participants, for example, a group A participant:

“We must ensure that we’ve an ability to think outside of the box (...) will always have a human rational to be required and considered in the decision making (...) I think RPA will help us to maximise this ability”.

(Z12 PG)

Cooper *et al.* (2019) assert that while RPA supports professionals in mundane tasks, it also frees up them to exercise their exclusive competencies. Another group A participant made a comment on that:

“ RPA will give lot more time for accountants to focus on more issues that require more judgment while RPA perform basic tasks”.

(Z13 PG)

Kokina *et al.* (2019) emphasises that the ability to apply an inquisitiveness thinking is fundamental for accounting and finance professionals to obtain a significant role in the RPA era. In the analysis, were found that part of group A participants consider their exclusive human competencies are good, while another important part see themselves with A low level of knowledge and skills (Figure 16) in this matter. This substantiates ACCA Global and KPMG (2018) report *Embracing Robotic*

Automation which displays a lack of exclusive human skills among professionals in the accounting industry.

Figure 16: Respondents Self-Assessment – Exclusive Human Competencies (E.g. emotional intelligence, teamwork, communication, organisational abilities)



Source: Author (Data collection and analysis in the period between Apr and May 2020)

The data analysis proposes that many of the group A participants see the need to improve requisite competencies and also demonstrates a gap existent in these competencies among this sample participants study. The investigation of the literature present in this study also identified that abilities and knowledge belonging to this category, such as the ability to communicate clearly, work well in team, creativity and organisation of ideas are skills and knowledge that professionals in the accounting industry need to improve (ACCA Global and KPMG, 2018; Farrar, 2019). In line with that, a group B participant describe that in RPA era:

“Professionals need to have the ability to identify your own emotions and those of others, harness and apply them to tasks, and regulate and manage them (...) Need to be creative and have the ability to use existing knowledge in a new situation, to make connections, explore potential outcomes and generate new ideas”.

(Q24 AB)

Emphasising that, another group B participant states:

“(…) Big gap is clearly in the soft skills area (...) I've learned a lot as well in the last years in my career path. Probably much more on the soft skills side because working as an individual contributor is one thing. Then when you ask to work alongside other individuals, especially as a financial analyst, when you're dealing with the very senior people within the company, there's a lot of soft skills components that you have to really master in order to deal with them effectively and to make an impact on their day to day life and making sure that they reach

their targets and that the company overall performs well and that your clearly communicate what is needed”.

(Z15 EP)

Thus, ‘communication’ becomes a key factor in the RPA era as also affirmed by Lyon (2020) who advise professionals to become able to translate and give meaning to stakeholders the outputs of robots. For one group A participant, the ability to communicate in this new age is an essential skill to develop:

“Data communication and visualisation are critical skills for supporting and making robust data-driven decisions. Those in the finance function must be able to describe their conclusions to technical and non-technical colleagues”.

(Q5 PG)

Therefore, based on data analysis and literature review, this set of skills must be developed by accounting and finance professionals, as they are necessary to create value for organizations, leverage customer relationships, translate and make appropriate decisions from a complete view of the robots outputs, etc. in the RPA era.

4.2.1.3 Beyond Numbers

This sub-theme depicts analytical competencies and explores the ability of accounting and finance professionals to interpret results and figures meaningfully. Lawson *et al.* (2013) claims that these competencies are mandatory in the new digital age. A group B participant makes an observation:

“The ability to review data, analyse it and prepare useful information from it - both numbers and narrative is fundamental in this transformational era”.

(Q23 EP)

Although, according to Bahador and Haider (2018), these competencies have always been expected from professionals in the accounting sector, technological advancements, such as RPA, intensify the need that professionals master these. Then, they can be able to translate information received from the digital workforce and apply critical analysis to produce valuable information for the decision-makers and stakeholders. Another group B participant highlights the connection between analytical competencies and RPA:

“The capacity released through RPA can be directed toward real value added activity for finance. There is significant opportunity to retrain and redeploy finance staff and leverage their analytical skills for sharper predictive insights to better inform decisions”.

(Q24 AB)

As stated by Kokina and Blanchette (2019) RPA provides a chance for professionals to apply their analytical competencies more efficiently due to the RPA condition of relieving these professionals from routine activities. In this line, a group B participants understands that:

“Accounting and Finance is in charge to provide insight about the company results. Tools like RPA will enhance this capacity. Thus professionals must develop that”.

(Q17 EP)

These extracts meet with the literature review outcomes (Ernst Young, 2016b; ACCA Global and KPMG, 2018; Cooper *et al.*, 2019), as is found a similar perception that analytical competencies will be highly demanded in RPA era.

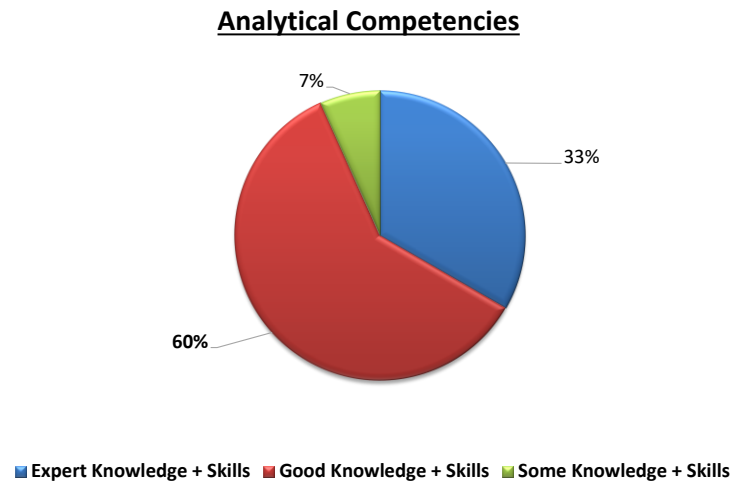
Regarding the postgraduate awareness about analytical competencies, a group A participant thinks:

“Analysing information skills is very important for us to develop, it because RPA software gives you just numbers; thus, you're going to have to understand that (...) You have to be aware of what happened during data processing (...) have to gather the most important things or be alert of anything that might happen on the information analysed (...) For example, transaction A is going to be right. That is ok. But there must more there; it could be something wrong in the real world (...) So you have to be alert on that and try to figure any mistake out in order to give value to the company”.

(Z12 PG)

Here an ability to see beyond numbers is assessed as an essential form of engaging effectively and efficiently with this new transformational time in the accounting industry. The majority of group A participants consider having analytical competencies, ‘solving-problems’, ‘understanding numbers’, ‘analyse Information’ are essential to build a career path in the RPA era. From data analysis, it was noticed that a large number of participants see their analytical competencies as good enough (Figure 17) to deal with RPA ad technological advancements.

Figure 17: Respondents Self-Assessment – Analytical Competencies (E.g. to solve problems and apply critical thinking to assess information, pieces of evidence, and considered the effects of options prior to making a decision)



Source: Author (Data collection and analysis in the period between Apr and May 2020)

Despite that, some of both groups of participants believe that professionals in the accounting industry need to improve analytical competencies if they want to remain valuable in the RPA era. Thus, participants demonstrate an awareness about the need of master these competencies and reach the job market expectations. These findings are also in line with those found in the literature review on the importance of analytical skills in the RPA era and the need for accounting and finance professionals to improve these (Kokina *et al.*, 2019; Cooper *et al.*, 2019; Lyon, 2020).

4.2.1.4 The Basis for All

This sub-theme captures perspectives in relation to technical competencies and core principals for accounting and finance professionals. The need to keep up to date on this matter is logically understood as the basis for all other competencies analysed from data collected to date. For instance, a group A participant states:

“I think basic knowledge is very important, ACCA, for example, is one of the ways to keep informed about how technology can impact basics accounting knowledge (...) I know that there's a lot to learn in accounting (...). I would say that because there's always something new out there. For example, these new financial reporting standards, it is basic, and I must to learn as it can impact how to deal with new technologies”.

(Z12 PG)

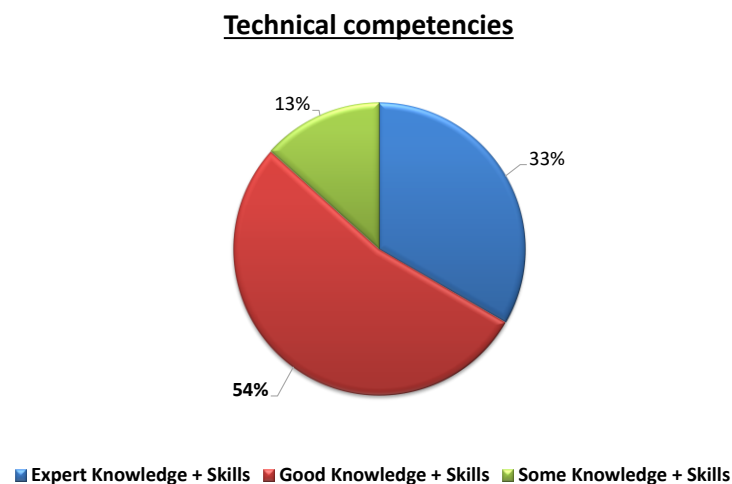
This passage puts technical competencies as the basis for maintaining relevance when advancements, such as RPA, take over mundane activities, and professionals become robot trainers. Bahador and Haider, 2018; Kokina *et al.* (2019) also believe that accounting and finance professionals are those responsible for technically guiding the digital workforce in this new digital era. In this matter, another group A participant comments:

“First of all, you have to have your hard skills always up to date, you have understand the accounting standards, for than develop and use IT knowledge in this new digital time”.

(Z13 PG)

Pincus *et al.* (2017) emphasise that technical competencies will always be essential; it is fundamental for professionals to remain significant in the RPA era. The data analysis demonstrates that for most postgraduate participants, these competencies have a direct relation to the ‘constant learning’ requirement in the accounting and finance sector. Furthermore, it was noted that the majority of group A respondents consider that they have good knowledge (Figure 18) regarding the level of technical knowledge in the accounting and finance field. In the Appendix H is placed some sample quotes from both participants group in relation to this matter.

Figure 18: Respondents Self-Assessment - Technical Competencies (accounting and financial knowledge [intellectual content] and skills [ability to employ technical knowledge])



Source: Author (Data collection and analysis in the period between Apr and May 2020)

From Group B perspective in relation to technical competencies, one of participant highlights:

“In the current time, you have to have hard skills and by hard skills, I mean knowing the subjects (...) It is the drive of the accounting and finance career in the digital transformational era”.

(Z15 EP)

In relation to the relationship between technical competencies and RPA, one of group B participants asserts:

“People who have the skills for doing that manual work [they] would be used robotized processes, meaning that you need to understand your company processes and rules. Then, you need to describe the approaches that need to be robotized, so the person who has been done the manual work is the one who will draft that blueprint for the robot”.

(Z16 SP)

In this extract is emphasised that it is necessary to acquire technical competencies and understand clearly laws, rules, standards that govern accounting and finance professionals in order to perform properly in this new era. This is also highlighted in the report *Learning for the Future* (ACCA Global, 2016). In contrast to the idea that RPA boosts professionals to have a deep insight into processes, knowledge and rules applicable in the accounting industry, one of group B participants argue:

“Accountants will lose the ability to perform these operative tasks (eg. I met some professional that were not able to do explain how a simple VAT liquidation works and all this because their system is doing it for them!)”.

(Q17 EP)

This extract shows that the automation of processes may lead professionals to a reduction of technical knowledge, since they will no longer be directly involved in these basic activities, which require knowledge and skills regarding business law, standards, etc.

From data analysis was also shown that *“professional behaviour, ethical behaviour”* (Z14 PG), *“integrity”* (Q1 PG) and *“ethical awareness of possible bias”* (Q20 LP) are significant competencies to apply and develop in this transformational era (Ernst Young, 2018) where accounting and finance professional will be responsible for deploying RPA and train robots. Nevertheless, the skills and knowledge that compose the core of professional principles (ICAEW, 2019b) were not recurring in the data analysis findings. ACCA Global (2020) emphasises that *“ethics, accountability and integrity”* are highly demanded skills in this new age. Thus professionals must master them in order to create continuous value to their organizations, and consequently for their own careers. Nevertheless, the skills and knowledge that compose the core of professional principles were not a recurring subject in the data analysis findings.

4.2.2 Upskilling as a Key for Successful Career Path

This theme is directly related to the previous theme since it reinforces competencies need to be acquired, developed and maintained at a high level. ACCA Global and KPMG (2018) emphasises that in order to keep relevance in the RPA era, professionals must constantly upskill themselves in all of the competencies spheres (technological, exclusive human, analytical, technical besides the preservation of core professional principles) Group A participants typically termed factors to succeed in this new age as the acquisition of technological competencies and familiarity with RPA and technological trends. One of the group A participants describes:

“Having only technical knowledge about accounting will not work anymore. To be successful in this field, I should be familiar with latest trend/improvements in technology and must know how to operate them since most companies now require that you have knowledge and experience of certain technology in assessing whether you’re qualified for the job or not”.

(Q8 PG)

This quote supports the understanding that theoretical knowledge and the ability to apply it to the daily routine contribute to accounting professionals developing the ability to train, monitor and manage RPA and its digital workforce. Cooper *et al.* (2019) assert that in the RPA era professionals must have a range of competencies (skills plus knowledge) to be able to handle possible new roles that will emerge due to RPA deployments in an organisation. Additionally, ICAEW (2019) suggests that professionals must preserve the core professional principles in this transformational age to promote trustability and faithfulness on their management of digital workforce. Some participants in group A also define human competencies, as such as ***“communication”*** (Z14 PG), ***“soft skills”*** (Z13 PG), ***“flexibility and adaptability”*** (Q11 PG), ***“eager to bring value”*** (Z12 PG), ***“ability to judgement and decision-making skills”*** (Q6 PG), as competencies that would lead accounting and finance professionals towards a career with relevance in this new digital age. Indeed, according to Xero (2020), skills and knowledge that compose exclusive human competencies are deemed very significant factors for professionals to acquire and develop in order to deal with innovations, such as RPA. This is because roles they will play, for instance, as a negotiator and value generator for their companies, must demand from them a high ability to apply these exclusively human skills (Kokina *et al.*, 2019; Cooper *et al.*, 2019), while RPA serves as a support in manual, repetitive and rule-based activities.

From group B perspective, there are skills, abilities and knowledge that professionals should improve or acquire to build a successful and sustainable career in times of RPA. For instance, a group B participant states:

“A successful career in finance and accounting lies in a cluster of soft skills (...) like the ability to be brief, concise, straight to the point when you present an analysis. You also have to be

able to understand what other people want from you (...) be able to speak in a very simple language, because most of the people you interact with are not financially savvy”.

(Z15 EP)

In line with the perceptions of group A and the literature review mentioned above, this extract highlights a series of skills that are part of exclusive human competencies, considered one of the fundamental factors for accounting and financial professionals to be viewed precious in this new digital age. Another group B participant points out:

“(...) A&F professionals should stay updated with new technologies and embrace changes (...) apply adaptability, flexibility in order to add value to their organisation and be involved in any transformation that might happen”.

(Q18 RP)

This extract suggests that professionals need to adopt a posture that aims to be multidisciplinary and multi-skilled so that they can remain valuable in the job market. Ability to 'add value' for the company consequently appears as a driver in the desired valuation of the professional in the accounting industry.

Specifically with regard to technological competencies, such as ***“Digital skills”*** (Participants: Q4 PG, Q2 PG, Q5 PG) ***“programming skills”, “technological competencies”*** (Participants: Q8 PG) were identified as recurring patterns found among group A participants' responses when the subject was the factors to succeed in the accounting industry. This presents a similarity with those discovered during the investigation of the literature review regarding how to build a successful career in this new digital age. For example, Santos *et al.* (2019) agrees with Cooper *et al.* (2019) and Kokina and Blanchette (2019) that technological competencies are critical matter for a successful career in the RPA era.

Although technological competencies are essential to deal with RPA and technological advancement, based on the analysed data and information derived from the literature review in this study, acquisition, development and maintenance of multiple skills (exclusive human, analytical and technical) plus the preservation of the professional's fundamental principles, are fundamental conditions to leverage the accounting and finance career in a sustainable way in the RPA era and for the anticipated preparation of possible technological advances that may impact these sectors.

4.2.3 RPA to Accounting and Finance Professionals

This theme captures whether RPA is perceived as an opportunity to leverage accounting and finance professionals career or as threat to their maintenance in the job market. This discussion was

unearthed during the literature review (Davenport and Kirby, 2015; Osborne and Frey, 2018), whether technology, such as RPA can replace human and, consequently, impact their professional life. Due to the duality of this theme and with the aim to present the findings in a clear format, it is divided into two sub-themes: *How Susceptible are Accounting and Financial Roles and Tasks to RPA in the Job Market* and *RPA opportunities or threats to accounting and finance professionals*, and are presented below.

4.2.3.1 How Susceptible are Accounting and Financial Roles and Tasks to RPA in the Job Market

This sub-theme captures participants perceptions in relation to the susceptibility of accounting and finance roles and tasks that was performed only by humans. Rozario and Vasarhelyi (2018) affirm that repetitive processes based on rule are exponentially subject to RPA. Participants demonstrate awareness about this matter; for example, a group A participant states:

“I believe that the activities within accounting changed a lot and will continue to. For example, the accountant will no longer have to worry about generating reports, reconciling data, calculating taxes and expiring payment slips, as these activities all of these bureaucratic and repetitive tasks will have already been performed by RPA. The accountant's job has become more analytical and now requires much more critical thinking rather than bringing numbers out”.

(Q5 PG)

This extract describes the routine accounting and financial activities susceptible to RPA, but also highlights the activities in which professionals in this area must prepare to perform. Indeed, such understanding also is underlined in Chapter 3 (literature review) as researches. For example Cooper et al. (2019) and Kokina *et al.* (2019) describe new functions, such as “business analyst”, “robots managers”, “data analyzer”, “robots trainer” that professional should be ready to carry in the RPA era. The important point is that in the literature review, authors emphasise that professionals need to be aware that these “new roles” will highly require a great judgement, decision making and negotiations abilities. Another group A participant, made a comment that:

“Accounting and finance professionals will be more diversified, value-add and decisive, instead of mere booking and recording of transactions”.

(Q10 PG)

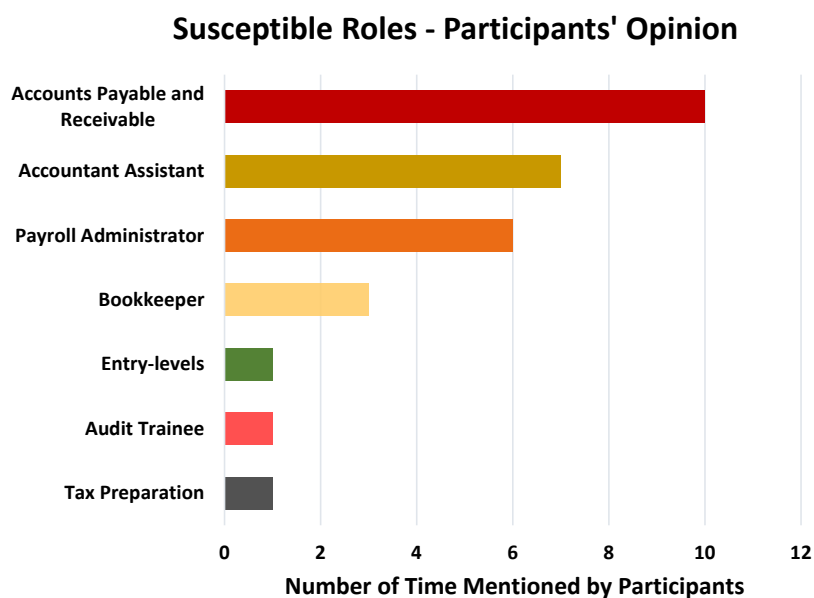
This quote reveals an awareness about the roles that professionals will represent in organisations which Lyon (2020) sees as a motivational factor in the career path. This exchange of activities and roles is also underscored by a group B participant, who stresses:

“All those analysts, the two who constitute the vast majority of the finance team, for instance, they may be exposed the way more not only because they may be impacted by the fact that there would be fewer jobs available, but also because on the job itself repetitive characteristics. To minimise that exposure (...) They will have to be able to program robots, work together with robots and interact with robots”.

(Z15 EP)

This extract highlights mainly functions related to entry-level which is very relevant information for postgraduates in accounting and finance who are at the beginning of a career. Although the participants have labelled different activities and functions in the accounting and finance sector that would be susceptible to RPA, common features among the examples were identified such as repetition, constateness, and rule-based mainly. The following graph presents the roles and tasks identified during data analyses.

Figure 19: Susceptible Accounting and Finance Roles - Participant's Opinion



Source: Author (Data collection and analysis in the period between Apr and May 2020)

As the graph illustrates, the roles that were more mentioned by participants were accounts payable and receivable, payroll administrator and accountant assistant. This finding meets with the literature review. However, initial roles in auditing (Cooper *et al.*, 2019) in and tax preparers (McKinsey Global Institute, 2019) that were mentioned once by participants are roles highly susceptible to RPA. A table crossing these findings with the literature review was placed in Appendix I.

Therefore, from the data analysis and outcomes of Chapter 3 (literature review), it was possible to identify that despite the existence of a susceptibility of tasks in accounting and finance to RPA, opportunities emerge at the same time; This is addressed in the next sub-theme.

4.2.3.2 RPA opportunities or threats to accounting and finance professionals

This sub-theme depicts how participants perceive RPA in the accounting and finance career path. The data analysed show that participants express awareness of the growing adoption of RPA in the accounting industry and their concerns and expectations about RPA effects on career path. As illustrated by the following group A participant quote:

“I believe that most of the clerical tasks can be automated already, this means that companies don’t actually need a lot of accountants than they used to do which could lead to unemployment and difficulty for some to apply if they wish to pursue accounting in the private sector”.

(Q8 PG)

In fact, another group A participants share similar thoughts about the potential of RPA to replace professionals in the back-office, which also Frey and Osborne (2013) alert in their study about automation impact in the human workforce. For example, a group A participant comments:

“RPA would lead to less demand for accounting professionals, leading many professionals to become unemployed”.

(Q10 PG)

This quote demonstrates a certain anxiety about RPA causing unemployment due to it being able to perform repetitive tasks faster and more accurately than humans. Another Group A participant expresses a similar unease as in following quote:

“RPA is referred to as a disruptive technology. First of all, disruptive technologies are technologies that have the potential to replace (...) It can do tasks that are carried out by accountants. (...) It can replace a lot of manual or routine audit tasks, for example, I mean, it can replace auditors on tasks, such as testing a large amount of documentation”.

(Z13 PG)

Across the literature review, researchers (Acemoglu and Restrepo, 2018; Kokina *et al.*, 2019; Clair and Kirkwood, 2019) investigate this fear among finance and accounting professionals and argue whether technological advancement, such as RPA, can bring positive or negative effects to the job market. This ambiguity was also found during the data analysis, although the above extract demonstrates disquietude in some postgraduate professionals in relation to RPA effects in their career; other participants understand RPA as co-worker and supportive tool. Once RPA starts to

perform manual activities that consume a large number of hours of work, such as “account receivable” and “payroll”. Ernst Young (2018) highlights that RPA expands the opportunities of the professional to dedicate more time to analytical analyses and value-adding activities. Overall participants expressed awareness of RPA as a support software in routine activities. It is observed in the following quotes:

“RPA can be used as a tool to help the accountants professionals (...), it can provoke some changes, but accounts demands judgment (...) It will allow the accountants to do a more analytical work than operational”.

(Q2 PG)

“Since RPA can automate many processes that traditional accountants perform, it will greatly help companies to have their accountants to focus on management of financial aspect of the business. More on financial analysis, evaluation of company performance, investment decision-making and other activities that require critical thinking. In other words, all non-routine activities which needs to be addressed on a case-to-case basis should be the main responsibility of the accountants, routine activities (e.g., encoding and processing of invoices for payments) shall be performed by RPA but still, final review and approval shall be made by the accountants”.

(Q8 PG)

Thus, the view of RPA as a collaborator to improve professional performance is considered essential for the professional in the accounting industry in order to overcome the fear that innovation may cause. Silva (2018) asserts that those professionals must adopt an adaptable and flexible mindset in order to take advantage of the opportunities and benefits that RPA can provide on a daily basis.

Although RPA may threaten some roles, group B participants’ perspective is that RPA only can replace human if they do not adapt themselves to new technological reality. One of the participants relates:

“ There's a big push towards the use of robots like we have seen for information systems and if you struggle with technology systems, and you struggle to understand how robots work. Well, clearly, you better upskill yourself. (...) I mean, you may not lose your job, but when you're looking for a job, the ability to run those software and robots (...) is going to be a plus and an advantage. And we'll reach a point where it's going to be just assumed as a given”.

(Z15 EP)

This extract exposes not only the issue of replacement, but also interconnects and urges professionals to prepare to use RPA as an opportunity to climb a path to professional success, rather than considering it a threat. Similar results were also found during the investigation carried out in the literature review, in which RPA is seen as beneficial software for accountants and finance

professionals. As long as they are able to acquire and develop the skills required to work with RPA, professionals will have the opportunity (ACCA Global and KPMG, 2018) to invest their time in analysis, deep insights and negotiations that will bring value to their companies and consequently their careers. In the same line, another group B participant mentions:

“Accountants roles will become more “value-added” (...) By keeping up to date with RPA and bringing new ideas to businesses, A&F professionals can improve ways of working and improve efficiencies for organisations (...) Time will be saved and better used, and processes will be carried more efficiently”.

(Q18 RP)

Thus preparedness appears as a key for professionals in the accounting industry to be able to work successfully in the RPA era. A table with recommendations from group B participants is presented in Appendix J aiming to provide to readers some guidance in relation to actions needed to be ready for job market requirements in this new transformational era.

Although RPA is seen as positive disruptive software in the accounting industry, overall participants assume that it still in the infancy in the Irish job market, and they do not foresee a drastic changes in the accounting industry in next years. The following quotes illustrate that belief:

“I believe it is still quite early days but A&F professionals should stay updated with new technologies and embrace changes in order to add value to their organisation and be involved in any transformation that might happen”.

(Q18 RP)

“I haven't noticed a big change just yet, but I'm sure it'll come in a few years (...) It is likely that over the coming years the risk of not being up to date to handle digital developments will make professionals unsuitable to many accounting roles”.

(Q23 EP)

“Dublin is characterised by a lot of SCC [Smarter Companies Challenges] and some tasks are processed manually, collection, reservation, invoice booking etc.. All the above roles will disappear in the next 10 years. People in these roles should start to up-skill themselves in order to avoid to be left out from the market”.

(Q17 EP)

Although participants see the impacts of RPA, Recruiters Ireland (2020) points out that “good risk and compliance skills coupled with technology” are increasing in demand from 2020. Such information demonstrates that innovations are already changing the Irish market requirements. Thus, it is important to keep in mind that sooner or later, professionals will face RPA in their daily lives. Therefore, regardless of the stage at which the adaptation of the RPA is found, specifically in the Irish working environment, professional updating is constantly evidenced in the findings.

4.3 Conclusion

In summary, the main points from data analysis-findings of this research are as follows: It was identified that professionals in the accounting industry understand that acquiring and developing multi-competencies are the key to maintaining relevance in the RPA .i.e., they will need much more than numerical abilities and knowledge of how to use a software. It was also found that RPA is still in the infancy stage in the Irish market, but is already perceived as an innovation that will disrupt the marketplace.

Regarding the possibility of RPA replacing humans, for this not to happen, it is necessary for professionals to be flexible about the changes that RPA will cause in the accounting industry. The most relevant and supportive findings to the main question of this study are that professionals in the accounting sector would have their opportunities expanded by the adoption of RPA in the organisations rather than a threat. However, it is necessary that they take a proactive stance and keep themselves informed about RPA trends and the effects of this in the accounting industry. That is, seeking to be up to the date with the requirements in the job market so that they are prepared to exercise roles related to negotiation, critical thinking, relationship with the client and adding value to their organizations.

5 Concluding Thoughts on the Contribution of this Research, its Limitations and Suggestions for Further Research

This chapter aims to highlight some crucial points for this study.

5.1 Implications of Findings for the Research Questions

The interviews with different groups of professionals made it possible to answer the main research question and also supported the understanding of the objectives of this study placed in Chapter 3. These results corroborate with existing evidences found in Chapter 2 (literature review), but underpinning the perspective of professionals based in the Irish market.

5.1.1 The Research Question

What are the skills, competencies (knowledge plus skills) that accounting and finance professionals should acquire and expand in order to work together with RPA and its digital workforce in the Irish accounting industry?

The findings, from the perspectives of professionals based in Ireland and one based in Germany, propose that professionals in the accounting industry should work constantly to update not only traditional skills required in this industry, but it also to follow technological trends, such as RPA, which can impact sustainability and career success.

Thus, the outcome of the data analysis suggest:

- Professionals in the accounting sector must adopt an adaptive mindset to face the changes in the sector caused by RPA.
- Professionals must be open to RPA transformation in order to take opportunities that this advent may bring to their career.
- Professionals should acquire competencies that they are lacking. Furthermore, they should continuously update and improve their competencies.
- Professionals must align their competencies with those required not only at the moment, but also with those required in the near future due to the advent of RPA.
- Professionals must recognize that the technological and exclusive human competencies were perceived a gap among accounting and finance professionals. As these competencies are highly required in the RPA era, the gap must be fulfilled.

- Competencies traditionally required in the accounting industry, such as accounting knowledge, numerical ability, analytical thinking and preservation of core of professional principles will always be required; therefore professionals must master those.
- Technological, exclusive human, analytical and technical competencies are those will be required in the RPA era.

To summarise, the results substantiate and meet with the theory and previous paper examined in the Chapter 3 of this study.

5.2 Contributions of the Research

The literature review clearly demonstrated that RPA is disruptive software in the accounting sector, and despite being in its infancy, the forecast is that its adoption by organizations around the world grows exponentially in the next three year due to its disruptive characteristics, RPA seems already to impact the accounting and finance professional career path, as this caused the lack of technological and exclusive human competences to be seen with concern among researchers and professionals in this industry. The study has addressed the competence needs in this new digital era and also highlighted the big gap among these professionals, the technological competencies.

The empirical research is distinctive as no other research paper has addressed the competencies needed to work in the RPA from Irish job market perceptions. Additionally, the *Conceptual Framework (CF) - Competencies Transformation in the RPA Era* developed from the literature review applied in this research encapsulates the competencies professionals need to remain relevant in the RPA. Thus, it aims to provide guidance for the preparation of accounting and finance professionals for a sustainable and successful career in this new digital era.

Furthermore, this research contributes to the comprehension of the impacts of RPA on accounting and finance professionals, especially for those who are in the initial stage of their career based in the Irish job market. The findings provide a list of competencies perceived as essential to succeed in the accounting industry. The result of this research can be used by professionals in the accounting and finance industry as a guide to overcome the challenges imposed by the growing adoption of RPA by companies.

5.3 Limitations of the Research

The limitation of this research is addressed as follows:

Firstly, considering the number of professionals in the accounting and finance sector, approximately 70,000 in Ireland (Nolan, 2016; Engage People Recruitment, 2019) the generalisation of this study is limited; due to the number of participants (14 postgraduate and 10 experienced professionals composed of 3 lecturers in the accounting field, 1 recruiter specialised in finance and accounting roles, 1 member of an accounting body, 1 an expert RPA salesperson and 4 experienced professionals in accounting and finance sector.

Secondly, due to Covid-19 and its emotional, financial and timeless impact worldwide and in Ireland, it was not possible to interview a larger number of professionals.

Thirdly, there is a lack of research papers in relation to RPA and its impacts on the Irish job market; therefore, it was not possible to compare the results geographically speaking with the literature review.

Finally, due to the lack of experience in conducting academic research, the scope and strength of discussions in this paper are compromised in many degrees in relation to the research of experienced scholars. Furthermore, as a non-native English speaker, this was a significant barrier in the whole process of this study.

5.4 Recommendations for Practice

The results of this research indicate that accounting and finance professionals must continually improve their technological, exclusive human, analytical and technical competencies, always in line with technological trends, such as RPA. Professionals must preserve and apply the core professional principles, along with updating these competencies. RPA is modifying the accounting industry in relation to skills and knowledge required. Consequently, professionals in these sectors must seek to be up to the date with the RPA impacts in the Irish market and on their career.

5.5 Recommendations for Future Research

This research reveals that there is a tendency for changes in accounting and financial functions and activities as a result of RPA increasingly being used to perform tasks that were done exclusively by humans. The changes identified in this study are directly related to competencies required from employers to professionals in the accounting industry. Therefore, the outcomes from the literature review and interviews in this study lead to a range of possibilities to future research. For instance, a future study could:

- Explore the RPA influence in hiring in the Irish accounting industry.

- Investigate how feasible is RPA deployment in the Irish SME accounting firms.
- Explore how the implementation of RPA affects the employability of professionals in the Irish accounting industry.

Furthermore, as the deployment of RPA increases and the deployment matures in the Irish market, future research could:

- Explore possible new accounting and financial functions that may arise from the transformation caused by the adoption of RPA in organizations.

5.6 Self-Reflections

This research work was beginning with a lot of uncertainty about the topic. The first research topic was “A Study on the Impact of Robotic Process Automation in Accounting Profession for Post-Graduated Level at Irish Market”, with a cloudy idea about to connect RPA, postgraduate and Irish job market. A full Chapter 2 (literature review) was written, but the objective to connect subjects was not achieved. For this reason, this chapter was redone and later restructured. Thus, the first suggestion would be to choose a topic that concerns you. Then, draw a map with possible titles and subtitles that would be preferred to use in the literature review chapter. Finally, pre-define possible objectives that will drive you to the answer the main research questions of your study.

The interviews were carefully planned and designed thematically according to the literature review findings aiming to support, later, the analysis of collected data. Despite that, if I was doing it again, I would design the questions to capture deeper views of how RPA, as a disruptive software in the accounting industry, can impact positively or negatively on professionals career path. Thus, to increase the comparability with the findings in the literature review.

5.7 Final Conclusion

RPA is increasingly a subject in reports released by accounting bodies, Big 4's and developers who display and try foreseen RPA impacts in the overall accounting industry. Although the literature review shows that many organisations are deploying RPA; however, data analysis shows that this does not seem to be happening in the Irish accounting industry. Nevertheless, findings demonstrate that sooner or later, the RPA adoption will increase in Irish organisations and accounting and finance professionals must prepare themselves to work with the new digital co-workers. For that reason, professionals must follow RPA trends and requirements needed in this new transformational era in order to update in advance so that the impacts caused by the RPA can be perceived positively. Some of these changes are already seen as skills and knowledge, such as

programming, SQL query, ability to negotiate and communicate clearly are being required from accounting and finance professionals. Therefore, there will be an expansion of opportunities for these professionals, as they are expected, for example, to identify processes susceptible to RPA, conduct implementation, monitor, manage and explain RPA outcomes.

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Appendices

Appendix A – Ethical Clearance

Griffith College Dublin RESEARCH ETHICS COMMITTEE	
NOTIFICATION FORM FOR LOW-RISK PROJECTS	
Section A: Applicant Details	
PROJECT TITLE:	A study of the effect of robotic process automation on the role of the accountant from the perspective of the post-graduated in
APPLICANT NAME:	Tatiane dos Santos Costa
SCHOOL/UNIT:	Griffith College Dublin/Graduate Business School
APPLICANT EMAIL:	tatiane.dossantoscosta@griffith.ie
If a student applicant, please provide the following additional information:	
Programme of Study:	MSc in Accounting and Finance Management
Supervisor Name:	
Supervisor Email:	
Section B: Questions	
. Notification Review is reserved for low-risk social studies that fall under the following classifications. Please indicate your project type below:	
Please mark as appropriate:	
	Anonymous Survey (the topic will not elicit significant difficulties for participants)
	Observation (without audio or visual recording) of a public setting
	Questioning participants regarding their opinions on products or services
	Questioning students about standard educational practices
	Study will monitor the impact of participants' daily activities
✓	Questioning public figures/professionals in their professional capacity regarding their professional activities
	Analysis of existing anonymised data which has been provided to the researcher by a third party
	Collection of biological samples which are anonymised and do not require invasive techniques (e.g. hair, nails).
	Other Please explain:
2. Please provide a justification for why your study is considered to be low-risk?	
The responses will not be attributed to the respondents individually in my dissertation. All the results of this research my identity will remain anonymous.	
3. Please describe how your participants will be recruited?	
Participants will be recruited through LinkedIn and Social Media (e.g. WhatsApp Accounting Groups). The professionals subject of this study will be post-graduated professional in accounting/finance based in Dublin and experience experienced professionals in the Robotic Process Automation.	
4. Informing your participants – Plain Language Statement	
Please see appendix A.	
Please confirm whether the following issues have been addressed in your plain language statement for participants:	
	YES or NO
Introductory Statement (PI and researcher names, school, title of the research)	YES
What is this research about?	YES
Why is this research being conducted?	YES
What will happen if the person decides to participate in the research study?	YES
How will their privacy be protected?	YES
How will the data be used and subsequently disposed of?	YES
What are the legal limitations to data confidentiality?	YES
What are the benefits of taking part in the research study (if any)?	YES
What are the risks of taking part in the research study?	NO
Confirmation that participants can change their mind at any stage and withdraw from the study	YES
How will participants find out what happens with the project?	YES
Contact details for further information (including REC contact details)	YES
If any of these issues are marked NO, please justify their exclusion:	
here are no risks associated with participating in this study since the answers will not be identified to each participant in my dissertation	
5. Capturing consent – Informed Consent Form	
Please see appendix B.	

Appendix B – Consent Form

**Griffith College GBS
Informed Consent Form**

A Study of the Effect of Robotic Process Automation on the Role of the Accountant and the Financial Professional from the Perspective of the Post-Graduate in Accounting in The Irish Market conducted by Tatiane dos Santos Costa, a Master student in Accounting and Finance Management at Griffith College Dublin.

I. Clarification of the purpose of the research

This study aims to promote an understanding of the impacts of RPA in the Irish job market from the perception of the postgraduate in accounting and finance (or those who are in the final stage of the course), and whether RPA is reshaping this profession. In this context, to investigate what the possible opportunities and threats that those professionals are facing or will face in the new digital era, specifically in relation to RPA.

Hence, surrounded by the context of RPA innovation in the accounting industry, the objectives of this study are to:

- 1) Investigate which accounting and finance roles are most susceptible to RPA.
- 2) Explore the researcher's assessments regarding the actual and foreseen RPA's impacts on the accountancy profession.
- 3) Determine the necessary competencies (knowledge plus skills) that accountants and finance professionals must acquire to
- 4) Explore accounting professionals' views and actions regarding RPA and innovation effects in their career path.
- 5) Devise recommendations on professional upskilling.

II. Confirmation of particular requirements as highlighted in the Plain Language Statement

Requirements may include involvement in interviews, completion of questionnaire, audio/video-taping of events. Getting the participant to acknowledge requirements is preferable, e.g.

Participant – please complete the following (Circle Yes or No for each question)

I have read the Plain Language Statement (or had it read to me)	<input type="checkbox"/>	<input type="checkbox"/>	Yes/No
I understand the information provided	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Yes/No
I have had an opportunity to ask questions and discuss this study	<input type="checkbox"/>	<input type="checkbox"/>	Yes/No
I have received satisfactory answers to all my questions	<input type="checkbox"/>	<input type="checkbox"/>	Yes/No
I am aware that my interview will be audiotaped and transcribed	<input type="checkbox"/>	<input type="checkbox"/>	Yes/No

III. Confirmation that involvement in the Research Study is voluntary

· I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.

IV. Advice as to arrangements to be made to protect confidentiality of data, including that confidentiality of information provided is subject to legal limitations

- I understand that all information I provide for this study will be treated confidentially.*
- I understand that in any report on the results of this research, my identity will remain anonymous.*
- I understand that disguised extracts from my interview may be quoted in a dissertation work*
- I understand that signed consent forms and original audio recordings will be retained in security arrangements and be accessed only by*
- I understand that a transcript of my interview in which all identifying information has been removed will be retained until 30/08/2020.*
- I understand that under freedom of information legislation, I am entitled to access the information I have provided at any time while it is in storage as specified above.*
- I understand that I am free to contact any of the people involved in the research to seek further clarification and information.*

V. Signature:

I have read and understood the information in this form. My questions and concerns have been answered by the researcher, and I have a copy of this consent form. Therefore, I consent to take part in this research project.

Participants Signature: _____

Name in Block Capitals: _____

Date: _____ / _____ / _____

Appendix C - A Questionnaire for the Semi-Structured Interviews for Postgraduate Professionals (A Group)

A Questionnaire for the Semi-Structured Interviews – Script for Post-Graduate Professionals

First of all, I would like to thank you for taking part in this interview and giving your valuable time. I am very appreciative of the time you have taken to assist in my research and commit to utilising the information provided in the most honest way to complete this study.

Researcher: Tatiane dos Santos Costa, a Master student in Accounting and Finance Management at Griffith College Dublin.

Research topic: A Study of The Effect of **Robotic Process Automation (RPA)** on the Role of the Accountant and the Finance Professional from the Perspective of The Post-Graduate in Accounting in the Dublin Market.

Professional Profile Target: Post-graduate (or in the late stage) professionals in accounting which are based in Ireland

Questions approach: Open-ended divided into blocks. Please feel free to respond to the bellow questions in informal and meaningful manner.

Notes:

Note 1: RPA: "Ranges from a simple to a very complex computer program that is able to automate the input, processing, and/or output of data across computer applications or systems without altering a firm's existing infrastructure. RPA software mimics the actions of a human and can, therefore, be used to complete a variety of tasks, including manipulating data, processing business transactions, generating responses, and communicating with humans (e.g., via email) or other digital systems" (Robotic Process Automation

Note 2: Competencies (Technological, Exceptional Human, Analytical, Technical): This study comprehends a range of knowledge in the accounting and finance field and a set of skills such as communication, work team, programming ability, software implementation ability. As a foundation of these competencies is placed the core of accounting and finance profession (integrity, objectivity, competence and due care, confidentiality and professional behaviour).

Note 3: New Digital Era: "Organisations are no longer questioning whether to digitalise and are instead focusing on how fast they embrace the opportunities and remain relevant to their customers. The traditional digital tools, with which we have long been associated, are being eclipsed by new technologies which are drawing on various data sources and virtually representing data using ML to forecast trends" (ACCA Global, 2020).

Note 4: Digital Era: It refers to the rise of new technologies. Satell (2018) understands this new era as "increasingly incorporate machine learning algorithms as well as new computing architectures, such as quantum computing and neuromorphic chips, that function very differently than digital computers do.

More About ROBOTIC PROCESSES AUTOMATION (RPA) at links below (CTRL+Click)

[What is ROBOTIC PROCESSES AUTOMATION \(RPA\)?](#)

[AccountancyCompetencies](#)

[Predictions2020](#)

[ACCA Future Accountancy](#)

[ACCA Embracing ROBOTIC PROCESSES AUTOMATION \(RPA\)](#)

[UdemyFreeCourseROBOTIC PROCESSES AUTOMATION \(RPA\)](#)

[UipathFreeCoursesROBOTIC PROCESSES AUTOMATION \(RPA\)](#)

[Digital WF Free Course ROBOTIC PROCESSES AUTOMATION \(RPA\)](#)

BLOCK A – QUALIFYING QUESTIONS

- What is your role title?
- How much experience have you as a practising accountant?
- Do you know what Robotic Process Automation (RPA) is?
- Have you ever used RPA?
- If you have not used RPA yourself, are you familiar with the use of RPA in organisations?
- On a scale of 1 to 5 where '1' indicates 'no knowledge' and where '5' indicates 'a lot of knowledge' how do you rate your knowledge of RPA?

1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

BLOCK B QUESTIONS

Theme: Robotic Processes Automation (RPA) - Accounting Roles and Digital Transformation (Related to Objectives 1 and 2 of this study)

- Technological advancements, such as RPA, have been a hot topic among researchers in the accounting and finance field. In your view, can technology, such as RPA, reshape accounting and finance roles and its activities? Please give examples in your answer.
- To what extent do you think RPA is or will reshape the accounting profession?
- What do you recognise as some advantages of RPA to the accounting and finance professional?
- What do you understand as RPA drawbacks concerning the accounting and finance profession?
- In your opinion, which would be the accounting and finance roles most susceptible to RPA?
- What is the perspective of a newly qualified accountant?

BLOCK C QUESTIONS

Theme: Accounting and Finance Competencies (knowledge plus skills) in the RPA era and digital age (Related to the Research Question and Objectives 3 and 4 of this study)

- In your view, what are the roles that accounting and finance professionals are playing in the digital era?
- In this new digital era, what factors do you consider to be crucial to succeed in your career path in the accounting industry?
- In your opinion, does the syllabus in your postgraduate course help or not help you work with RPA in this new digital era? (Could you please write a short note to explain your answer)
- On a scale of 1 to 4 please rate your competencies where:
'1' indicates 'I do not have';
'2' indicates 'I need to improve'
'3' indicates 'It is good'
'4' indicates 'It is very strong'

Competencies

Technological Competencies (E.g. Programming, SQL, IT knowledge)

Exclusive Human Competencies (E.g. Emotional Intelligence, teamwork, communication)

Analytical Competencies (E.g. Solving-problem, critical thinking, making-decision)

Technical Competencies (E.g. Accounting and finance knowledge [intellectual knowledge] and skills [ability to apply

1	2	3	4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

17. Would you notice any changed competencies requirements (knowledge and skills) in the Irish market related to RPA and technological advances?

18. Would you perceive any gap in your competencies that would make you unable to work with RPA? What would that be?

19. Besides digital skill, would you see other skills and knowledge needed to work with RPA? Please, justify.

(E.g.: Technical knowledge, communication skills, teamwork, ethical behaviour, empathy and etc.).

20. Are you willing to learn new skills and knowledge? Which one? Please, justify.

21. If you are not working with RPA at the current moment, would you wish to be working with this in the near future? Why?

22. Would you wish to become specialised in RPA?

Please write a short note to explain your answer.

23. Would you rather build a portfolio of experiences across different technologies that can impact the accounting industry?

Please write a short note to explain your answer.

24. Would you be interested in taking a course in RPA to prepare yourself for the Irish job market? Justify, please.

25. Would you see any risk factor to your career in the Irish market, if you decide not to follow technological trends, such as RPA, as a part of your continuous professional development?

26. Feel free to add extra thought regarding the subject addressed in the above questions.

Appendix D – A Questionnaire for the Semi-Structured Interviews for Experienced Professionals (B Group)

A Questionnaire for the Semi-Structured Interviews – Script for Lecturers and professionals in accounting education field and experienced professionals in Robotic Processes Automation (RPA).

First of all, I would like to thank you for taking part in this interview and giving your valuable time. I am very appreciative of the time you have taken to assist in my research and commit to utilising the information provided in the most honest way to complete this study.

Researcher: Tatiane dos Santos Costa, a Master student in Accounting and Finance Management at Griffith College Dublin.

Research topic: A Study of The Effect of **Robotic Process Automation (RPA)** on the Role of the Accountant and the Finance Professional from the Perspective of The Post-Graduate in Accounting in the Dublin Market.

Professional Profile Target: Lecturers and professionals in accounting education field and experienced professionals in Robotic Processes Automation (RPA).

Questions approach: Open-ended divided into blocks. Please feel free to respond to the below questions in informal and meaningful manner.

Notes:

Note 1: RPA: "Ranges from a simple to a very complex computer program that is able to automate the input, processing, and/or output of data across computer applications or systems without altering a firm's existing infrastructure. RPA software mimics the actions of a human and can, therefore, be used to complete a variety of tasks, including manipulating data, processing business transactions, generating responses, and communicating with humans (e.g., via email) or other digital systems" (Robotic Process Automation

Note 2: Competencies (Technological, Exceptional Human, Analytical, Technical) : This study comprehends a range of knowledge in the accounting and finance field and a set of skills such as communication, work team, programming ability, software implementation ability. As a foundation of these competencies is placed the core of accounting and finance profession (integrity, objectivity, competence and due care, confidentiality and professional behaviour).

Note 3: New Digital Era: "Organisations are no longer questioning whether to digitalise and are instead focusing on how fast they embrace the opportunities and remain relevant to their customers. The traditional digital tools, with which we have long been associated, are being eclipsed by new technologies which are drawing on various data sources and virtually representing data using ML to forecast trends" (ACCA Global, 2020).

Note 4: Digital Era: It refers to the rise of new technologies. Satell (2018) understands this new era as "increasingly incorporate machine learning algorithms as well as new computing architectures, such as quantum computing and neuromorphic chips, that function very differently than digital computers do.

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[UjpathFreeCoursesROBOTIC PROCESSES AUTOMATION \(RPA\)](#)

[Digital WF Free Course ROBOTIC PROCESSES AUTOMATION \(RPA\)](#)

BLOCK A – QUALIFYING QUESTIONS

1. What is your role title?
2. How much experience have you as a practising accountant?
3. Do you know what Robotic Process Automation (RPA) is?
4. Have you ever used RPA?
5. If you have not used RPA yourself, are you familiar with the use of RPA in organisations?
6. On a scale of 1 to 5 where '1' indicates 'no knowledge' and where '5' indicates 'a lot of knowledge' how do you rate your knowledge of RPA?

1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

BLOCK B QUESTIONS

Theme: Robotic Processes Automation (RPA) - Accounting Roles and Digital Transformation (Related to Objectives 1 and 2 of this study)

7. Do you think that your education as an accountant has prepared you well to work in this new digital era?
8. Technological advancements, such as RPA, have been a hot topic among researchers in the accounting and finance field. In your view, can technology, such as RPA, reshape accounting and finance roles?
9. To what extent do you think RPA is reshaping or will reshape the accounting profession?
Please give some examples of how you think RPA is already reshaping or might reshape the accounting profession.
10. Which advantages would you see that RPA can provide to the accounting and finance professional?
11. Which RPA drawbacks would you see concerning the accounting and finance profession?
12. In the case of professionals who are in the earlier career stage (recent post-graduate in accounting or finance), would you think that RPA can impact their career differently?
13. In your opinion, which would be the accounting and finance role and activities most susceptible to RPA?

BLOCK C QUESTIONS

Theme: Accounting and Finance Competencies (knowledge plus skills) in the Robotic Processes Automation (RPA) era and digital age (Related to the Research Question and Objectives 3, 4 and 5 of this study)

15. In this new digital era, what factors do you consider to be crucial to a successful career path in the accounting industry?
16. Why do you think professionals in accounting and finance should upskill in RPA at the current time?
17. Which are the competencies accounting and finance professionals should acquire and develop in order to work with new technologies, such as RPA?
18. What do you believe are the gap areas in competencies, in relation to accounting and finance professionals in the digital age? In other words, what do you think that you would need to know as an accountant to operate effectively with technologies such as RPA in an organisation?
19. Would you already see changes in the Irish market requirements of competencies for accounting and finance professionals?
Please write a short note to explain your answer.
20. To what extent would you think that accounting and finance professionals based in the Irish job market would be at risk if they do not upskill themselves to face the new digital age?

Appendix E – Interviews Overview

Panel 1: Interviewee Overview

Group A participants

Group A participants (Postgraduates in Accounting and Finance)					
Interview No	Interviewee	Interviewee Code	Code Description	Industry/ Field	Country Base
1	Post-Graduate	Q1 PG	Questionnaire - Postgraduate Professional	Accounting and Finance	Ireland
2	Post-Graduate	Q2 PG	Questionnaire - Postgraduate Professional	Accounting and Finance	Ireland
3	Post-Graduate	Q3 PG	Questionnaire - Postgraduate Professional	Accounting and Finance	Ireland
4	Post-Graduate	Q4 PG	Questionnaire - Postgraduate Professional	Accounting and Finance	Ireland
5	Post-Graduate	Q5 PG	Questionnaire - Postgraduate Professional	Accounting and Finance	Ireland
6	Post-Graduate	Q6 PG	Questionnaire - Postgraduate Professional	Accounting and Finance	Ireland
7	Post-Graduate	Q7 PG	Questionnaire - Postgraduate Professional	Accounting and Finance	Ireland
8	Post-Graduate	Q8 PG	Questionnaire - Postgraduate Professional	Accounting and Finance	Ireland
9	Post-Graduate	Q9 PG	Questionnaire - Postgraduate Professional	Accounting and Finance	Ireland
10	Post-Graduate	Q10 PG	Questionnaire - Postgraduate Professional	Accounting and Finance	Ireland
11	Post-Graduate	Q11 PG	Questionnaire - Postgraduate Professional	Accounting and Finance	Ireland
12	Post-Graduate	Z12 PG	Zoom Meeting - Postgraduate Professional	Accounting and Finance	Ireland
13	Post-Graduate	Z13 PG	Zoom Meeting - Postgraduate Professional	Accounting and Finance	Ireland
14	Post-Graduate	Z14 PG	Zoom Meeting - Postgraduate Professional	Accounting and Finance	Ireland

Panel 2: Interviewee Overview

Group B participants

Group B Participants (Experienced Professionals in the Accounting Field and a Expert in RPA)					
Interview No	Interviewee	Interviewee Code	Code Description	Industry/ Field	Country Base
15	Professional	Z15 EP	Zoom Meeting - Experienced Professional	Finance	Ireland
16	Salesman	Z16 SP	Zoom Meeting - Salesman Professional	RPA development	German
17	Professional	Q17 EP	Questionnaire - Experienced professional	Accounting	Ireland
18	Recruiter Accounting	Q18 RP	Questionnaire - Recruiter Professional	Recruitment (Accounting and Finance)	Ireland
19	Lecturer	Q19 LP	Questionnaire -Accounting Lecturer Professional	Education (Accounting and Finance)	Ireland
20	Lecturer	Q20 LP	Questionnaire -Accounting Lecturer Professional	Education (Accounting and Finance)	Ireland
21	Lecturer	Q21 LP	Questionnaire -Accounting Lecturer Professional	Education (Accounting and Finance)	Ireland
22	Professional	Q22 EP	Questionnaire - Experienced professional	Finance	Ireland
23	Professional	Q23 EP	Questionnaire - Experienced professional	Accounting and Finance	Ireland
24	ACCA Manager	Q24 AB	Questionnaire - Accounting Body Member	Professional Certification (Accounting and Finance)	Ireland

Source: Author (Data collection and analysis in the period between Apr and May 2020)

Appendix F - Data Analysis and Sample Quotes about Technological Competencies Needed to Work in the RPA Era

Panel 3

Example Quote	Participant Group	Code
"I should be more familiar with latest trend/improvements in technology and must know how to operate them since most companies now require that you have knowledge and experience of certain technology in assessing whether you're qualified for the job or not" (Q8 PG).	A	Skills Gap
"Ireland is a very technologically savvy nation, and not following technological trends will be a weakness and limitation (...) We need to have our digital skills in accordance with technological trends" (Q9 PG).	A	Skills Gap
"I think we need to update ourselves, not only about laws and compliance, but also with technology. We need to open our mind to new ways of working" (Q11 PG, Pos. 1).	A	Skills Gap
"I think the programming language skills is a big gap (...) I know there is a lot to learn not only in programming but also in RPA knowledge and other digital skills"	A	Skills Gap
"We have to learn how to use these technologies as well, to learn tools like how to program these RPA, develop I.T. skills (...) on the accounting aspects and evolve in the same way as technology (...) to fulfil that need of new digital era" (Z13 PG).	A	Skills Gap
"I think I need to learn to work with some software and programming (...) For accountants, programming is an important thing at the moment. I lack programming skills. I would be glad to learn about it" (Z14 PG).	A	Skills Gap
"(...) We're already seeing the employment of a lot of information systems and a lot of technology. So we would probably reach a point where rather than carrying out only your accountancy duties, you will also have to be able to maybe train a robot or program a robot to do some tasks for you because the company is as decided to invest more in in technology. (...) So the ability to deal with technology every day and the ability to understand how technology works and how you can benefit from technology" (Z15 EP).	B	Competencies Needed to be Improved
"Accounting and finance professionals would need to be familiar with the specific technologies that organisations are using (...) professionals should stay updated with new technologies and embrace changes in order to add value to their organisation and be involved in any transformation that might happen" (Q18 RP).	B	Skills Gap
"It's also true that the employees need to gain the skills required in order to be up to speed with this evolution. (...) IT knowledge are increasing in importance. Now a lot of jobs require to accountants and analysis the ability to run SQL queries, for example" (Q17 EP).	B	Competencies Needed to be Improved
"I believe there is a shortage of RPA skills and knowledge in accounting and finance graduates especially RPA implementation and software coding skills. At the initial adoption stage it is not unusual for organisations to rely on external third parties to assist with initial RPA implementation and software coding, but typically capability is then transferred to the internal team. This requires significant knowledge transfer and can take time and would be a welcomed skill for graduates to have" (Q24 AB).	B	Skills Gap
"Accounting professional have a poor computer literacy and a lack of understanding of how and when to use technology for benefit" (Q23).	B	Skills Gap

Source: Author (Data collection and analysis in the period between Apr and May 2020)

Appendix G - Data Analysis and Sample Quotes about Analytical Competencies Needed to Work in the RPA Era

Panel 4

Example Quote	Participant Group	Code
"Accountants are more on the analysis part and are expected to make timely and detailed useful reports of the results of the operations of the business as recent developments in technology already make their lives easier" (Q8 PG).	A	Skills Required
"Accounting professional will have to develop new digital skills in addition to those already expected. This professional will have to be able to work with the new digital tools, in order to add this knowledge with those already acquired to maximize their performance and results" (Q5 PG).	A	Skills Required
"Critical intelligence might be applied to add value to our companies in this new digital era" (Q2 PG , Pos. 1)	A	Skills Required
"Technology repurpose workforce towards a more value added or value adding jobs that require more need of thinking outside of the box, which normally drives enormous value for it for society overall. (...)So, attention to detail, the ability to flag errors or identify mistakes or demand functioning also of software. Definitely, it is very required in the Irish companies" (Z15 EP).	B	Skills Required
"RPA free professionals up, for instance, you analyse reports so you don't do report. But to analyse reports, you will say that this report is telling you this and that. So they are really, really adding value to the numbers. Not only tranced, transmitting numbers from one place to another one. Professionals must show that they understand what the numbers are meant (...) you must be able to do this from now on to be considered valuable for your company's" (Z16 SP).	B	Skills Required
"Professionals should become aware of the importance of controlling tasks in order to understand if the output of a robot does not make sense or it's not correct" (Q17 EP).	B	Skills Required
"In the new digital age, analytical mindset is crucial to succeed in accounting career" (Q20 LP).	B	Skills Required
"Accountants must have the ability of review data, analyse it and prepare useful information from it - both numbers and narrative. Being able to explain the meaning of numbers and trends to the required audience." (Q21 LP).	B	Skills Required

Source: Author (Data collection and analysis in the period between Apr and May 2020)

Appendix H - Data Analysis and Sample Quotes about Technical Competencies Core Professional Principles Needed to Work in the RPA Era

Panel 5

Example Quote	Participant Group	Code
"Accounting technical knowledge is essential to remain relevant in our profession" (Q4 PG).	A	Technical Skills
"I also try to keep my accounting knowledge updated. I think it is important to adapting to new technologies" (Q10 PG).	A	Technical Skills
"I believe we need to study much more accounting fundamentals (...) and to adapt to this new era" (Q11 PG).	A	Technical Skills
"I think you need to know the accounting theory properly. It has always been important. We need to know the theoretical aspect to be able to manage RPA and processes" (Z13 PG).	A	Technical Skills
"I think that my ACCA studies will help me to manage better robots when I be required" (Z14 PG).	A	Technical Skills
" Professionals should acquire a deep understanding of integrated accounting in this transformational era" (Q19 LP).	B	Skills Required
"Professionals need to have technical skills and abilities to perform activities consistently to a defined standard while maintaining the highest standards of integrity, independence and scepticism" (Q24 AB).	B	Skills Required

Source: Author (Data collection and analysis in the period between Apr and May 2020)

Appendix I - Susceptible Accounting and Financial Roles - Participants' Opinion

Susceptible Tasks and Roles	Number of Time Role Mentioned - Group A Participants	Participant Code	Number of Time Role Mentioned - Group B Participants	Participant Code	Some Literary References
<i>Accountant Assistant</i>	4	Q2 PG; Q5 PG; Q6 PG; Q10 PG	3	Q22 EP, Q23 EP; Q24 AB	(Haenlein and Kaplan M., 2019)
<i>Accounts Payable and Receivable</i>	3	Q4 PG; Q8 OG; Q9 PG	7	Z15 EP; Z16 SP; Q20 LP; Q21 LP; Q22 EP; Q23 EP; Q24 AB	(Deloitte UK, 2015); (Anagnoste, 2017)
<i>Audit Trainee</i>	1	Z14 PG	0	N/A	(Cooper et al., 2019)
<i>Bookkeeper</i>	3	Q3 PG; Q6 PG; Q11 PG	0	N/A	(PwC, 2016); (Haenlein and Kaplan M., 2019)
<i>Entry-levels</i>	1	N/A	1	Z15 EP	(Deloitte UK, 2015).
<i>Payroll Administrator</i>	4	Q5 PG; Q8 PG; Q9 PG; Z14 PG	2	Z16 SP; Q20 LP;	(Deloitte UK, 2015); (Cloudpay, 2018)
<i>Tax Preparer</i>	1	Q4 PG	0	N/A	(Cooper et al., 2019); (Mezzio et al., 2019); (Santos et al., 2019)

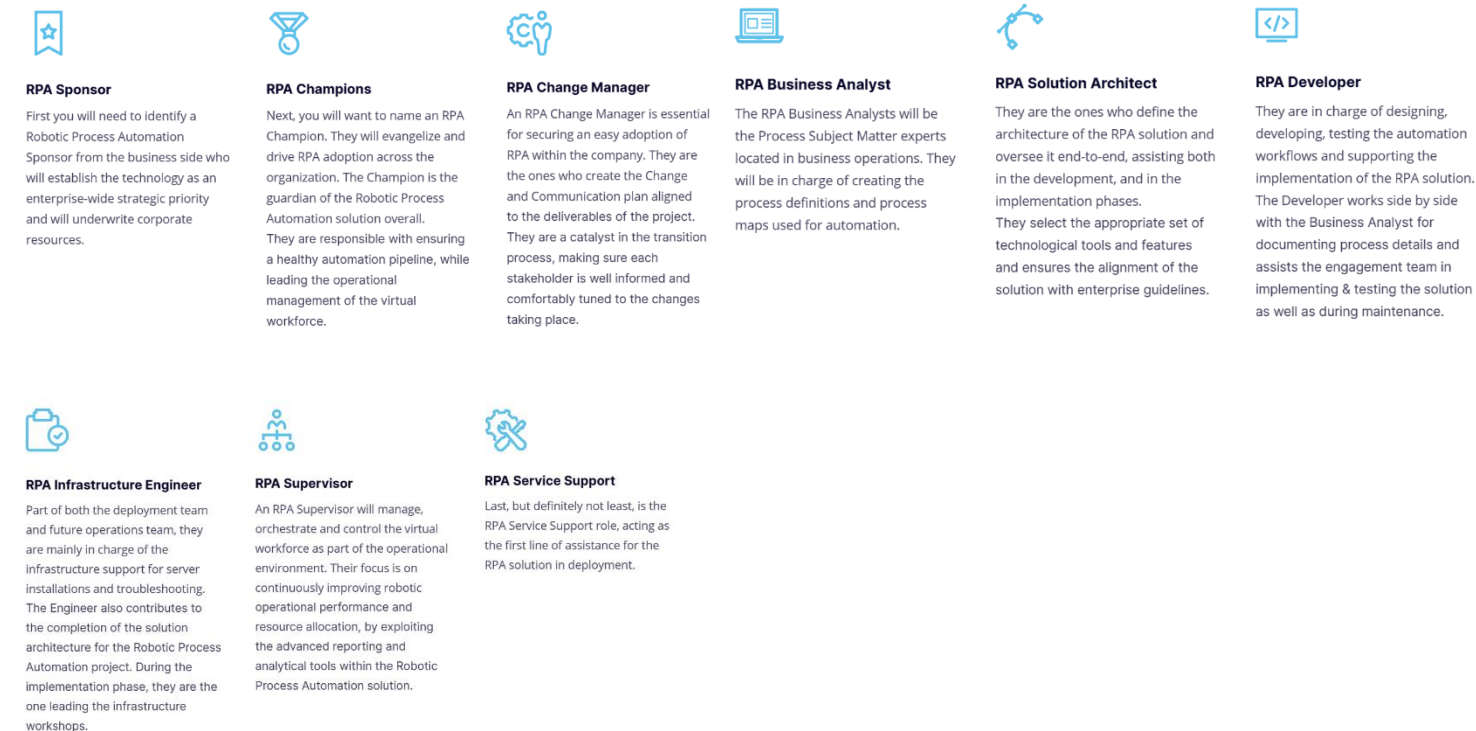
Source: Author (Based on data collection and analysis in the period between Apr and May 2020 and the literature review)

Appendix J - Data Analysis and Sample Quotes on Recommendation to Accounting and Finance Professionals Concerning Preparation for this New Digital Age

Example Quote	Participant Group	Code
"I would stress just with one final sentence is, is that at the university we tend to focus more on just hard skills. And that is important because you won't be able to take on any job if you don't possess those skills. But we don't have to lose sight of what is becoming more and more important. And even probably more important, like the use of technology, as well as the ability to interact effectively with the with the people around us. So that's my that's my advice" (Z15 EP).	B	Recommendations
"Take on any opportunity to get involved in projects outside of day to day accounting in your current job. Keep up to date with what is happening in Big 4 firms, they are generally to the fore of new technology and innovation. Be curious and always learning, see this as an opportunity rather than a threat!" (Q18 RP).	B	Recommendations
"Nowadays we have a lot of free resources, free university and tutorial on the web. People should use them. I have personally learned SQL query and database management with Youtube's videos" (Q17 EP).	B	Recommendations
"Keep up to date with contemporary issues" (Q19 LP).	B	Recommendations
"See it as an opportunity, not a risk or threat to your career/profession. Learn how to harness it and help you to achieve more and obtain greater job satisfaction" (Q21 LP).	B	Recommendations
"There is significant opportunity to retrain and redeploy finance staff and leverage their analytical skills for sharper predictive insights to better inform decisions" (Q24 AB).	B	Recommendations
"See it as an opportunity, not a risk or threat to your career/profession. Learn how to harness it and help you to achieve more and obtain greater job satisfaction" (Q23 EP).	B	Recommendations

Source: Author (Based on data collection and analysis in the period between Apr and May 2020 and the literature review)

Appendix K – Center of Excellence (CoE) Structure



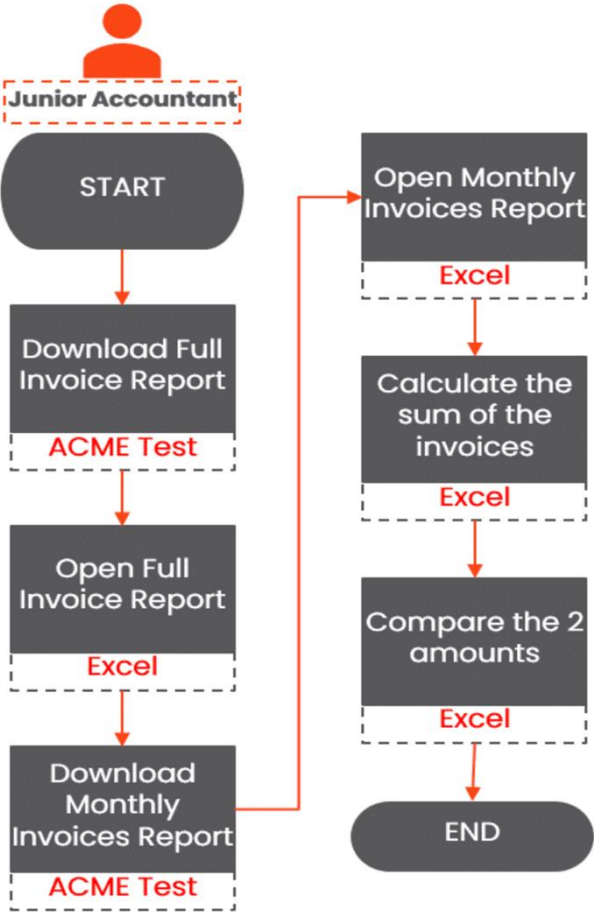
Source: (UiPath, 2018)

Note:

CoE is a group of professionals built in the organisation that will deploy RPA. It aims at the successful implementation of the RPA, incorporating the RPA efficiently and accumulating knowledge to improve and apply in future implementations (Anagnoste, 2018).

Appendix L – Reconciliation Process – Human vs RPA

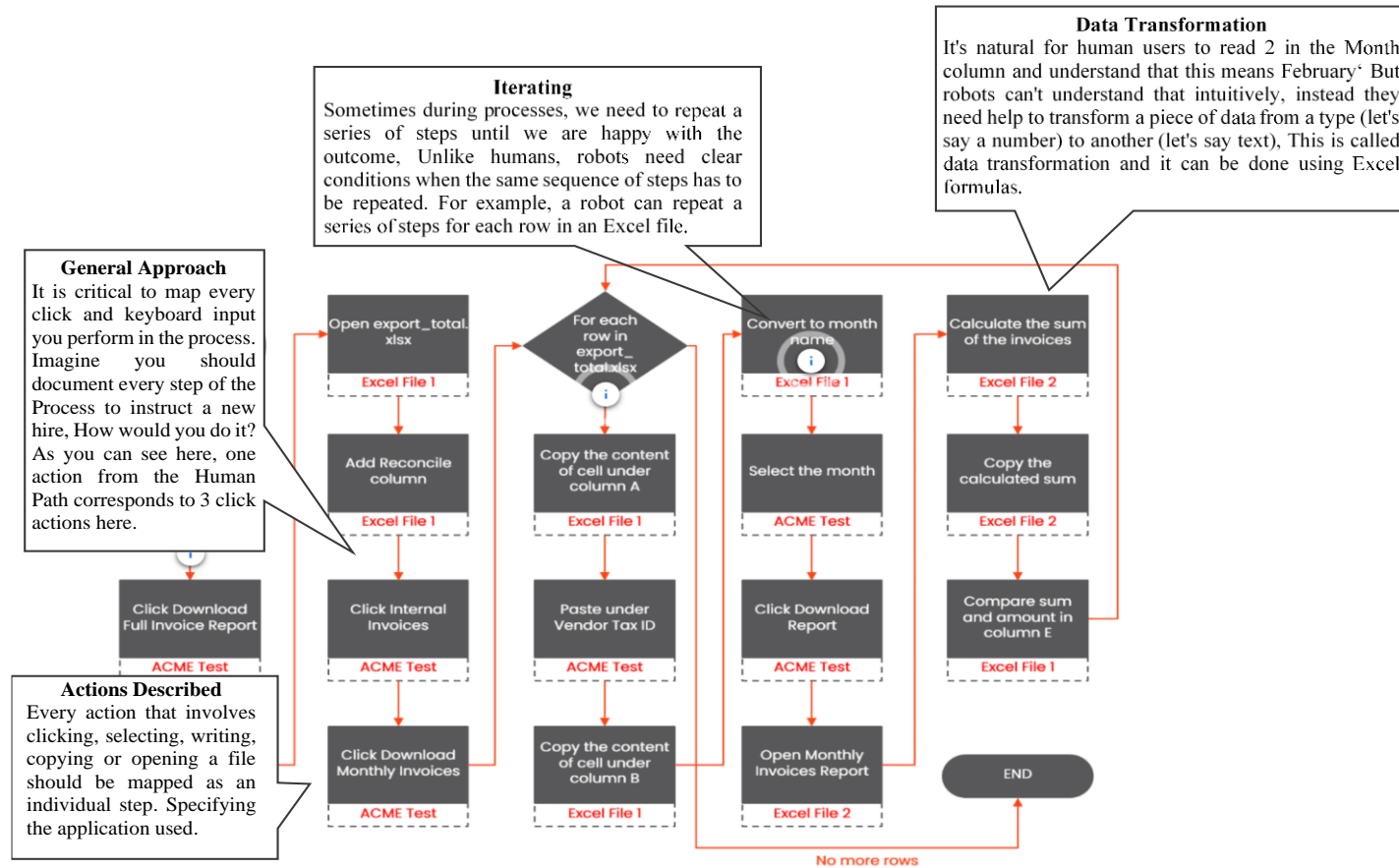
Human – One Day’s Revenue Reconciliation Equal Five Days’ Human Labour



Source: (UiPath, 2020 ACME Test Course)

Appendix L – Reconciliation Process – Human vs RPA

RPA – One Day’s Revenue Reconciliation Equal Four Hours Digital Workforce (UiPath RPA – Step by Step Automation)



Source: (UiPath, 2020 ACME Test Course)

