Master's Degree in Management

Final Thesis

Changes in competencies, capabilities, and decision-making in the accounting profession as a result of information digitalization, big data analytics, and artificial intelligence

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Abstract

The exponential growth of Big Data Analytics, Information Digitalization, and Artificial Intelligence is pushing businesses to reconsider their Human Resource (HR) standards. Therefore, the main question for accounting scholars and professionals becomes: What changes in competencies, capabilities, and decision-making in the accounting profession lead by information digitalization and big data analytics/artificial intelligence?

The dissertation aims to answer this concern by reviewing numerous publications and articles on the topic and comparing the information stated in academic papers with the realistic demand from companies by analyzing 300 samples from job postings in the US market. The dissertation studied the effects of Industry 4.0 technologies on the accounting profession. Furthermore, by analyzing data from job postings, this dissertation studies the employers' expectations of specific knowledge and skills from controllers/accounting managers.

The main purpose of this study is to help current and future accountants to have a better picture of the market. This study can also help companies and universities to gain insights on how to adjust to match the demand and supply of the marketplace.

From the literature review, the replacement of human activities with machines and robotics in repetitive tasks in accounting is expected, especially for financial accounting. Therefore, accounting practitioners see a need for change and innovation. Accountants must focus on constant learning and self-improvement, especially in gaining knowledge in data analysis.

Furthermore, academics and universities must integrate various accounting technology and simulations applicable to the Industry 4.0 context into their teaching and learning practices. Educators need to collaborate with companies to get in touch with the expectation of the market.

This study also specifies the skill set that the employers are looking for at both the technical level and the impersonal level.

Keywords: Artificial Intelligence; Controller; Managerial Accounting; Big Data, Data Analytics; Blockchain; Digitization, Cloud-based, Software, Accounting Education, Accounting Job Posting.

1. Introduction

The world is constantly changing, and so many factors affect our future, and job security is one of the most concerning elements that comes together with the new invention of technology. We all know that some jobs will be replaced by artificially intelligent, robots and machines and at the same time, new jobs will be created. We certainly need to constantly learn and improve ourselves so that in any circumstances, we will be able to secure our job and our value in society. When these concerns come to the accounting profession, there are many questions that accountants have been asking:

- What kind of opportunities and challenges do the new technology and AI present?

- How can accounting educators prepare their students for the future?

- What does the accounting job advertisement tell us?

There are numerous research and publications on the topic of employability skills demanded of accounting students in the Industry 4.0 era. Some research scholars highlight that accounting programs either fail to satisfy the expectations and demands of employers or are out of touch with the requirements of reality (Bui and Porter, 2010).

According to Lawson et al. (2013), most accounting curricula focus on educating graduates for entry-level accounting positions rather than long-term career objectives. Students participate in accounting degree programs not just because they are interested in the topic, but also because they believe that the skills they will learn will strengthen their employability in the future (Stewart and Knowles, 2001). This highlights the critical role of educators in accounting.

However, there is some disagreement among accounting scholars: some say that employability skills should be fostered in the accounting curriculum, and others argue that certain generic skills are best learned and applied in the workplace rather than in a university setting (learning by doing concept) (Collison and Gray, 2002).

According to Bhimani and Willcocks (2014), new technologies such as big data, predictive analytics, AI, blockchain, machine learning, and robotics are disrupting management accounting, as are many other disciplines. Accountants wonder if they have the necessary knowledge and skills to grow their careers in this era of new technology, and they want to know what essential technical and soft skills they need to succeed in their role.

First, this dissertation aims to answer questions by looking at the literature. Second, by analyzing 300 jobs posted from different states in the USA, it analyses what employers are expecting when they

recruit controllers and managerial accountants (MAs). Third, the dissertation concludes with the finding and discussion of the data analysis. Finally, some useful insights will be addressed with the hope to bring some helpful information to accounting students, the accounting profession, and accounting educators.

2. Research objectives

The research objectives serve as a road map for this dissertation. They emphasize the study's intention and purposes; they keep the dissertation on track and in line with the key goals. The dissertation's ultimate aim is to address the following questions:

- What kind of opportunities and challenges do the new technology and AI present?

- How can accounting educators prepare their students for the future?

- What does the accounting job advertisement tell us?

3. Literature review

3.1. Industry 4.0

We are in the early stages of the fourth industrial revolution, known as Industry 4.0, which is distinguished by the rapid growth and integration of technological advancement. Every day, billions of people are linked by smartphones and computers, which provide low-cost access to expanding computing power, massive storage capabilities, and a huge amount of information.
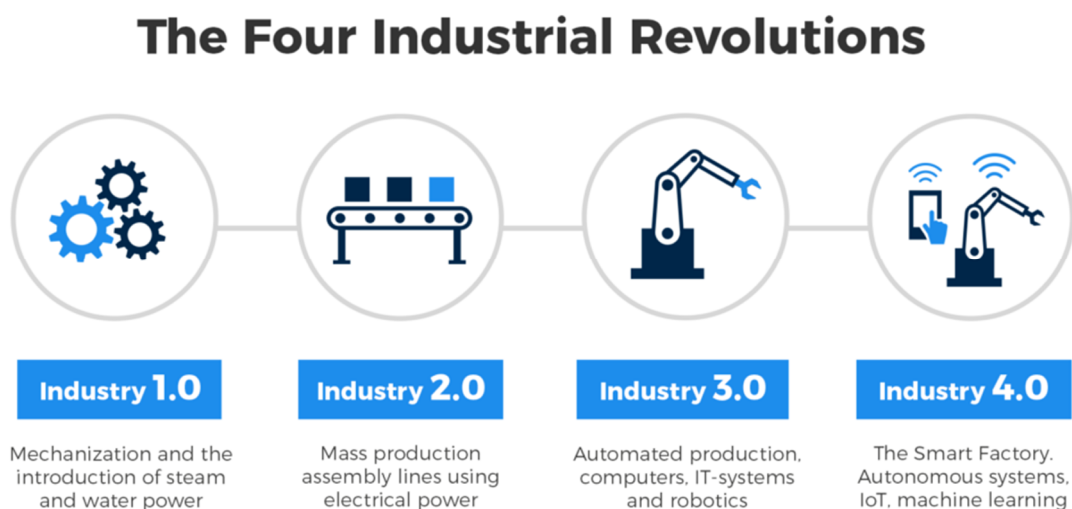
Figure 1. The Four Industrial Revolutions. Source: spectralengines.com

Many businesses anticipate a significant rise in operational efficiency and productivity as a result of a combination of high-tech and innovative technologies such as Artificial Intelligence (AI), Block chain, Cloud computing, Machine Learning (ML), Internet of Things (IoT), Big Data and data analytics, Robotics, among others.

Speedy technology advancements will have an influence on several industries, including the entire supply chain, logistics, manufacturing, automobiles, communication and information, banking and finance service, and medical services.

Many technological developments associated with Industry 4.0, according to researchers, will certainly transform the accounting profession, the characteristics of accounting work, and the future roles undertaken by accountants (Moll and Yigitbasioglu, 2019).

Figure 2: The fourth industrial revolution by dat4zero.eu

The purpose of this chapter is to present a broad theoretical foundation for explaining the influence of those advancing technologies including AI, Cloud Computing, Machine Learning, Block chain Technology, and Big Data will have on accounting procedures and professional practice, including the job market and accounting career options. This chapter is built on a review of academic papers and industry publications to provide a comprehensive picture of the effects of Industry 4.0 on accounting systems and professional practice. This study concentrated on the operational and strategic aspects of accounting practice's digital transition, with a focus on management accounting.

3.1.1 Blockchain technology

Blockchain, as the name implies, is a chain of blocks containing information. This technology was first developed in 1991 by a group of researchers and used to timestamp digital documents so that they could not be backdated or tampered with. However, it became only well-known only when Satoshi Nakamoto adapted it to develop the cryptocurrency Bitcoin (Nakamoto, 2008).

According to the Centre of International Governance Innovation (CIGI)[1], *block chain* is a term that refers to a group of distributed ledger systems that can be designed to track and record anything of value, from financial data to medical data, to land ownership. The blockchain contains information

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[1] www.cigionline.org

in groups called blocks, which are sequentially connected to form continuous lines, or metaphorically, a chain of blocks. If the data in a given block is changed, the block is not rewritten; rather, the change is recorded in a new block that states that A changed to B at a certain date and time.

Blockchain is based on the centuries-old general financial ledger system. It is a non-destructive method of monitoring data changes over time. Unlike the traditional ledger technique, which was originally a book and later a database file kept on a single system. Blockchain was created to be decentralized and shared over a wide network of computers.

The possibility to tamper with data is reduced when information is decentralized. And what distinguishes blockchain is that it builds trust in data. A few things must occur before a block may be added to the chain (CIGI, 2018).

To begin, a cryptographic puzzle must be solved, which results in the creation of the block. Proof-of-work occurs when the computer that solves the puzzle shares the solution with all the computers in the network. The network will then validate this proof-of-work and add the block to the chain if it is valid.

Because the network accomplishes trust-building, people have the chance to interact directly with the data in real-time thanks to the combination of these complicated mathematical puzzles and verification by multiple computers.

The Centre of International Governance Innovation explained another factor that contributes to blockchain technology's significance is the elimination of middlemen. People typically do not show others their financial or business records when doing business instead, they rely on a reputable intermediary, such as a banker or a lawyer, to analyze the documents and keep the information confidential. These intermediaries foster confidence between the parties and reduce risk and exposure, but it also adds up to time and money invested.

This form of trustworthy peer-to-peer interaction with data can change how people access, verify and transact with each other. Furthermore, blockchain is a sort of technology rather than a single network, it can be applied in different ways. Some blockchains can be entirely public and accessible to everybody. Others can be restricted to a small number of authorized users, and there are also hybrid public-private blockchains.

The combination of these reasons - decentralizing data, increasing trust in data, and allowing individuals to interact directly with data - gives blockchain technology the potential to underlie the ways we work and interact.

Many scholars believe that blockchain technology can alter the accounting profession and the structure of accounting information systems, help in the detection of fraud in financial statements, boost productivity, and real-time operation, and raise audit assurance standards (Dai and Vasarhelyi, 2017).

The system might start implementing what is known as a triple entry accounting method, in which each two-party transaction is validated by an intermediate, resulting in an extra third verification entry (Schmitz and Leoni, 2019). The technology's authentication of transactions is being done transparently using a verification method that inhibits tampering with entries.

According to Atanasovski et al. (2020), many businesses now use Enterprise Resource Planning (ERP) systems for transaction tracking and reporting, with installed information technology (IT) controls that make it difficult to manipulate transaction data and distort operational outcomes. However, because there is no significant requirement in the structure to publicly confirm the exact nature of the transaction, corporations may typically impact earnings retrospectively in a typical ledger setting by adding additional backdated entries.

If blockchain technology is used, it has the potential to significantly alter how accounting professionals plan and carry out assurance processes. Since the birth of Bitcoin, blockchain technology has evolved through numerous stages.

The first phase is focused on cryptocurrencies and the possible disruption of global financial and payment networks.

The second stage is smart contracts, which are small autonomous computer programs on the blockchain that run automatically when contracts are fulfilled. Smart contracts lower the contract execution costs by enabling tamper-proof execution and preventing contract parties from engaging in random activity and fraud (Atanasovski et al, 2020). Smart contracts can also be used on accounting blockchain to increase accounting efficiency and automated accounting process.

Even if blockchain technology has the potential to automate audit and assurance operations, auditors' professional judgment is still required to evaluate complicated accounting cases and manage the evaluations of the financial statements.

Auditors will still need to collect proof of the presence of transactions recorded on the blockchain and validate the coherence of recorded data with the real world (Atanasovski et al, 2020).

Many organizations, governments, and regulators have undoubtedly grasped the promise of blockchain technology, and there is investment enthusiasm among tech company executives.

However, there are several constraints to wider and faster adoption across a variety of companies and uses.

Among the technology's flaws are its lack of scale, the requirement for processing power, and high transaction costs, as well as compatibility and secrecy (Atanasovski et al, 2020).

3.1.2 Cloud computing

Cloud computing refers to the delivery of computing resources as readily available services through the internet rather than traditional IT systems, such as selling and installing software/hardware and increasing the capacity within organizations.

Cloud computing services are broadly classified into three types, according to Atanasovski et al. (2020):

- Cloud service of data storage: This involves storing and managing massive amounts of data online on the cloud service provider's server.

- Cloud service of application software: in which the cloud service provider provides various business software tools and apps online to handle business processes such as customer relationship management (CRM), sales, purchases, or human resource management (HRM).

- Cloud service of the infrastructure/platform category, in which a cloud service company provides computing services for system software and computer hardware, including network systems, operating systems, and security.

According to Atanasovski et al (2020), from an accounting perspective, an increasing number of businesses of differing sizes rely on cloud-platform software. Accountants and other staff save time by backing up their data using cloud solutions, and they can access data and information from anywhere at their convenience as long as they have an internet connection.

Many cloud solution providers are rapidly providing mobile apps to help managers with control, management, and data analytics.

In comparison to classic customized ERP solutions that may differ widely across multiple subsidiaries, cloud ERP is more of a prepackaged solution for multinational organizations and enables greater integration of the accounting information system on a global level.

Cloud accounting software means greater flexibility and massively improved accounting productivity for small and medium-sized accounting firms because they must spend less time

communicating accounting information with customers. After all, the customers have direct access to up-to-date data to assist their financial decision-making.

According to Cong et al. (2019), the ERP market is shifting as newer, more mobile, and technologically aware market entrants take considerable market share from larger, less agile enterprises that have previously dominated the sector.

The choice to migrate to cloud accounting software is not without downsides and limits that organizations must evaluate. Generally, the service reliability of the cloud provider and the internet are a major concern for users (Atanasovski et al, 2020). Furthermore, data confidentiality and security are pressing matters, because users may have worries about how their data is being treated or perhaps being stolen.

According to Strauss, Kristandl and Quinn (2015), worries regarding data safety and security are the major factors for not leveraging cloud technology for financial accounting procedures.

Cloud service customers should additionally evaluate service performance quality, data ownership, and regulatory compliance issues. Many organizations may prefer to establish in-house capability rather than employ a cloud solution to keep complete control over data and information sharing with regulatory authorities. Authorities may have easy access to and immediately share data and information with the cloud service provider, depending on the jurisdiction, which can sometimes be unfavorable for cloud service customers.

The cloud service provider also faces additional going concern risk; if the cloud service provider substantially disrupts its operations or goes bankrupt, it may cause significant interruption or even threaten user companies' operational continuity. Businesses may also be trapped with a certain vendor as a cloud service provider, that is unable to change quickly the supplier without facing large expenses or upgrading whole systems (Strauss, Kristandl and Quinn, 2015).

The affordability and other advantages make cloud accounting solutions more appealing to small and medium-sized businesses, which often lack the resources to spend lots of money on IT infrastructure. Many small firms worldwide are using cloud solutions for single or multiple business operations, such as transaction accounting, financial management, and financial information preparation.

3.1.3   Big Data and Analytics

Big data are enormous datasets that exceed the capacity of relational databases and the capabilities of traditional database tools and software to handle and analyze the data efficiently.

The growth of current digital technologies, particularly mobile, computer and internet technology, has advanced the massive rise of data collection and contributed to the emergence of the big data trend. Nowadays, global data production doubles every eighteen months, and organizations have gathered more data in the last two years than they have in the past 2000 years (Warren, Moffitt and Byrnes, 2015). Data becomes a valuable asset for companies in different industries.

A broader perspective is required to fully grasp the concept of big data because it encompasses not only data, data storage, and computational capability. But also include a new generation of IT tools and data analytics, the identification of economic, social, and technical configurations, and the provision of valuable and actionable insights.

According to Atanasovski et al. (2020), big data is defined as high-volume, high-velocity, and/or high-variety information assets that require cost-effective and innovative types of information analysis to deliver greater insight, decision-making process, and automation.
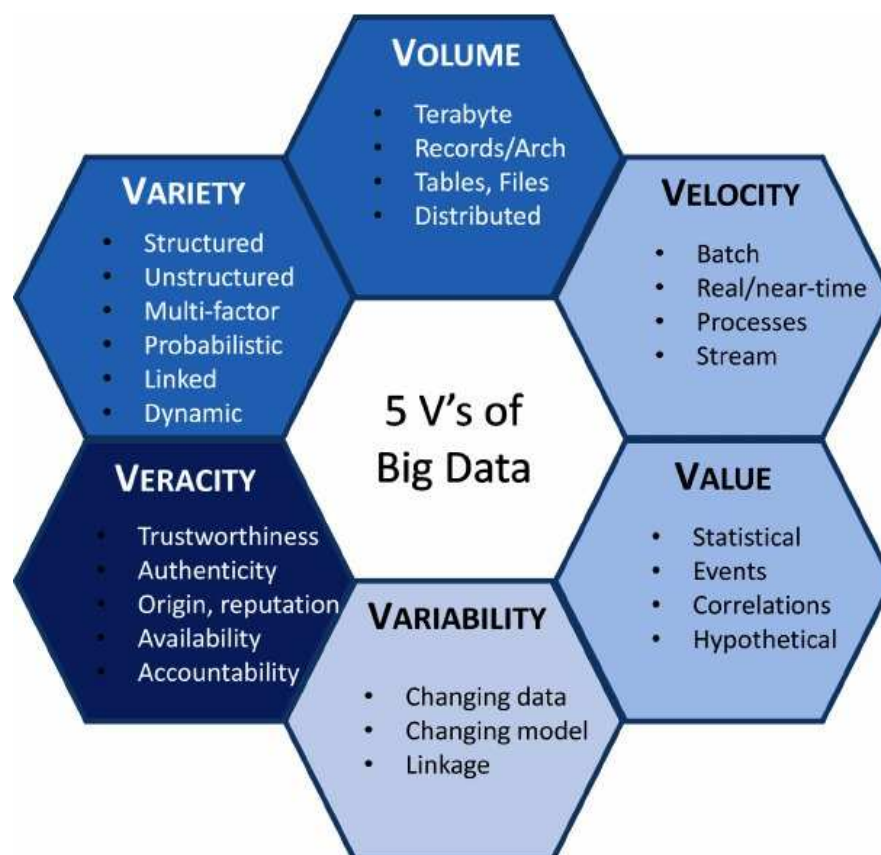

Figure 3: The 5V's of Big Data. Source: Moura and Serrão (2015).

Volume, Velocity, and Variety are the three **Vs** that characterize big data as a massive volume of data generated from various sources.

- Volume refers to the size of the data in terms of massive storage needs or a high number of records.

- Velocity refers to the rising rate or frequency at which data is being gathered and transmitted.

- Variety denotes a wide range of data types, including structured and unstructured data such as e-mail messages, social media postings, phone conversations, website traffic, GPS data, photographs, and videos. The data comes from various sources, including industrial and individual sensors, satellites, social media feeds, pictures, and data generated by numerous internet sources and physical equipment (GPS, phone signals, cameras, etc.).

Additional Vs, such as Veracity and Value, have been included over time (White, 2012).

White (2012) emphasizes the significance of big data's veracity element, which is the quality of data and the amount of trustworthiness in the data's various sources. If big data is of poor quality, when combined with other information, a misleading linkage may be formed, leading to inaccurate business analysis and decision-making. The value dimension of big data is concerned with the hidden economic benefit that must be recognized, translated, and extracted through the analysis of a greater volume of structured and unstructured non-traditional data.

Exogenous data from sources such as social media, locational data, web traffic analytics, and electronic sales data influence investor decision-making in addition to financial statements (Cong, Du and Vasarhelyi, 2019).

Corporate reporting may adapt its approach and expedite its shift toward real-time reporting with an emphasis on prospective relevant information by using Big Data analytics (Atanasovski, Bozhinovska Lazarevska and Trpeska, 2020).

There are some considerations when incorporating big data in accounting analysis, such as accountants' capabilities to use tools and technology to analyze data, integrate and correlate big data with traditional financial and non-financial data, and capabilities to adapt accounting tasks and measurement practices accordingly.

Instead of employing traditional customer satisfaction surveys, the MA might use the technology to collect and analyze textual data from social media to evaluate product performance and consumer experience.

Big Data analysis has the potential to extend and strengthen the system's performance measures. Analysis of customer social media posts, review posts on other web pages, and the voice tone of client care conversations might give useful information from the customer satisfaction evaluation.

Social media (Facebook, Instagram, Twitter, Tiktok, etc.) are growing fast and are valuable sources of textual data that, if properly analyzed, may deliver excellent information to help decision-making. Customers' posts on corporate websites, chat forums, audio data from phone conversations, and video reviews put on the internet by consumers and bloggers might all contribute to the study.

MAs are in charge of developing management control systems that collect data and analyze whether employees' performance and behavior correspond with company goals.

If the organizational management control system is based on the popular balance scorecard structure then the management will want to have powerful decision-making information that assesses organizational performance in terms of finances, customers, internal business processes, learning and expansion, and so on.

Warren et al. (2015) described that Big Data has the potential to turn traditional management control systems into complete monitoring control systems. Big Data analysis may inspire more firms to shift away from typical inward-focused budgeting efforts and toward beyond-budgeting approaches.

Outside of the internal ERP system, new information sources and data can help optimize operational planning, performance evaluation, communication, and the creation of targets and strategies. Big Data also has the potential to disrupt and change the audit and assurance services tasks.

Big Data analytics is being employed by a growing number of firms that have chosen to count more on technologies when supplying goods and services to a broad client base.

Big data analytics can strengthen fraud risk analysis systems and their capacity to detect employee fraud. Text mining and analysis of employee e-mail exchanges might detect dissatisfied employees and more accurately identify corporate fraud risk (Holton, 2009).

Other Big Data analytics techniques that can be used to build fraud detection models in financial statements include supervised and unsupervised neural networks, genetic programming, sentiment analysis, natural language processing tools, support vector machines, and statistical logistic regression models (Gepp *et al.*, 2018).

3.1.4   Artificial Intelligence and Machine Learning

The use of AI in accounting and auditing is not a new notion, having begun in the early 1960s, but recent developments in information and technology connected to big data and low-cost processing power will boost the technology's potential influence.

In a report named "Sizing the prize: What's the real value of AI for your business and how can you capitalize" created by PwC (2017), it is stated that AI may add up to $15.7 trillion to the world economy by 2030, more than China and India's existing production combined.
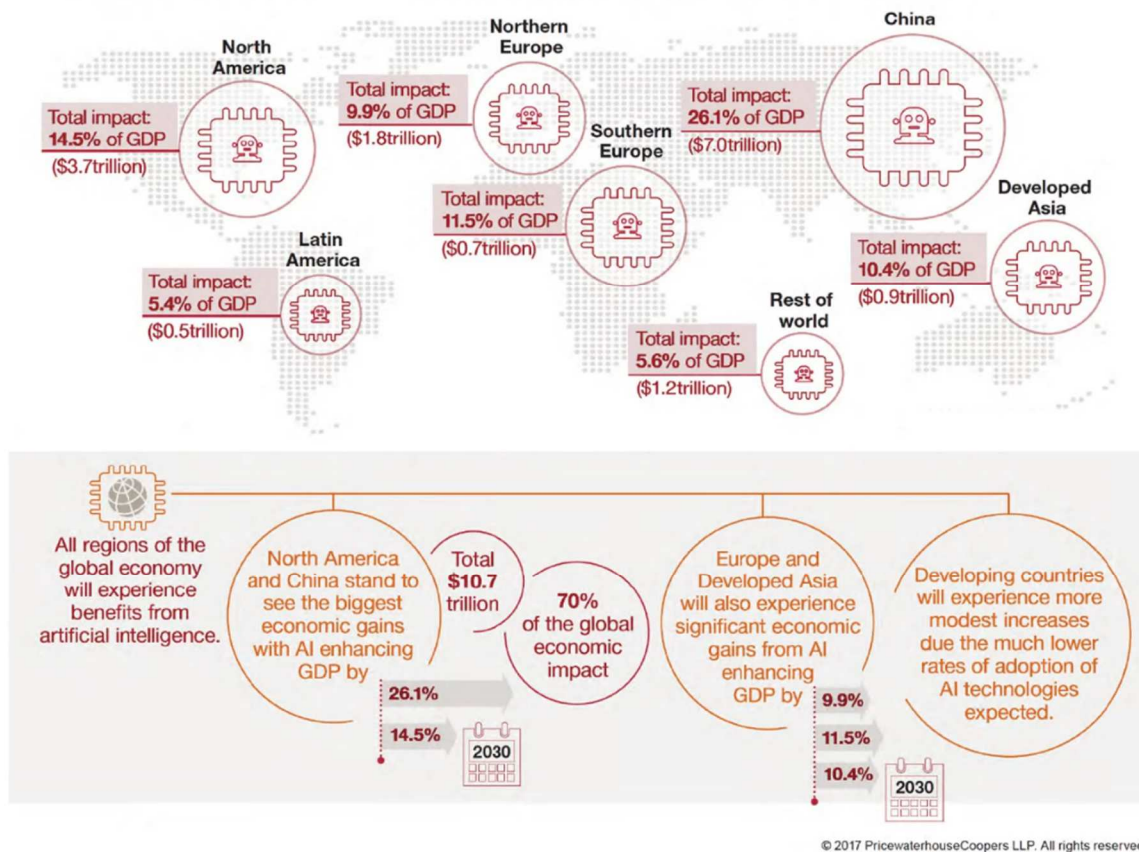
Figure 4: Total economic impact of AI in the period to 2030. Source: PwC analysis

Increased productivity is expected to generate $6.6 trillion, while consumption-side impacts are expected to generate $9.1 trillion. Though certain industries, segments, and individual organizations are further advanced than others, AI is still in its early stages. From a macroeconomic standpoint, developing markets have the potential to outperform their more developed peers.

To date, AI and machine learning still have limited applications; however, as technology develops, they will most likely be used for:

- Coding accounting entries and compliance with changes in accounting rules/policy, with little or no human intervention when accounting standards are updated.

- Improving fraud detection using powerful machine learning models for fraudulent activity forecast.

- Automated contract and other document evaluation, as well as assisted specialists for more efficient compliance assessment or predictive analytics.

Auditing is well suited for the use of data analytics and AI because many audit tasks are repetitive and could be automated. And it is becoming increasingly difficult for auditors to work with massive amounts of data (both structured and unstructured) in analyzing financial performance and risk. (Kokina, Mancha and Pachamanova, 2017).

AI technology help auditors in detecting and extracting useful information from enormous volumes of documentation, enabling the professional to use unstructured analysis and insight in analyzing trends, patterns, and anomalies.

Accountants and auditors have traditionally done algebraic number analysis, but are increasingly incorporating business intelligence, and predictive and visual analytics to analyze data and communicate effectively. When these processes are operationally repetitious, AI and machine learning can be helpful.

Several famous professional accounting companies have begun to implement cognitive AI technology.

Deloitte collaborates with several suppliers to provide technology-enabled cognitive skills for audit-specific tasks and technology-enhanced solutions for clients' businesses. Deloitte US created an AI-enabled document review platform in 2014, automating the process of collecting information from legal contracts, bills, financial statements, and other documents. According to their assessments, the platform assisted them in cutting their document review time by up to 50% or more.

KPMG developed its own AI tool portfolio, KPMG Ignite, and used artificial intelligence to forecast future anomalous business occurrences, check document compliance for leasing and investment contracts, and establish a call center analytics engine using the technology of natural language processing (Faggella, 2020).

AI and machine learning technologies are more likely to replace certain repetitive tasks performed by accountants than to result in significant cuts in accounting-related job employment over time. However, in the future, the technology will be increasingly exploited, putting more pressure on

accountants to develop skills to work alongside AI and machine learning software to conduct a more effective assessment, oversee technology-enabled external and internal audit processes, and collaborate with technology developers for new AI-enabled tools.

3.2 The role of managerial accountants (MAs) and controllers

According to Ahrens and Chapman (2000), "controller" is a familiar term in German-speaking nations, and "management accountant" (MA) is familiar in English-speaking countries like the United States and the United Kingdom. According to Schäffer (2013), when comparing the two professions, the controller's responsibilities are often perceived as wider in scope, focusing not just on accounting concerns but also on management.

3.2.1 Controller

According to DePersio (2021), a company's accounting activities are overseen by the controller. This senior position often needs years of experience at various levels of accounting. The responsibilities of a controller are diverse depending on the company size. In smaller firms, the controller must handle greater responsibilities and the controller often has the last word on all financial decisions, including budgeting, reporting, investing, and risk assessment.

The controller is in charge of accounting records and the creation of financial reports. These reports are legally required for shareholders to evaluate for trading on stock markets. The controller is accountable for making sure that the financial reports are issued timely, and in compliance with accounting principles such as the generally accepted accounting principles (GAAP), and that the financial reports reflect the company's current financial condition accurately and fairly.

In bigger firms, the controller's responsibilities are typically more specialized because certain financial decisions are delegated to other leaders, such as the chief financial officer (CFO).

The controller is charged with maintaining the accuracy of accounting records. In the early 21st century, accounting scandals brought down corporations such as Enron and WorldCom. That is why it is critical for companies of all sizes to have an efficient operational system for storing and maintaining accounting records. For most businesses, the controller has the final word on how and where this information is kept. The controller is also in charge of all accounting personnel who are responsible for inventory, accounts receivable, accounts payable, payroll and compliance.

If a corporation has a subsidiary, the controller manages its accounting activities and guarantees its reporting and control processes comply with the parent company's requirements. Accounting professionals at these subsidiaries often report to an accounting manager or vice president at the subsidiary, who reports to the parent company's controller (DePersio, 2021).

The controller is charged with developing firm budgets and assuring that costs match predicted income. They make sure that the company's accounts payable payments are made on schedule and that debt is appropriately handled. Most organizations outsource these responsibilities to personnel, such as an accounts payable manager who reports to the controller, but the controller is ultimately responsible. Finally, they must guarantee that budgets are reasonable and payments are completed on time.

Forecasting is another task of controllers. Building a budget that allocates costs in the most efficient way demands having an accurate prediction of how much money will come in a certain period. The controller's department of a big corporation typically includes analysts and other specialized personnel that analyze internal and external data to produce the most accurate revenue estimates. Again, the controller may not perform these activities by themselves, but they are accountable for evaluating their staff's work and employing their results to make final budgetary choices.

No industry is more watched and controlled than finance. Following the 2008 financial crisis, many new laws restricted how firms handled their finance and presented their financial conditions to the public. Annual third-party audits of publicly listed corporations' financial statements are required, and the results of the audits must be made public. It is the controller's responsibility to oversee this procedure and ensure that the auditors have all of the necessary information to make an accurate evaluation of the firm's financial statements. The controller must be aware of all local, state, and federal tax laws and business rules that influence their organization and guarantee that it works within the right bounds.

A competent controller should have the same abilities as a good accountant, including great numerical proficiency, organization, good problem-solving capabilities, and good logic. Additionally, a controller needs to be a strong leader with a big-picture perspective because a significant portion of the job entails assigning tasks to employees and then combining their results to reach final judgments.

Typically, people do not start as controllers. To obtain this position, one must be willing to progress up the corporate ladder, frequently beginning with entry-level accounting or auditing. The

accountants who are well-performed and put the greatest effort into their work are likely to be given promotions, which move them up possibly to the controller position.

3.2.2 Managerial accountant (MA)

According to Fontinelle (2022), MAs can work for public/private/governmental companies/organizations and they can be called under different terms such as cost accountants, MAs, industrial accountants, private accountants, and corporate accountants. One characteristic that sets apart a MA from other sorts of accounting positions like public accounting is the task to prepare data for internal usage within a corporation.

To assist enterprises in better planning their budgets and their performance, MAs collect and process data for internal assessment. Along with other managers, accounting managers could assist the firm in selecting and managing its investments. Accounting managers are risk managers, budgeters, planners, strategists, and decision-makers. They carry out the tasks necessary for the owner, manager, or board of directors of the company to make further decisions.

MAs frequently lead other junior accountants who perform fundamental accounting duties including keeping track of tax liabilities and recording income and expenses. And this information is being used in creating income statements, cash flow statements, and balance sheets. Accounting managers in small companies might perform these operations by themselves.

A MA also could evaluate and manage risk, plan for funding and financing activities, spot trends and possibilities for improvement, also oversee and ensure compliance. They may develop, manage, and oversee the bookkeepers and data processors for a company's financial system. Budgeting or taxes may be an area of specialization for MAs as well.

According to Fontinelle (2022), to be a successful accounting manager one needs to have capacity and interest in numbers, mathematics, businesses, and production processes. MAs must have a solid foundation in hard accounting skills, including knowledge of GAAP, and tax principles.

Since MAs perform tasks inside companies, they require a solid foundation in economics as well as soft skills like writing, communication, and interpersonal interactions.

Accounting managers also need to be able to see the big picture because the main goal of management accounting is to help clients and the firm in reaching the best decisions achievable with the information at hand. This involves decisions making on operational structuring, capital investment, and risk assessments.

Regardless of the title, emerging technologies such as big data and business analytics are projected to revolutionize the data-intensive tasks of both controller and MA in enhancing management decision-making (Brands and Holtzblatt, 2015).

Business analytics (BA) and information technology (IT) skills have become one of the key competencies that the controller and MA must have. As a result, the controller and MA roles are likely to move in a data scientist direction with strong systematic and mathematical-statistical expertise, along with business analytics capabilities (Oesterreich and Teuteberg, 2019).

3.3 Changes in competencies, capabilities, and decision-making in the accounting profession.

According to Oesterreich and Teuteberg (2019), the emergence of big data has changed radically the competence set demanded by the controllers and MAs. Competencies in business analytics, such as IT knowledge is regarded as a "must have" skill for controllers and MAs.

The difficulties presented by the four Vs, particularly the variety of data from many sources with possibly dubious quality, have major impacts on the MA. The capability to efficiently process both internal and external data will be a crucial skill for financial analysts. To identify significant and trustworthy data amongst mixed data including both reliable and unreliable data, it is necessary to handle a large volume of data and build filters. As a result, a data scientist with strong systematic as well as mathematical-statistical skills will take over the position of MA. To fully utilize digitization in this scenario, the collaboration between finance, accounting, and other department becomes extremely important. The IT department will serve as a facilitator and support for the MA, which is crucial (Karenfort, 2017).

Planning and analysis are mainly based on historical financial data, which is deeply ingrained in management accounting. The focus of management accounting is still mostly backward-looking and static due to its nature. While forecasts and budgets make an effort to foresee future progress, they are typically only projections of historical data and are only as good as the assumptions that underlie them. Digitization makes it possible to process a lot of information and identify connections in complicated models. Thus, strategies based on models with greater predictive potential will be able to be developed. While statistical models built on real-time data enhance decision-making, static budgets become dynamic plans. As a result, management gradually moves away from its typical reactive-analytical approach and toward a more proactive-predictive approach (Karenfort, 2017).

The way that data is processed has changed as a result of technological advancements. Data was traditionally gathered from various sources, transformed into a standardized format, and then kept in a centralized data repository. The term "extract, transform, and load" (ETL) refers to a technique that is rapidly being overtaken by data virtualization, which allows data to be processed straight from its source in real-time. The process of making data accessible to programs in an integrated way, regardless of whether the data is distributed in such a different format across numerous databases, is known as data virtualization.

This solution for business intelligence has the advantage of making the architecture simpler, less costly, and more flexible while maintaining data integrity with the original data source (Van der Lans, 2012).

The MA can provide data to management in almost real-time thanks to new technology like dash boarding. It also enables data visualization, which makes it possible to identify connections and patterns that are increasingly important for assisting decision-making (Karenfort, 2017).

Additionally, new ERP approaches based on in-memory technology enable the utilization of data and direct processing in mathematical-statistical models. Ex-post variance analysis will be gradually substituted with an automated, real-time explorative logic for optimization.

One of the most common discussions about the future of accounting and assurance is focused on technical changes and innovations that have the greatest potential to impact accounting practice. Many accounting procedures, including those of expenditure management, billing, and account receivable and payable processing, are being performed by machines with artificial intelligence.

There are concerns that in the long run, further components and sectors of the profession will no longer need human labor and will be replaced by robotics and artificial intelligence. Basic auditing tasks suited for entry-level jobs and new entrants into the field, such as vouching for recorded transactions and checking the audit trail, will most likely be automated over the next decade or two.

This will be the outcome of further development and implementation of technologies such as big data analytics, cloud computing, blockchain, and the expansion of the Internet of Things by the accounting and assurance profession.

Accounting professionals' future roles will revolve around doing extensive analysis and reporting to relevant parties using more complex accounting information systems combined with data analytics and supporting technologies such as robots and artificial intelligence.

According to Bhimani and Willcocks (2014), new possibilities for digitally enabled businesses present information challenges, opening opportunities for accounting and finance practitioners to use Big Data analytics and play a more strategic role in the future.

Companies will need to establish IT infrastructure and systems for continuous monitoring, analysis, and interpretation of data acquired both internally and externally because of the potential of the Internet of Things and Industry 4.0 to revolutionize manufacturing and logistics businesses.

MAs will need to have data analytics skills to exploit data created by Industry 4.0 to build new tools and indicators for monitoring operations and product quality, uncovering cost-cutting possibilities, and supporting management decision-making.

The future auditors will have a different role in terms of data and information analysis. They will need to go from fact-checking to massive and unstructured data analysis, displaying competence in in-depth regression analysis and predictive statistics (Krahel and Titera, 2015).

The digitization of the profession will have a significant impact on the skills and knowledge required of fresh graduates joining the industry.

Graduates must get training in IT such as automated identification systems, analytical programs, and data mining (Kruskopf *et al.*, 2020).

Students should seek to study how to engage with data analytics software and tools and become familiar with cloud computing solutions, artificial intelligence, and machine learning ideally through schooling or otherwise by internships.

3.4 Big data skill gap

According to Gamage (2016), the big data technology and services sector would increase at a 27% annual compounded rate to $32.4 billion by 2017. This would equal nearly six times the total growth rate of the information and communication technology industry.

In an article by McKinsey Global Institute in 2011, they forecasted that there would be a scarcity of skills required for enterprises to benefit from Big Data. By 2018, the United States might suffer a shortage of 140,000 to 190,000 employees with strong analytical abilities and 1.5 million managers and analysts who understand how to apply Big Data analysis to make efficient judgments (Manyika *et al.*, 2011).

Similar sentiments have been stated about other nations such as the United Kingdom, Australia, and India. It is evident that there is a global lack of Big Data expertise, and every country will confront a similar issue.

The shortage of competent Big Data practitioners constrains businesses' capacity to gain value from Big Data (Jeff, 2013).

According to recent research by Gamage (2016), there is an expertise shortage supply in data strategy and a wide variety of technical data management jobs, mainly because of a shortage in university, professional, and executive education programs designed to produce the skill set needed to fill the rising demands for Big Data specialist.

Ramachandran and Watson (2021) wrote an article on Deloitte Insight where they stated that AI and IoT technologies generate an escalating amount of data, but those data are meaningless if firms can't properly use it—one of the reasons why the industry has actively recruited analysts.

According to figure 5, the number of job openings for analysis skills—including machine learning (ML), data science, data engineering, and visualization—exceeded traditional skills such as engineering, customer service, marketing and public relations (PR), and administration for the second time in four years in 2020.

The US tech industry is looking for more 'analytical' and fewer 'engineering' talent
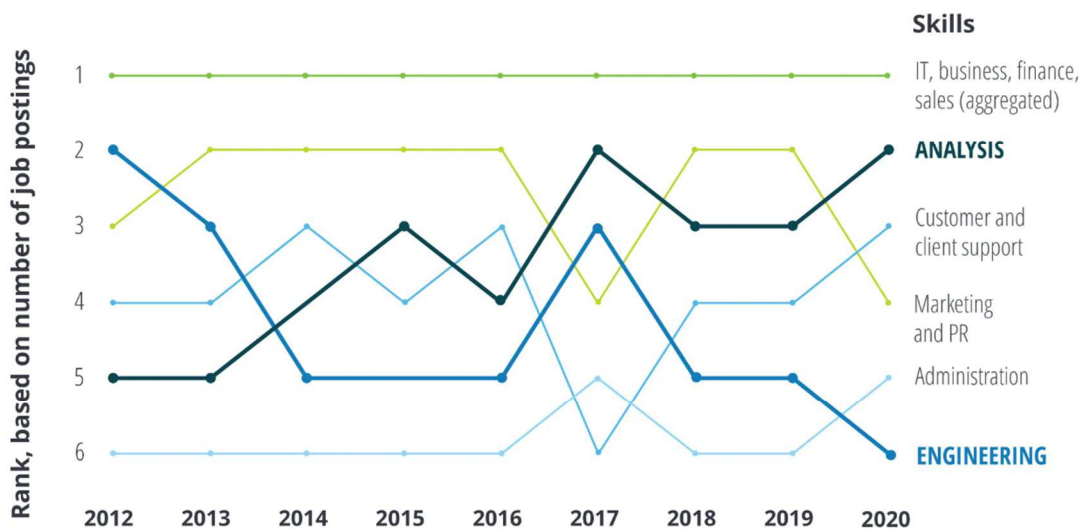
Note: At rank #1, we have combined/aggregated job posting numbers for four skills: IT, business, sales, and finance.
Source: Deloitte analysis based on data from the Burning Glass database.

Deloitte Insights | deloitte.com/insights

Figure 5: The US tech industry is looking for more analytical and fewer engineering talents.

Source: Deloitte analysis based on data from the Burning Glass database.

Another significant shift over the last eight years has been the depreciation of core engineering talents. While engineering is a valuable asset, the growth of cloud and Anything As a Service (AaaS) services has impacted computer and hardware professions such as server administrators, computer-hardware technicians, and experts that operate on the router and storage management hardware part (Stevens-Huffman, 2017).

The COVID-19 epidemic had a greater impact on electric and hardware design engineering positions than on other areas in the tech sector (Field, 2020). In contrast, even as the pandemic worsened business circumstances in spring 2020, employment vacancies for data analyst, data engineer, and data architect jobs in tech majors remained strong (Pradhan, 2020).

According to Ramachandran and Watson (2021), tech firms have always been at the forefront of catching professionals with enhanced analytical skills. Since 2014, tech employers have directly aimed at professionals with mathematics and statistic majors who are searching to leverage their ability to learn and analyze data to find the solution for real-world business problems.

The race to AI has intensified the rush, as leading Silicon Valley firms have rapidly scaled up their personnel, focusing on advanced analytical skills such as machine learning, natural language processing, data engineering, data visualization, and image processing (Rayome, 2019).

In 2016, there was a rise in demand for data scientists, machine learning, and artificial intelligence expertise (Plavljanić, 2019). Tech firms keep on hiring data scientists and data analysts (Beck, 2020). However, with companies across industries seeking to hire AI expertise and improve their core decision-making driven by data, the need for data analysis specialists will certainly exceed the supply of talents on the market for some time (Jarvis, 2020).

Tech firms may manage this complicated personnel market by employing various strategies, including a targeted strategy to recruiting fresh analytical talent, maximizing the potential of existing employees, and developing collaborations.

Ramachandran and Watson (2021) suggested some ideas for tech firms to fill this gap:

- **Selective strategy**: Managers can use a selective strategy, guided by strategic objectives, to determine whether analytics expertise is truly required, or whether the objectives can be met using automated systems, XaaS programs, or AI-based solutions.

- **Reskilling strategy**: Managers might aim to improve current employees' abilities in areas of machine learning, data analytics, data modeling, data architecture, and data engineering. The company can consider a budget to provide training, and courses to provide the necessary education to their current employees.

- **Partnership strategy:** Collaborate with academics and universities, business institutes and entrepreneurs, and the start-up ecosystem to discover and recruit the best and brightest data and analytics workers.

Furthermore, studies show that Big Data is not restricted to a specific subject. According to Miller (2014), the debate around big data and analytics skills has mostly concentrated on a single role: the data scientist. However, the demand extends well beyond data scientists. Data has transformed into a valuable asset to companies; therefore, every profession must shift to meet this new perspective.

Lawson et al. (2013) analyzed senior accounting, finance managers and observed skills gaps in areas such as business strategy, business intelligence, analytics, and operational experience. According to the findings of Lawson's study, accounting and finance specialists need training for better risk reporting and submitting data to support capital deployment judgments, so that they can grow the company fruitfully in the short-run and long-run. And the information needs to be used in a way that accounting can enhance decision-making as well as foster the success of the company.

3.5 The educational gap

Siegel et al. (2010) report that even though more than 80% of graduate students in accounting eventually choose career paths other than public accounting, most fundamental accounting courses concentrate on subjects that educators presume prepared students to work in public accounting. Therefore, accounting education should incorporate organizational contexts instead of just focusing on public accounting.

Educators must act proactively by collaborating with industries to guarantee that the students they educate have the skills needed for the Big Data age.

Griffin and Wright (2015) emphasize the necessity of Big Data in accounting education, stating that academics, as educators, must rethink their accounting and auditing programs to teach the requisite skills for Big Data in the accounting sector.

CGMA (2013) listed the following skills that are necessary for future finance professionals who handle a data-centric finance team:

- Recognize which datasets are valuable in evaluating what leads the business.

- Having a full idea of what matters most to the customers, and having strategies for tracking this.

- Having the competency to adapt to new types of data and being able to find out the new methods to utilize them in business decisions.

- Getting used to ambiguity, such as the possibility that big data will not bring clear findings.

- Having the curiosity to try out new data interpretation methods to improve management results.

The traditional accounting courses should be updated and changed to assure appropriateness, and new curricula and degree programs are required to teach the above-mentioned competencies.

In reality, some colleges have already begun to include Big Data and data analytics into their curriculum. Figure 6 shows so examples of University courses and certifications in different countries which integrated accounting and financial knowledge with information technology.

Name of university	Location	Type of degree	Course name	Teaching content
St. Edward's University (www.stedwards.edu)	Austin, United States	Bachelor degree	Accounting information technology	A 150-hour curriculum allows students to earn a Bachelor of Business Administration in Accounting as well as a Bachelor of Arts in Computer Information Technology.
Swinburne University (www.swinburne.edu.au)	Melbourne, Australia	Bachelor degree	Accounting and Business Information Technology	Developing, designing, testing, and consulting on software solutions. Study how people, information, computers, networks, and processes interact to provide business solutions. Using accounting systems to record, analyze, and create financial statements and management reports.
Texas state university (www.txst.edu)	Texas, United States	Master degree	The master of science in accounting and information technology (MSAIT)	The MSAIT focuses on management accounting, accounting information systems, database management, information security, project management, and business consulting. Courses in data warehousing, enterprise resource planning and business intelligence, data analytics, cost and management accounting, and fraud detection are available as electives.
University of Maryland Global Campus (www.umgc.edu)	Maryland, United States	Master degree	Masters of Sciences in Accounting and Information Systems	The course provides integrated knowledge of accounting and information technology, as well as a solid understanding of business operations.
Colorado state university (colostate.edu)	Colorado, United States	Postgraduate Certificate	Certificate of Business Information Systems	The course teaches: • Business Intelligence • Project Management: Information Technology • Enterprise Computing • Systems Integration • Information Technology Management

University College Cork (www.ucc.ie)	Cork, Ireland	Master degree	Master of science in Management Information and Managerial Accounting Systems	• Accounting Information Fundamentals • Performance Management • Risk and Control • Programming for Business • Analysis of Accounting Information • Database Analysis and Design • Databases for Management Information Systems
Dublin Business School (www.dbs.ie)	Dublin, Ireland	Master degree	Master of science in Financial Analytics	• Principles of Financial Decision Making • Applied Research Methods • Data Analytics & Machine Learning for Finance • Applied Research Project • Predictive Financial Modelling • Applied Financial Analytics • Financial Intelligence & Data Visualization • Information & Cyber-security Management • Financial Risk Management • Behavioral Economics & Finance
Texas Tech University (www.ttu.edu)	Texas, United States	Graduate Certificate	Data Analytics Graduate Certificate for Accounting Students	Students enrolled in the 150-hour Professional Accounting Program in Audit can pursue a graduate certificate in Business Analytics. Students learn how to use cutting-edge technologies to analyze, transform, test, interpret, and visualize data.
St. Mary's University (www.stmarytx.edu)	Texas, United States	Bachelor degree	Bachelor of Business Administration (Accounting and	• Business Intelligence • Financial Modeling • Database Management • Enterprise Resource Planning

			Data Analytics Courses)	• Cost Accounting
University College Dublin (www.ucd.ie)	Dublin, Ireland	Master degree	Master of the science of Financial Analytics	• Principles of Financial Decision Making • Applied Research Methods • Data Analytics & Machine Learning for Finance • Applied Research Project • Predictive Financial Modelling • Applied Financial Analytics • Financial Intelligence & Data Visualization • Information & Cyber security Management • Financial Risk Management • Behavioral Economics & Finance

Figure 6: Some examples of the university that integrated information technology with accounting and financial courses.

Some developing countries have also responded to accounting curriculum adjustments to meet corporate concerns in Big Data.

For instance, the 2015 curriculum of the Institute of Chartered Institute Accountants of Sri Lanka's Chartered Accountants Program includes additional Big Data concepts in its final module (Corporate Level). This module concentrates on using information technology and systems capabilities in strategic planning and management processes, as well as being acquainted with current subjects like social media, cloud computing, and Big Data (Gamage, 2016).

Malaysia has also taken initiatives to confront the Big Data world's transformations. According to Ismail (2009), the Malaysian Institute of Accountants, the Ministry of Higher Education, and other higher education institutions formed a committee in 2006 to guarantee that accounting education at local universities is in pace with worldwide changes in the field. In the form of an accounting curriculum, the committee suggested a minimum of three Accounting Information Systems (AIS) courses which include IT basics, system analysis, and design, and AIS.

Furthermore, accounting degree programs cannot simply add extra data analytics units to the already available curriculum without compromising existing features.

As an outcome, an integrated way to incorporate data analytics topics into existing courses in the Accounting program such as Business Statistics, Accounting Information Systems, Financial Accounting, Management Accounting, Auditing, and Taxation is recommended to adequately address 'Big Data' in the accounting curriculum.

Accounting educators should encourage accounting and finance students to sign up for alternate units in the accounting degree program such as Introduction to Database Design and Management, Database Systems, Fundamentals of Business Analytics, Business Intelligence, Applied Statistics, and Enterprise Modelling (Gamage, 2016).

This point of view is confirmed by a recent study by one of the 'Big Four' accounting companies PwC (Davis and Williams, 2015) which believe data analytics shall be included in accounting education.

Furthermore, Lawson et al. (2013) believe that the knowledge, competence, and abilities of accounting education should arise and be fostered inside the program as linked qualities, as this is the way those competencies would be utilized within the company.

Figure 7 below lists some of the Big Data subjects which could be implemented into current courses (Gamage, 2016).

Course	Topics
Business Statistics	Data gathering techniques, Data exploration, Data summarisation, Data analysis, Data visualization, Communication of analytical findings
Business Information Systems	Advanced Databases, Information Retrieval, Advanced Data Mining Applications, Predictive Analytics for Decision Making, Big Data information management
Management Accounting	Application of Big Data to competitor analysis, Big Data as a strategic resource
Accounting Information Systems	Business intelligence, Enterprise analytics Information search and retrieval, Data mining, familiarity with languages such as XBRL, specialized software/reporting systems with decision support, ERP systems, Cybercrime, Data management issues
Business Finance	Financial analytics, modelling and computation of financial risks, Information Risk Management
Auditing and Assurance	Data Analytics in auditing , Mine new sources of data, Data integrity , Privacy, Safeguards, Cybersecurity, Design and evaluate IS controls, Manage IS risks and compliance, Overseeing fraud risk assessment
Forensic Accounting	Big Data, Benford's Law, Financial Analytics, Data Analytics for Fraud, Anomaly Detection in Forensics and Security
Taxation	Indirect tax and Big Data, tax value and non- tax value form data that is collected in the tax function, Visualize accounting data

Figure 7: Big Data subjects that can be implemented into courses by Gamage (2016).

4. Research methodology

By recalling the research objectives that were mentioned at the beginning of this dissertation to stay in line with the purposes of the dissertation:

- What does the managerial accounting job advertisement tell us?

- How can accounting educators prepare their students for the future?

To answer the questions stated, this dissertation collected data from indeed.com for addressing the study goals. By manually collecting job description data from Indeed.com and then using text mining techniques such as frequency analysis to discover the most critical skill that firms are looking for when they recruit controllers.

In the last step, the dissertation addresses some key results from data analysis in the hope that this study would be beneficial for future research as well as for accountants and accounting educators.

It is crucial to emphasize that this study focuses on management accounting in particular, and the findings present apply to managerial accounting job postings in the US market.

4.1 Data collection

Indeed.com was used to gather data for this study. Indeed.com was chosen for this study because of the following reason: It is the world's most popular job-search website according to Abney (2021) and many others research scholars. The structure of Indeed.com's homepage enables constant data collection and Indeed.com is a well-known website for job advertisement. It has a simple structure and a massive amount of information. It is free and accessible to everyone.

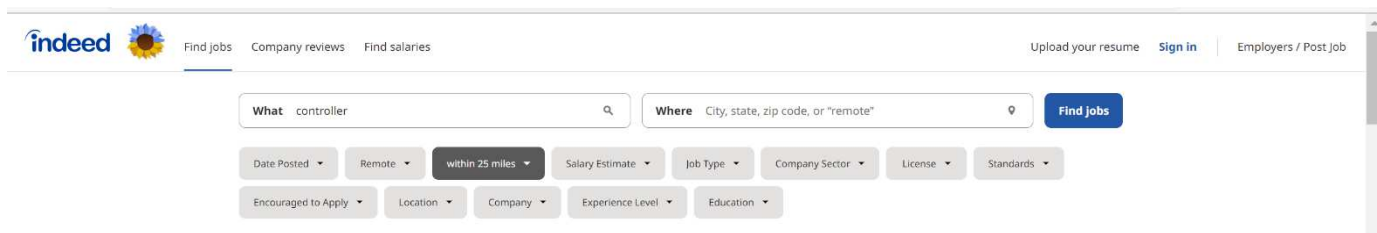In figure 8 below, the layout of Indeed.com is demonstrated.

Figure 8: The layout of the Indeed.com website. Source: Indeed.com

There is a "What" input text box at the top of Indeed.com's website where one can write in the job category of interest. In the case of this study, this input box is manually filled with the term "controller".

The script then fills up the "Where" input text box with the states of interest as follows: Washington, New York, and California. This process enables data collection in different geographical regions.

Following the input of "What" and "Where," the distance was set to "within 25 miles," as seen in figure 9.

After inputting the needed information, the search was requested by clicking on "Find jobs". Each job listing page has 15 distinct job posts.
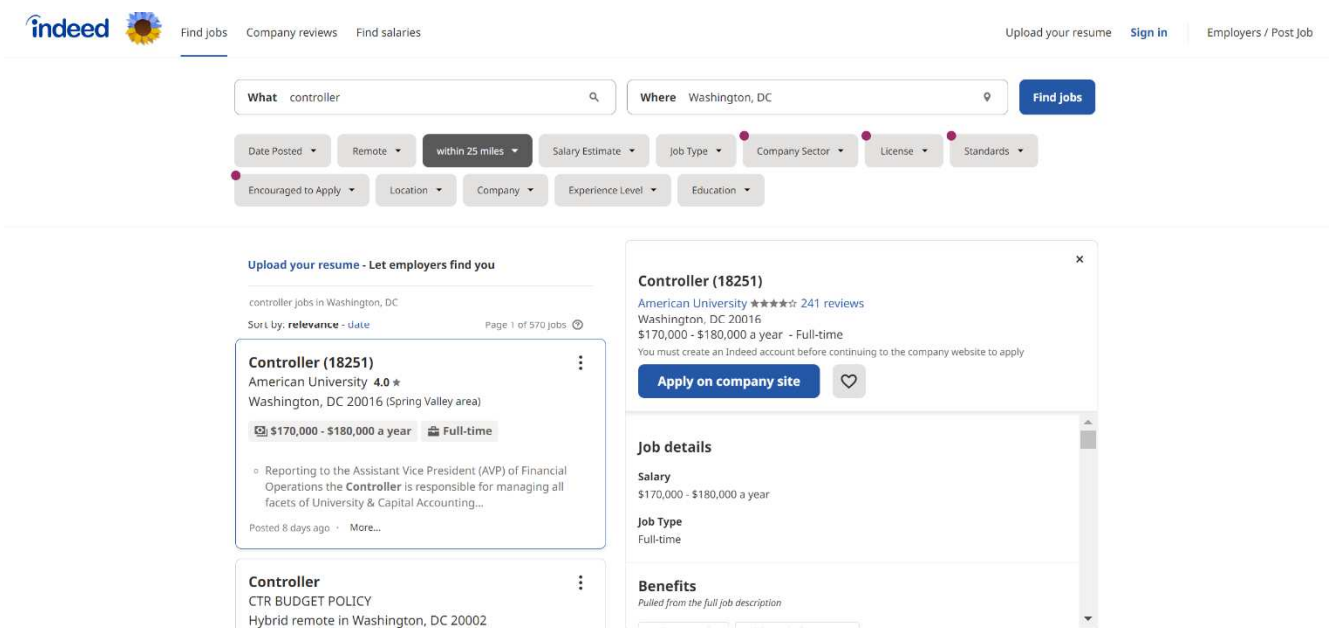

Figure 9 illustrates the placement of job ads information from Indeed.com

These sections include the Job title, Firm's name, Location, a brief description, type of job such as full-time/part-time, online/offline/hybrid, and, sometimes, salary information.

There is software that automatic web scraping but usually this automatic work can't extract the full job description. That is why all of the information collected for this research was by manually. This work is time-consuming but rewarding as lots of insightful information is being collected.

All the information collected from 100 samples of job posting from each state is organized in an excel file. In the excel file, the information is arranged as each category of Job position, Company, Link, Place, State, Full-time, Part-time, and then go into detail with the Job description. The full job description was put into a word file to make the task of word

analysis more convenient. A sample of 100 job postings was obtained from each state in the US which results in 300 job postings in total for this study.

The extracted data is saved and organized in excel, as seen in Figure 10. The data in the excel file is structured and ready for analysis. The data is now prepared for the next round of data collection which is gathering the full job descriptions' texts.

| No | Job position | Company | Link | Place | State | Remote | Type | | Job description |
							Full-time	Part-time	
1	Branch Contr	Limbach Hold	https://wv	Laurel, MD	Washington	1	0	0	
2	Controller	Defenders of	https://wv	Washington	Washington	0	1	0	
3	Chief Financia	US Congressi	https://wv	Washington	Washington	0	1	0	
4	Assistant Con	POLITICO LLC	https://wv	Arlington, V	Washington	0	1	0	
5	Senior Global	Quorum	https://wv	Washington	Washington	0	1	0	
6	Assistant Con	Hogan Lovells	https://wv	Washington	Washington	0	1	0	
7	Controller	SkyePoint De	https://wv	45240 Busin	Washington	0	1	0	
8	Corporate Co	EYP	https://wv	Washsingto	Washington	0	1	0	
9	Treasury Con	Securiport	https://wv	Washington	Washington	0	1	0	
10	CONTROLLER	Roche Bobois	https://wv	Washington	Washington	0		1	
11	Controller	Eagle Security	https://wv	Arlington, V	Washington	0	1	0	
12	Corporate Co	BRMi	https://wv	Silver Spring	Washington	0	1	0	
13	Corporate Co	3Pillar Global	https://wv	Washington	Washington	0	1	0	
14	Assistant Con	Koons Tysons	https://wv	Vienna, VA	Washington	1	1	1	
15	Controller	IRI Washingto	https://wv	Washington	Washington	0	0	1	

Figure 10. Snapshot of the dataset in Excel

Collecting the full job descriptions is a repetitive task by clicking on each job posting for the full details. This step extracts the full job descriptions' texts manually and all the full job descriptions' texts are copied and then pasted into a Word file for later analysis.

The full job descriptions specify the employment qualifications, tasks, benefits, and specific requirements on education, experience, and technical and interpersonal skills.

Figure 11 represents what a full job description for a specific job post looks like. The content in the "Full Job Description" portion of the page is the data that is extracted and saved in a word file for later analysis.

Figure 11: Full Job Description layout on Indeed.com

The content of "Full Job Description" that was collected from 300 jobs posted on indeed.com results in 399 pages of texts being saved on a Word file as demonstrated in figure 12 below:

POSITION SUMMARY/OBJECTIVE:

The incumbent partners closely with the branch operational and regional finance leadership. S/he assumes a lead role **in formulating strategies regarding resourcing and managing financial operations,** as well as safeguarding the Company's assets, in compliance with the organization's Code of Conduct & Ethics.

KEY TASKS & RESPONSIBILITIES:

- Maximizes billing, drives collections, **creates branch cash forecasts**, and manages opportunities to maximize branch cash performance.
- **Reviews weekly audit reports** then **works with branch leadership** to understand issues, explanations, etc and is prepared to discuss findings with Regional Finance.
- Ensures branch monthly/quarterly **compliance with GAAP and SOX** reporting compliance and testing standards.
- Actively participates in monthly medium to high risk **project reviews**, and works with local branch operations and project teams to **analyze project trends/inefficiencies**, identify any risks, and help develop mitigation **strategies**.
- Ensures the accuracy and integrity of operational and financial information reported to key stakeholders, and **identifies significant drivers of financial information and ways to add additional EBIT by increasing GP and reducing SG&A.**
- Works with the Regional Director to assess risk as the first line review for branch upstream contracts. Independently assesses risk on all non-standard downstream contracts and **communicates** assessment to Branch Management and coordinates with Legal for resolution.
- Assists in the annual **planning** and monthly **forecasting** process, while partnering with branch management to understand changes in the business and communicating changes to Regional Finance
- Provides **strategic recommendations** to local branch management related to the overall management, including implications of major financial decisions.
- **Manages** a team of Accountants to effectively and efficiently perform duties related to month-end

Figure 12: Texts collected from Indeed.com being stored on a Word file

4.2   Data cleansing

Before analyzing the data, the data cleansing process is a must. When the data was first collected, several job advertisements were duplicates. Duplicated job postings are removed to reduce data mistakes and misleading measurements. The data may then be analyzed in the next step.

Some out-of-scope information such as the Covid-19 vaccination policy, vacancy policy, gender equation policy, equal employment opportunity statement, and insurance were also removed manually because this information doesn't serve the purpose of this study. Removing unnecessary information makes it easier to find the needed data and allows one to get a clearer insight into the research.

5. Data analysis and insights

5.1 Data analysis

After the process of data collection and data cleansing, the data of 300 full job descriptions in the search for "Controller" from 300 job posting from 3 states in the US are now ready to be analyzed. All the text collected from the "Full Job Description" on Indeed.com are being read carefully and extracted the relevant information. All the information extracted is classified into different categories as follows:
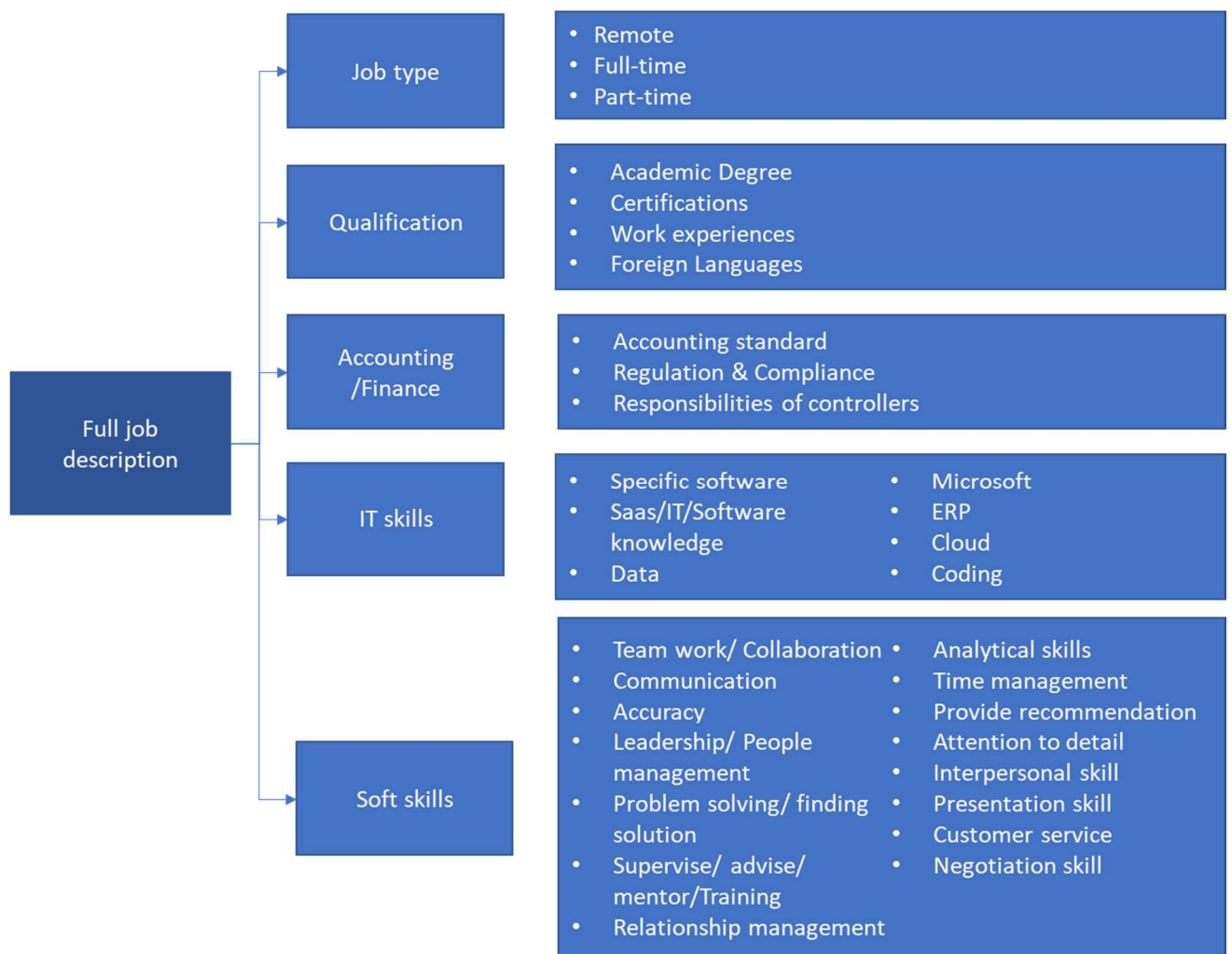
Figure 13: Demonstration of how data is organized and analyzed
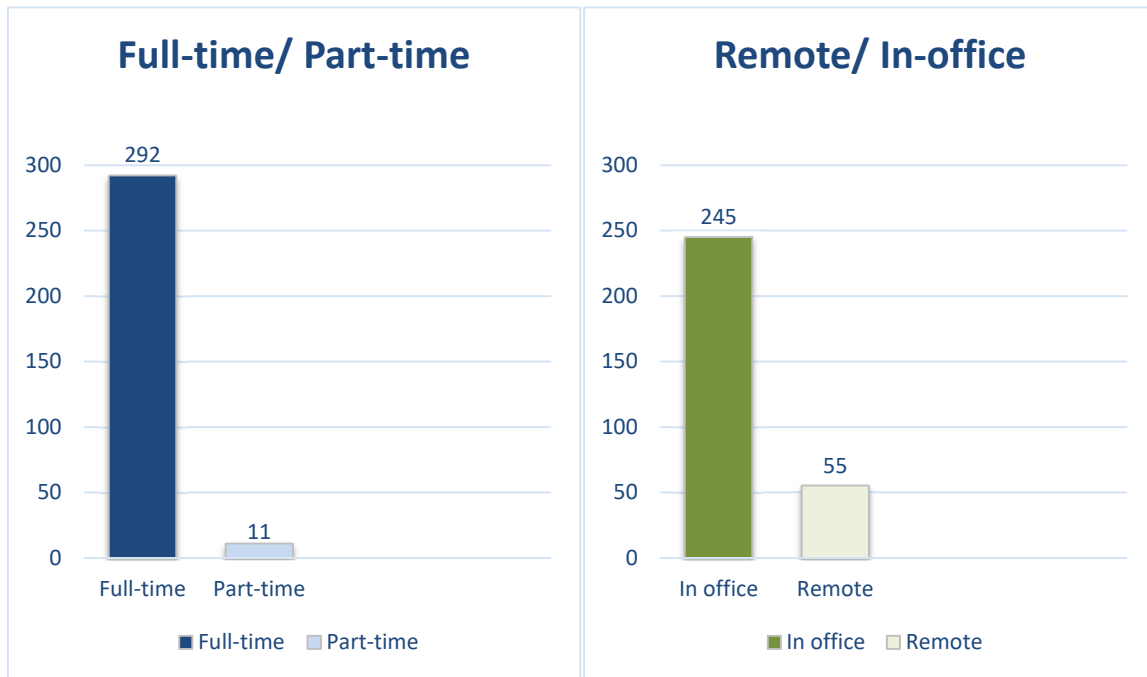
5.1.1   Job type

Figure 14: Illustration of the sample characteristics (job type)

In 300 samples, there are 292 out of 300 jobs posted are full-time and only 11 out of 300 are part-time.

Regarding the location of work, there are 245 out of 300 jobs require the candidate to work in the office and only 55 out of 300 jobs give the candidate the option of working online and hybrid (meaning mostly working online and going to the office occasionally).

5.1.2   Qualification

a) Academic degrees and certifications

Figure 15 demonstrates the qualification that the controllers should have. Most controllers must have a solid educational background to land a job because 85% of the job postings sample request a bachelor's degree. Typically, a bachelor's degree in accounting, business, or finance is expected.
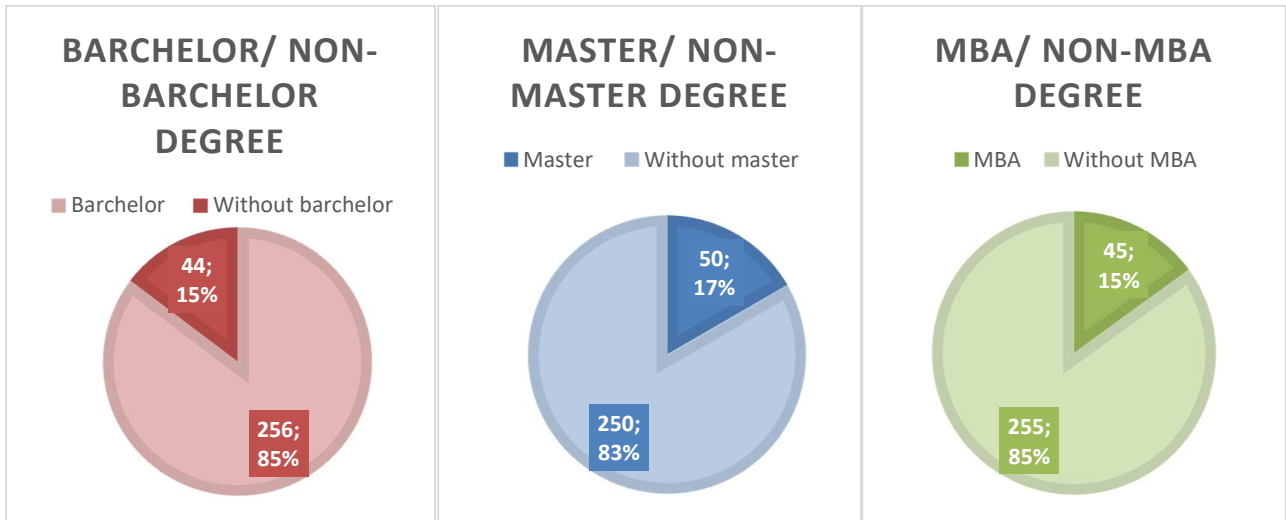
Figure 15: Academic degrees and certification required when hiring controllers.

There is 17% of the job postings require a master's degree.

Employers also prefer applicants with a Master of Business Administration (MBA) degree- 15% of the sample - in accounting or a similar discipline.

According to DePersio (2021), to stand out from the competition, young controllers should major in accounting, economics, finance, or statistics in college before pursuing an MBA or master of accountancy degree. The master's degree serves as more than just a record of academic proof; it also fills the educational necessary for taking the CPA exam, which is something that a future controller should have on their profile.
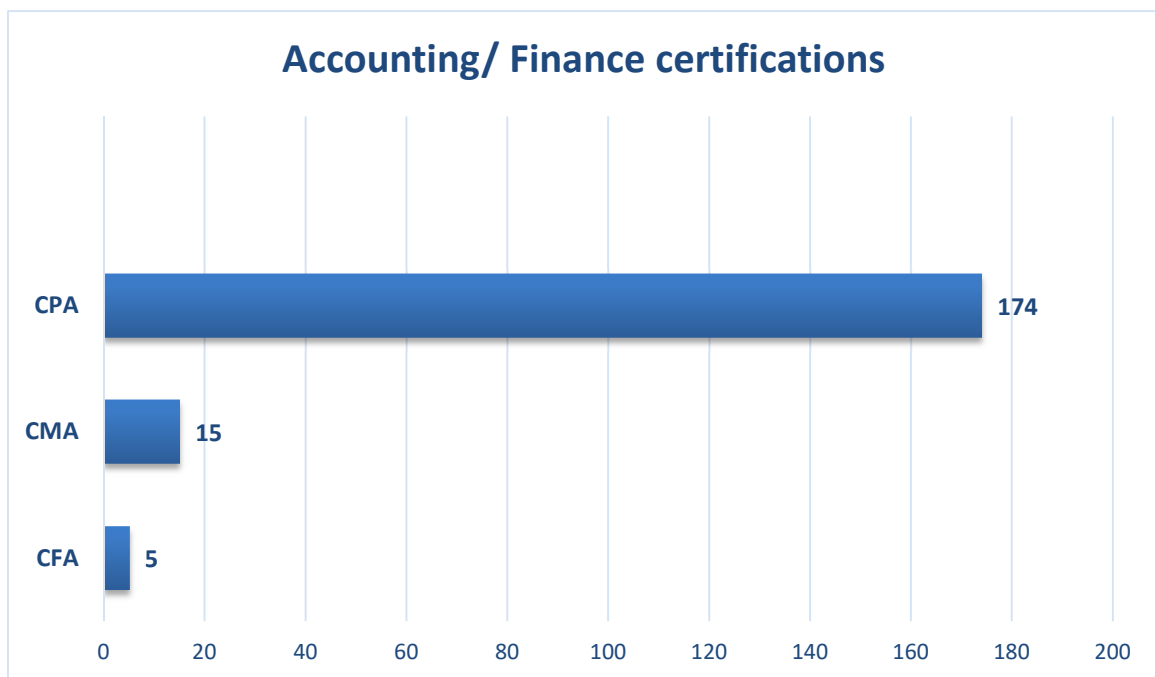

Figure 16: Post-degree certifications mentioned on the job posting sample

Obtaining post-degree certificates such as Certified Public Accountant (CPA) or Certified Management Accountant (CMA) can strengthen an individual's level of expertise and an advantage when a candidate applies for a "controller" position.

There are 174 out of 300 jobs posting on the sample, corresponding to 58% of the sample mentioned CPA as a plus point.

And there is 5% of the sample mentioned CMA and only 1.7% mentioned CFA

The American Institute of Certified Public Accountants offers a CPA, whilst the Institute of Management Accountants offers a CMA. And Chartered Financial Analyst (CFA) by the CFA Institute.

⇨ CPA seems to be the winner in the sample of this dissertation, having a CPA certification shows to be a huge advantage for the candidate when applying for the controller position.

b)   Working experiences
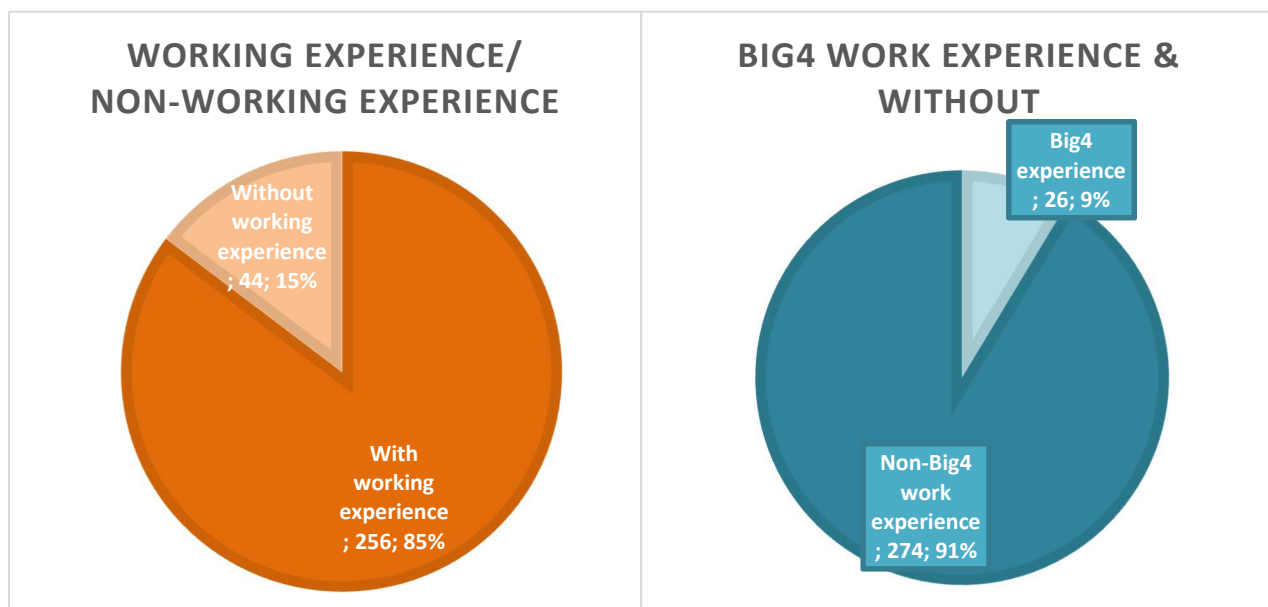
Figure 17: Working experience required for the Controller position

Figure 17 shows the working experience required in the job postings for the controller position in the USA. There is 85% of the sample shows the expectation for the candidate that has the working experience and only 15% of the sample doesn't mention this requirement.

There is 9% of the sample favorably looked for a candidate that has been working for Big4 companies (Deloitte, PricewaterhouseCoopers, Ernst & Young, and KPMG).

According to Rami (2022), it is rare to be able to land a job as a financial controller right out of college. Indeed, employers expect or even demand that the job hunters have spent a large amount of time in accounting and finance before applying for the controller position.

Five to fifteen years of working experience in accounting or finance are expected by most companies for the controller position. The number of years required is often based on the size of the firm, smaller firms are more willing to hire a candidate with less experience than larger firms.

Practical work experience provides an in-depth understanding of the way an accounting department functions, specific insights for running a business effectively, and comprehensive knowledge of the industry.

Financial controllers frequently start their careers as staff or cost accountants, then progress to accounting managers and, then, assistant controller.

Rami (2022) wrote an article on www.netsuite.com and is in agreement with this dissertation about the Big 4 working experience contact. He highlighted that the time working at a big public accounting firm that delivers accounting and auditing services to customers — particularly one of the "Big Four" — is a great advantage.

c) Foreign languages

Languages rather than English

Mention; 4; 1%

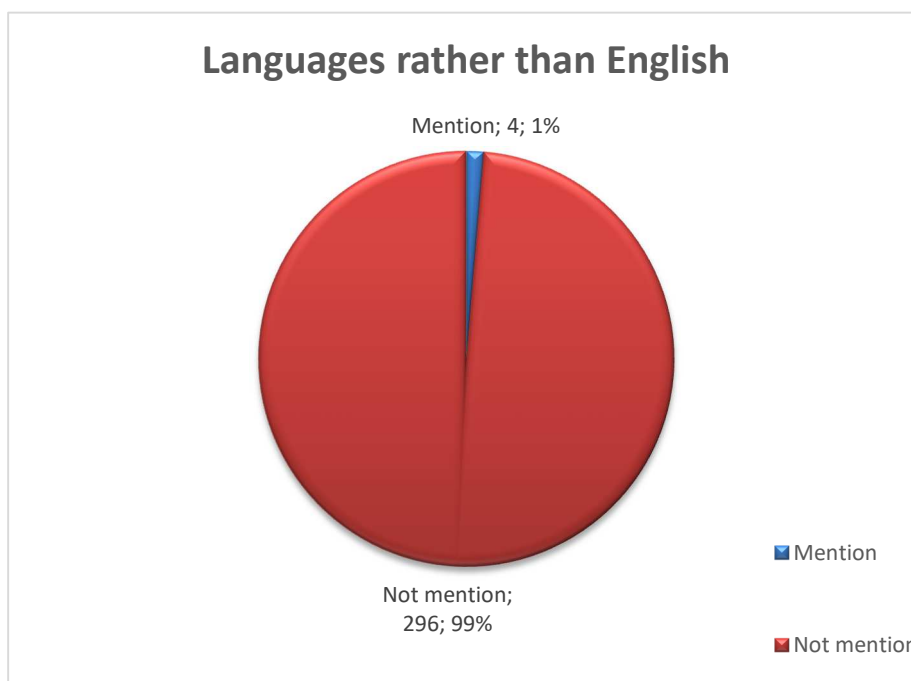Not mention; 296; 99%

Mention

Not mention

Figure 18: Foreign language required for a controller position

Within the sample, this dissertation analyzes, the foreign language doesn't seem to be a big concern when employers look for hiring controllers because only 1% of the job posting mentioned a language other than English, which is native.

5.1.3   Accounting/ Financial skills

a)   Accounting standard

A financial controller, as the head of the accounting department, must have a solid understanding of the profession and its different tasks (Rami, 2022).

A financial controller is supposed to have practical expertise in all aspects of accounting, which is typically expected because the majority of the controllers have come through the accountant positions and are CPAs.

A financial controller devotes a significant amount of time to accounting duties, such as closing the company's books, in bigger firms that also hire a CFO. A financial controller may also obtain various strategic tasks, such as financial planning and analysis, in smaller firms when the job of the financial controller is merged with that of the CFO.
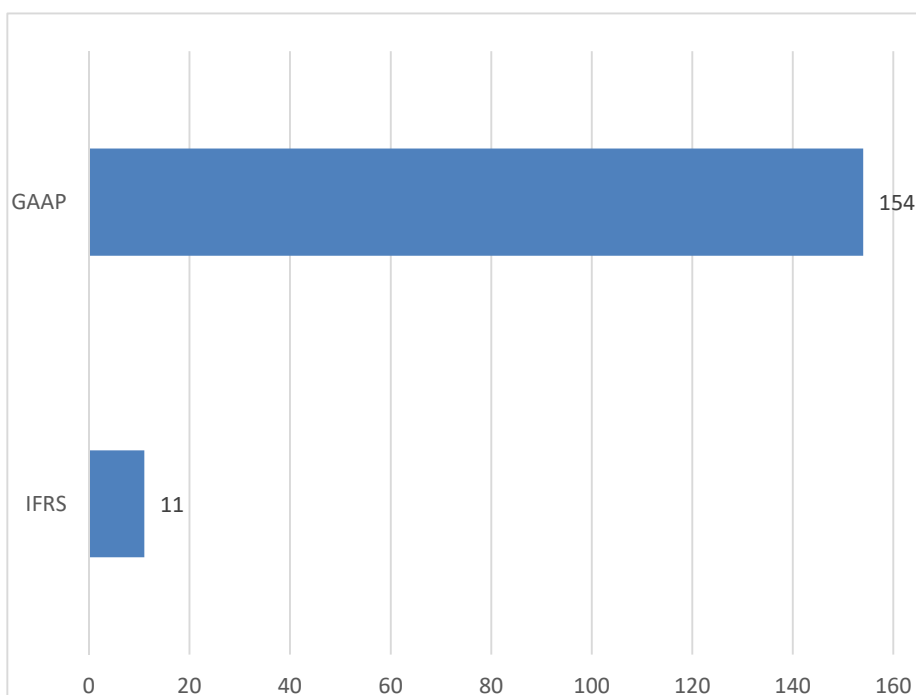

Figure 19: Accounting standard knowledge required from controllers.

Figure 19 above shows the accounting standard knowledge that the employers mentioned in the sample. There are 154 out of 300 job postings that require good knowledge of GAAP from the candidates. And 11 out of 300 require knowledge of IFRS.

This dissertation analyzes the job postings sample collected from the US market which indicates a huge gap between the requirement between Generally Accepted Accounting Principles (GAAP) and International Financial Reporting Standards (IFRS) because GAAP is standardize how publicly listed firms in the United States present their financial statements which apply to the companies in the US. Companies operating in the European Union and elsewhere in the world comply with the IFRS. That is why in the sample of this dissertation, most employers specifically require GAAP knowledge rather than IFRS.

⇨ A financial controller should be knowledgeable in accounting standards.

b) **Accounting regulation and compliance**

Figure 20: Accounting Regulation and Compliance

Figure 20 shows the accounting regulation and compliance knowledge that requires on the data sample. Finance and accounting are regulated by several outside rules and regulations that, if not fulfilled, might result in massive fines. The financial controller is in charge of assuring compliance as mentioned on 173 out of 300 of the job posting on the sample. The controllers must ensure that the company's financial reporting fits the required accounting and reporting standards, such as GAAP.

Accounting and financial regulations change often. The financial controller must remain at the forefront of new and emerging rules and inform their teams and colleagues. They need to make sure that their financial report complied with accounting standards as well as local laws, national laws, tax codes, and industry-specific rules.

The Sarbanes-Oxley Act (SOX) was introduced in 2002 to assure the accuracy and integrity of financial disclosures made by public firms. In big firms, the CFO and an internal audit team are accountable; in smaller, when one employee acts as both the financial controller and the CFO, that employee is in charge. Penalties for fraudulent actions can range from millions of dollars to prison terms for stakeholders (Rami, 2022). The knowledge and experience working with SOX were mentioned in 37 out of 300 job postings.

c)   Responsibility of controller

According to "Controllers: What They Do," (2021), a controller is a person in charge of all accounting-related tasks inside a corporation, including high-level accounting, management accounting, and finance.

A financial controller usually reports to a company's chief financial officer (CFO), however in smaller organizations, these two positions may be integrated.

A controller's responsibilities include helping with the creation of operational budgets, supervising financial reporting, and completing essential payroll activities.

The controller is responsible for a variety of activities, including budget preparation and management of critical budgeting schedules within a business. This comprises financial data collecting, analysis, and consolidation.

Although the controller role does not usually handle the annual budget, it does monitor variations, analyze trends, and examine budget shortcomings. The controller reports budget variations or expenditure variations to the management.

From the sample that this dissertation is analyzing the main responsibilities of a controller on daily basis are demonstrated in the figure below:

Responsibility of controllers

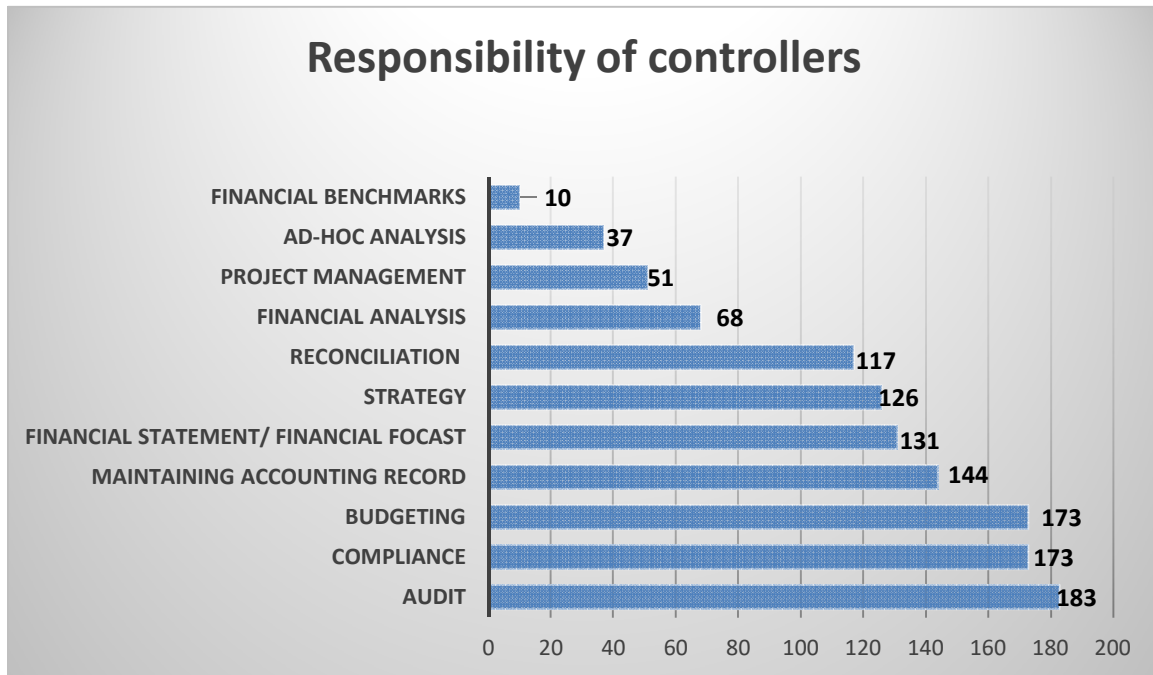| Category	Value
FINANCIAL BENCHMARKS	10
AD-HOC ANALYSIS	37
PROJECT MANAGEMENT	51
FINANCIAL ANALYSIS	68
RECONCILIATION	117
STRATEGY	126
FINANCIAL STATEMENT/ FINANCIAL FOCAST	131
MAINTAINING ACCOUNTING RECORD	144
BUDGETING	173
COMPLIANCE	173
AUDIT	183

Figure 21: Responsibilities of controllers

A controller is in charge of an organization's daily accounting activities, which include accounting, payroll, accounts payable, and accounts receivable. The controller also leads a company's strategic financial decisions and is thus critical to the firm's financial health.

Controller positions frequently entail the following responsibilities:

- Coordinating audit reports.

- Making sure compliance.

- Supervising budgets.

- Maintaining accounting records, including general ledger, payroll, and taxes.

- Preparing/ managing the financial forecasting reports and financial statements (internal and external)

- Strategy

- Reconciliation

- Financial analysis

- Project management

- Ad-hoc analysis

- Proposing financial performance benchmarks

5.1.4 Information Technology (IT) skills

Computers, servers, the Internet, Wi-Fi, and personal digital devices have changed the way businesses operate. Traditional operations and manufacturing procedures have also been enhanced by software. Accounting has made enormous progress as a result of the evolution of information technology. Accounting software replaces traditional paper ledgers and accounting books. Accounting departments have major gains from information technology (IT) (Ghasemi *et al.*, 2011).

IT networks and computer systems have reduced the amount of time accountants need to produce and deliver financial data to the management and stakeholders. Information technology also increased the overall efficiency and quality of the information.

Technology helps a company and its departments (particularly accounting) function more productively and manage costs more efficiently. The detailed information that this dissertation collected from the 300 samples of job postings in the US market, concerning the IT skill that is expected from the financial controllers will be present in the following:

a) Specific software

According to "Accounting Software Market,", the accounting software market was worth US$ 11,071.6 million in 2018 and is expected to be worth US$ 20,408 million by 2026 as demonstrated in figure 22 below.
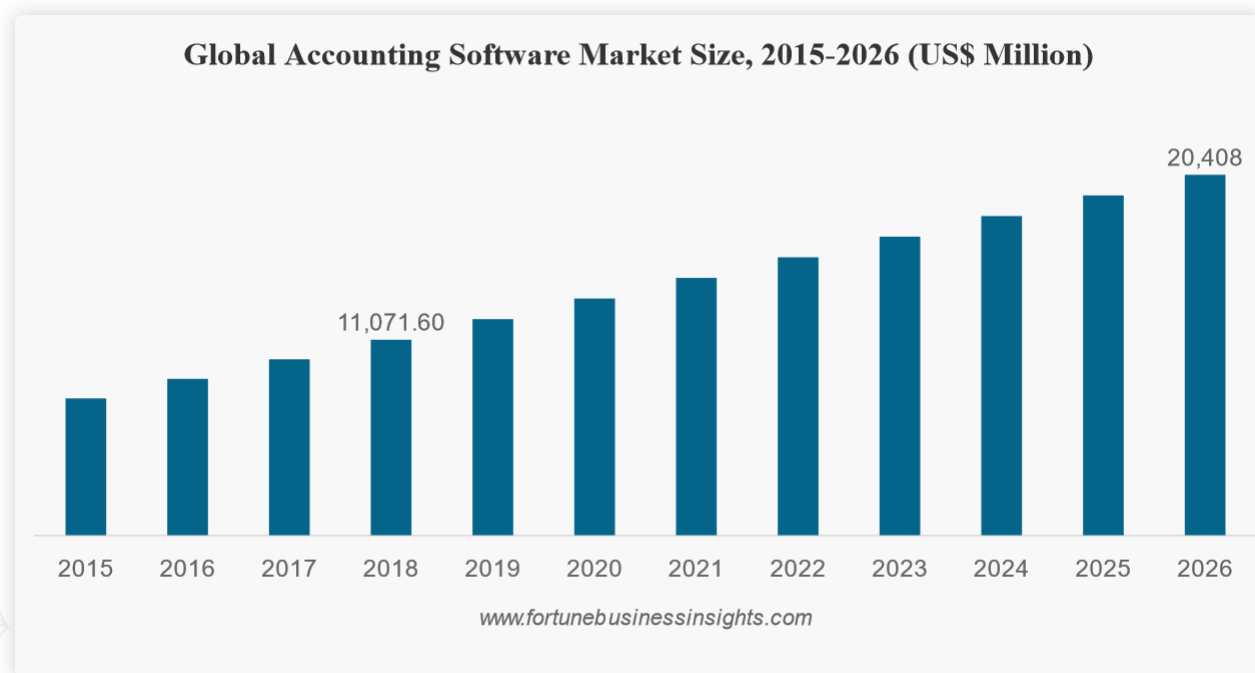
Figure 22: Global Accounting Software Market size, 2015-2026 by
www.fortunebusinessinsights.com

The worldwide market is predicted to have a considerable increase in the forecast period owing to the need for computerized accounting.

A notable tendency in the accounting software market is related to the constant evolution from the traditional approach of storing financial records manually to utilizing an accounting information system.

In the past, accounting software concentrated on fundamental functions such as inventory, accounts receivable, general ledger, and payroll.

Today, accounting software integrates with Customer Relationship Management (CRM), supply chain management, human resource management, dashboards, and reporting applications.

The accounting software is employed to perform and document all the payment information within main components such as account payable, receivable, payroll, and balance sheet. The software keeps track of transaction, cash flow, operate calculation, and generate dashboards and reports. Companies highly adopt accounting software to monitor financial transactions ("Accounting Software Market,").
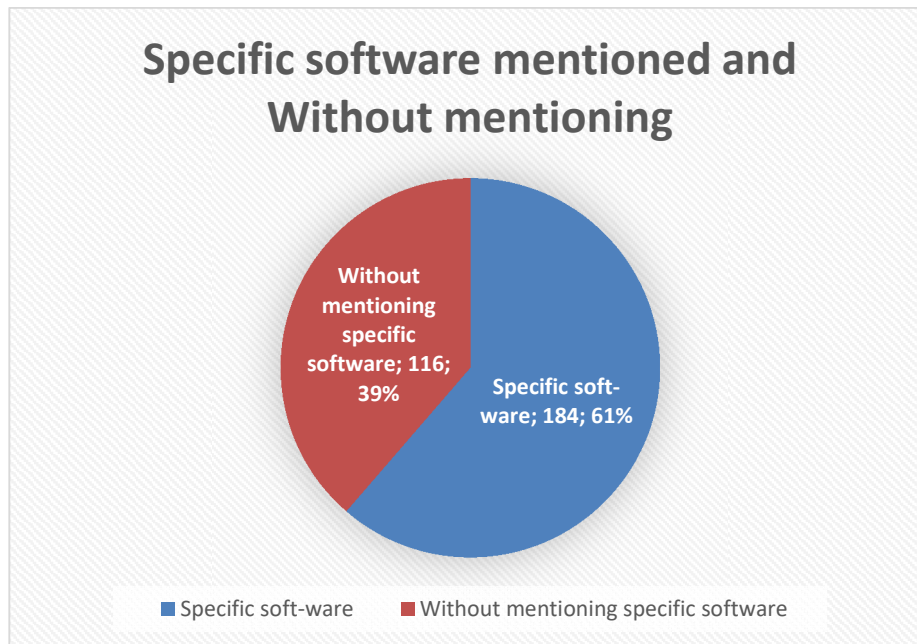
Figure 23: Job postings that mention specific software

In the dataset, there are 184 job postings, equal to 61% of the sample which specifically mentioned the name of the software that expected the potential candidates to be familiar with or to have experience working with. This indicates the important role of software in accounting nowadays. To acquire a job in accounting, accountants and controllers must have knowledge and experience working with the software.

b)   Software as a service (Saas) / IT skill

SaaS is a service model that enables customers to rent IT solutions from a third party and utilize them as if they had been purchased and developed by the users. It is a booming model of service due to its high operational efficiency and quick reaction abilities (Kim, Jang and Yang, 2017).

Since the introduction of SaaS by salesforce.com, which supplied the sales force automation solution, it has been used not just by big IT firms like IBM and Oracle, but also by small application service providers.

The global cloud accounting market was worth $2.98 billion in 2019 and is expected to grow to $4.57 billion by 2026, at a compound annual growth rate of 6.2% (Sastararuji *et al.*, 2021).

SaaS is one of the most popular cloud computing service platforms. SaaS, which is often charged on a subscription basis, is a vendor-owned model that allows users access to application software and databases via a variety of devices at any time and from any location.

The impact of SaaS on business and IT operation is significant, including cost savings, increased efficiency, improved mobility, and flexibility in hardware and software infrastructure maintenance and management access to cutting-edge technologies, as well as value co-creation through client-vendor interaction (Sastararuji *et al.*, 2021).

In the 300 samples, there were a quarter of job postings that required skill of Saas/ IT from the candidate for the controller's position.
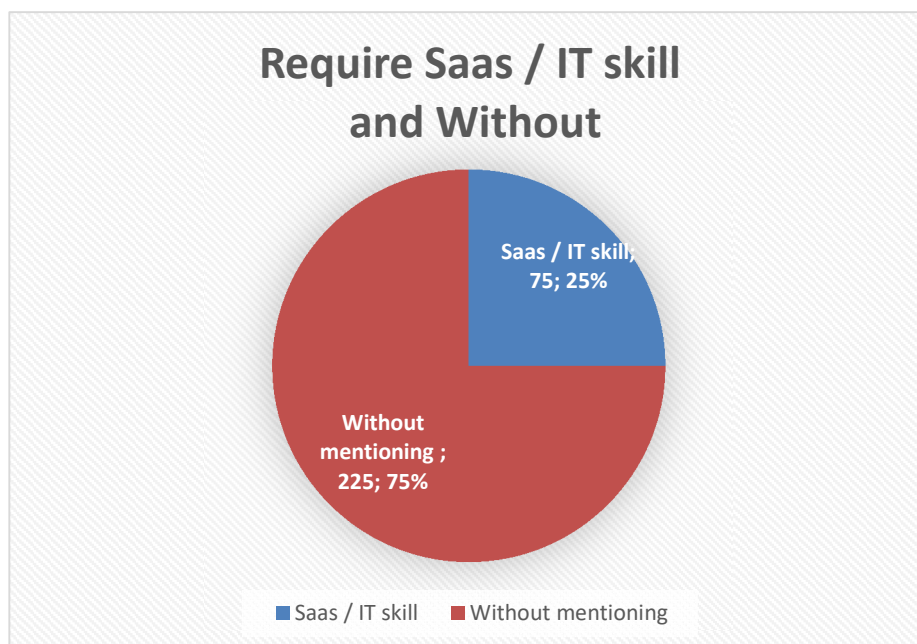
Figure 24: Job postings that required Saas/ IT skill

c) Data

The value of Big Data is not defined by the amount of data a company has. Its value comes from how the firm uses the gathered data. Every business uses the data in its way and the more successfully a firm uses its data, the faster it develops.

The importance of skill and knowledge related to data is also reflected in the sample of this dissertation. There is 52% of the sample required skill and experience in working with data, including data collection, data validation, data analysis, and data interpretation among others.

Data is the cornerstone of accounting and finance. The ability to properly track and evaluate information from several sources inside an organization is critical that financial controllers must be cultivated over time.

Figure 25: Job postings that required data skill

d)   Microsoft

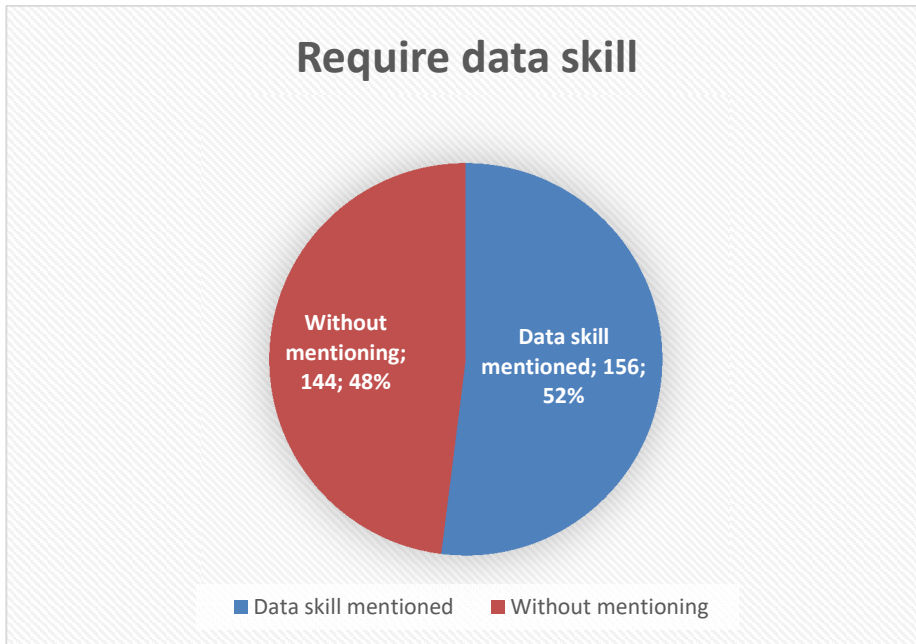There is 44% of the job postings on the sample required fluency and experience using the Microsoft application. The details of specific software that were mentioned are demonstrated in figure 27 below:
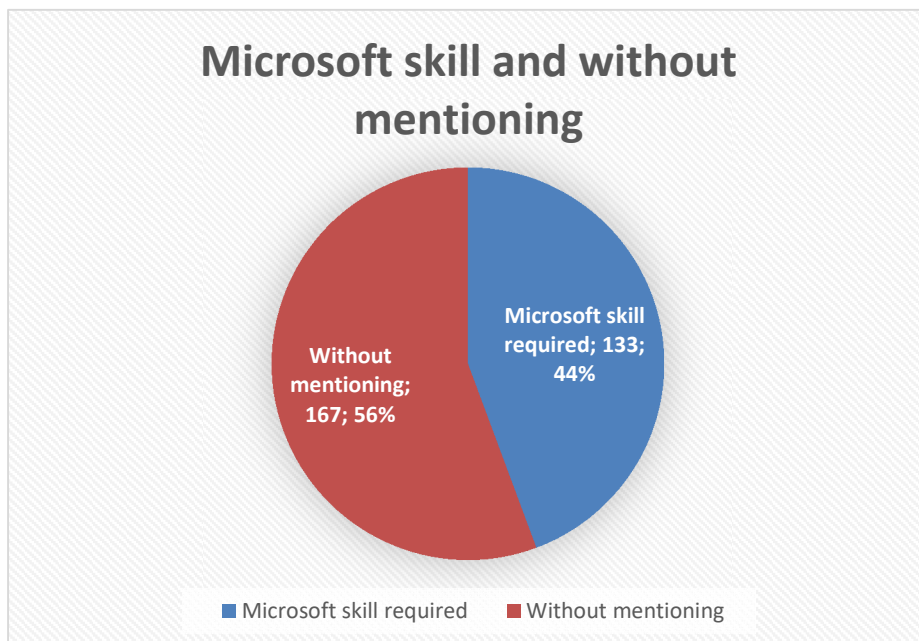
Figure 26: Job postings that required Microsoft skill

Microsoft's Office 365 refers to a collection of software products that provide productivity-related services to its users, including Outlook, OneDrive, Word, Excel, PowerPoint, OneNote, SharePoint, and Microsoft Teams.

On April 21, 2020, Office 365 was renamed Microsoft 365 (" Office 365 user," 2022).
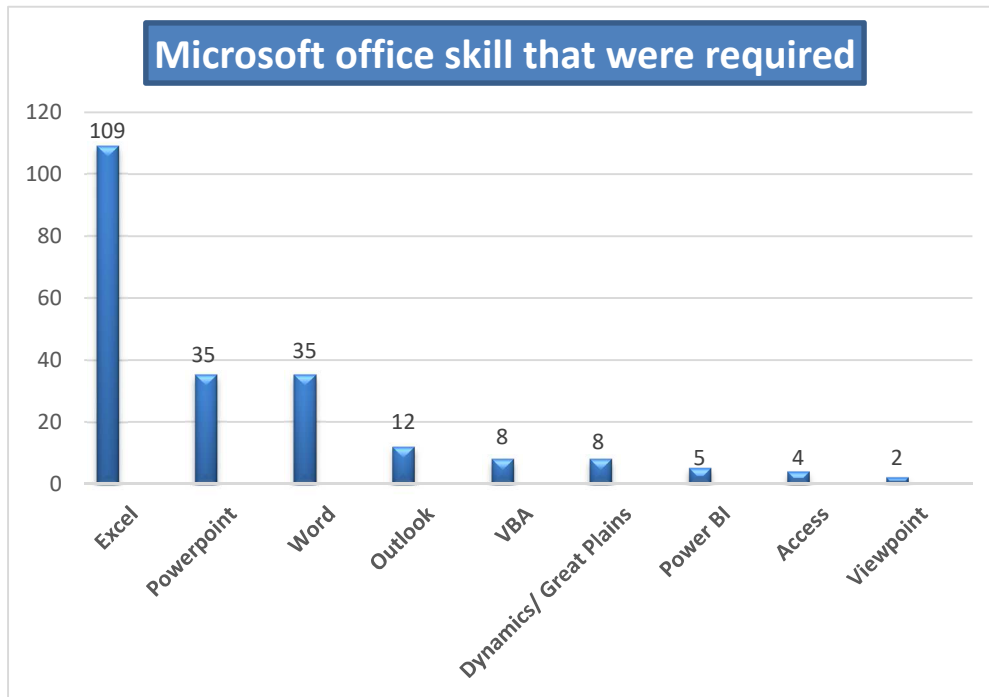
Figure 27: MS skill that was required on the sample.

Although advanced technologies such as SQL and Python exist, nothing beats spreadsheets for simple and quick data analysis. Excel is the most mentioned data analysis tool in the sample of this dissertation. Because good accounting and financial records are at the root of any good business; Excel is a valuable tool that can assist finance and accounting professionals in creating reports, analyzing data, and developing a financial strategy.
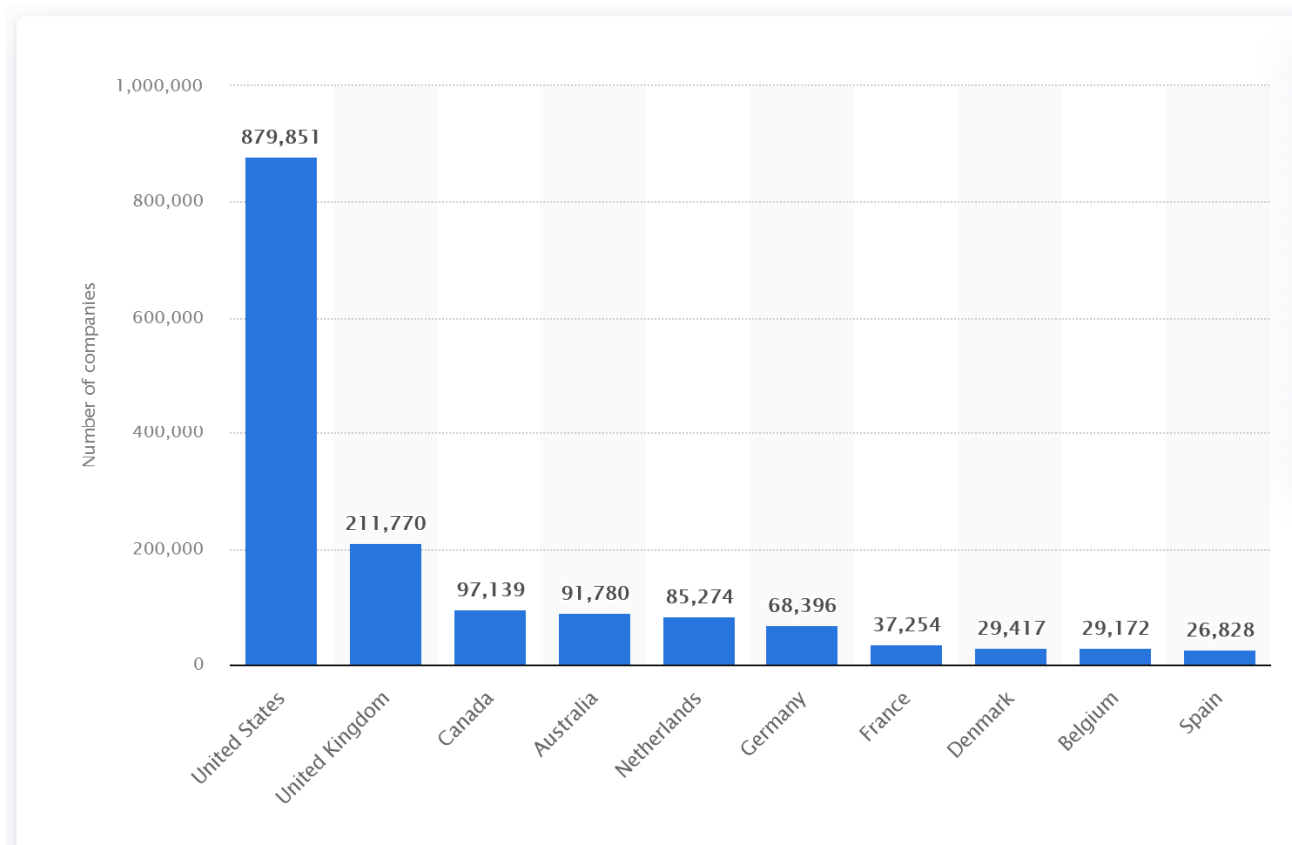
Figure 28: Number of companies that use Office 365 worldwide by June 2022, by leading country.

Source: www.statista.com

According to statistics, over a million businesses worldwide utilize Office 365, with over 879,851 firms in the USA alone employing office suite software.

According to " How Important Is Excel in Business?" (2022), spreadsheets are one of the most extensively utilized business tools. However, more firms emphasize the importance of learning programming languages such as Python to gain data analytics employment.

Excel is still used extensively in business. The ability to use spreadsheet technologies such as Excel or Google Sheets is considered basic knowledge for many business analysts and managers. Spreadsheets remain the most accessible and popular tool for business analytics; many firms have used spreadsheets since the beginning to store and analyze data and Excel is the easiest for most people to learn and apply. According to market research, around 54% of organizations use Excel in 2019—and this does not include other spreadsheet tools (" How Important Is Excel in Business?", 2022).

Spreadsheet tools such as Excel and Google Sheets are used by over 2 billion people worldwide. Companies recruit employees with Excel expertise since spreadsheets are widely used in everyday business analyses. Spreadsheets make it simple to organize data and view the data.

Excel provides likely the finest combination of power and accessibility among available solutions for data analytics; spreadsheets include strong capabilities such as graphs, pivot tables, and formulae, but are more accessible than advanced tools such as SQL.

Excel, in particular, is compatible with a wide range of other common data analytics tools such as Google Sheets because both are compatible with the standard "CSV" data storage format, they may interface with more complex data analytics choices such as Python's pandas package.

Although Excel is widely used and widely accessible, it is not necessarily the most appropriate tool for all businesses because of the following reason:

- Human error: Excel works well for smaller data sets, but it gets riskier and less trustworthy with bigger databases.

- Excel grows slower as the size of the database increases. So when a company's databases become too large and too complicated, analysts must switch to database-specific technologies like SQL and Python.

- Excel lacks powerful tools and capabilities for ensuring trustworthy data. Instead, SQL and other database technologies are intended to limit the likelihood of errors when storing, transferring, or exporting data.

- Although Excel has basic statistical analysis tools, such as linear regression, it is not the greatest tool for more complex data science jobs (" How Important Is Excel in Business?", 2022).

⇨ Excel remains the most user-friendly and commonly utilized data analytics tool for organizations, and this is unlikely to change. But when a company wants to apply complex statistical approaches like machine learning or predictive analytics, it's advisable to use the more advanced tools provided by programming languages like Python.

MS PowerPoint, MS Word, MS Outlook, VBA, Dynamics/ Great Plains, Power BI, Access, and Viewpoint were also mentioned on the job postings.

e)   Enterprise Resource Planning (ERP)

ERP, or Enterprise Resource Planning, is one of the fastest-growing software applications in the information technology sector. It combines essential business operations into a single software package that can be utilized across the enterprise.

According to "Best ERP Software 2022," (2022), an ERP system is a program that analyzes, interprets, and executes the everyday core activities of a company's numerous departments. Organizations can manage all business operations with this business management solution.

ERP includes modules like Finance, Sales and Marketing, Human Resources, Trade and Logistics, and others that facilitate corporate operations by optimizing procedures and managing data.

ERP system gives stakeholders great visibility across a company and its departments. The information obtained from ERP leads to more accurate financial planning decisions, approaches to boost cost efficiency across the company, and better management for the financial controller.

An ERP system, for example, can help with account reconciliation and financial reporting within the accounting department. It can also be used to provide internal controls that assure data accuracy, detect fraud, validate regulatory compliance, and protect corporate resources.

Modern ERP systems can handle complex calculations and advanced analysis, but it is up to the financial controller to analyze the data and apply them to influence business strategies (Rami, 2022).
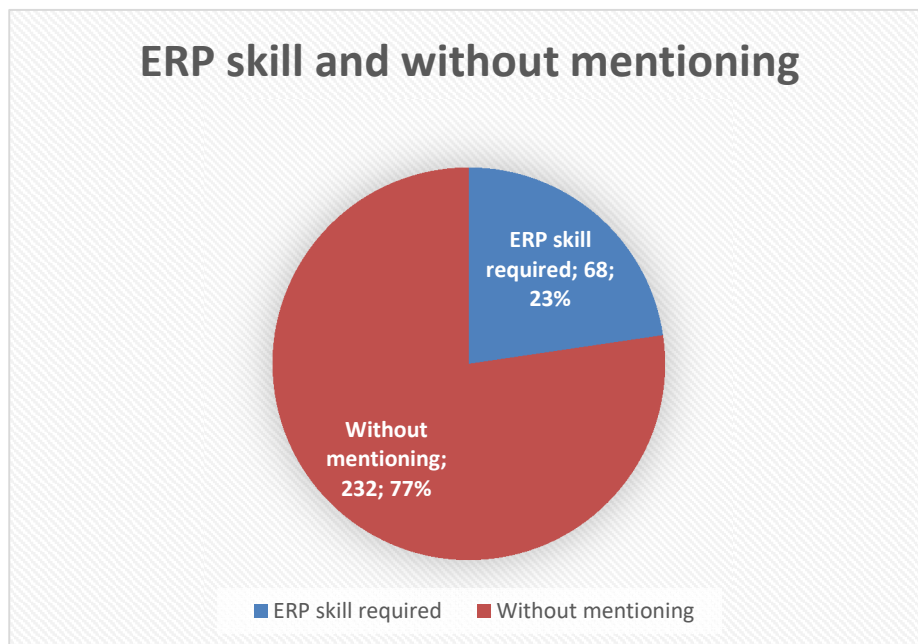

Figure 29: ERP skills that were requested

There is 26% of the job postings sample mentioned ERP as a requirement when hiring controllers. And the popularity of each ERP software that was mentioned in each job posting is demonstrated in figure 30 below:
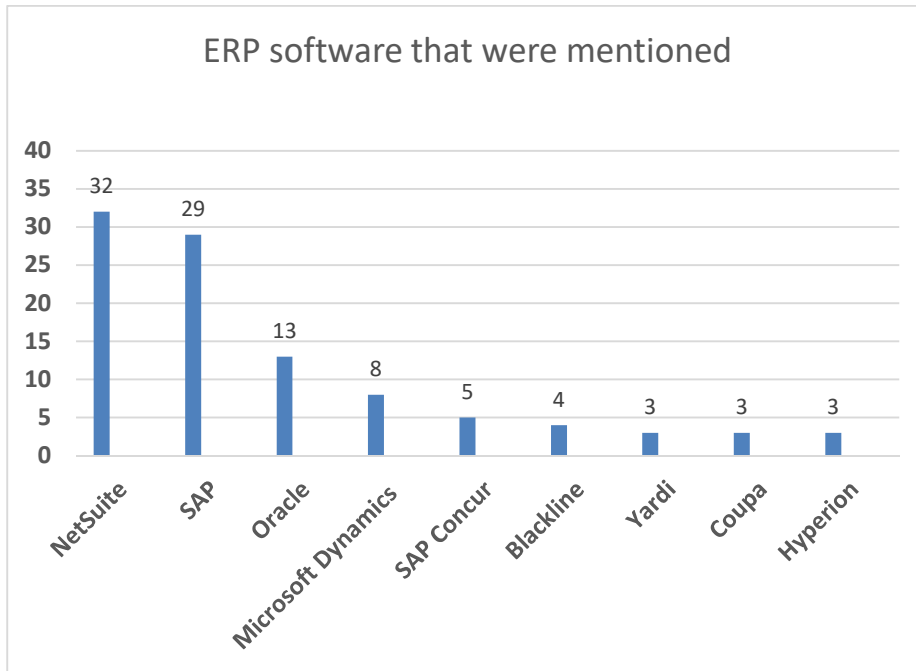
Figure 30: ERP software that was mentioned

1. **NetSuite** (mentioned in 32 out of 300 job postings)

NetSuite belongs to Oracle Corp. It suits best small and medium businesses. It is made up of five suites: ERP, CRM, E-Commerce, Professional Services Automation, and Human Capital Management, as well as NetSuite OneWorld, which allows NetSuite to be integrated across currencies and manage many subsidiaries of a business (" Best ERP Software 2022," 2022).

NetSuite's financial management tools include built-in business intelligence. Its financial planning tools will reduce cycle times and improve the quality of the planning process and it has order management tools that will speed up the order-to-cash process.

It includes Procurement, Warehouse & Fulfillment, Supply Chain Management, and Production Management features and functions.

NetSuite will help to simplify business procedures. It includes built-in business intelligence that integrates data and visual analytics. It is a scalable solution that allows users to easily add and change functionality as the company expands.

2. **SAP** (mentioned in 24 out of 300 job postings)

SAP stands for System Applications and Products in Data Processing. SAP is the global leader in ERP software, assisting businesses of all sizes.

SAP SE, headquartered in Germany, is well recognized for its SAP S/4HANA business suite and other cloud-based software solutions.

SAP was founded in 1972 by a group of former IBM employees, the company has subsequently evolved to become one of the world's leading software and programming firms. The corporation has had a very successful decade, with yearly revenues more than tripling and net profit jumping from roughly 1.8 billion Euros to over five billion over that period.

SAP has shown its determination to be at the top of the software industry for years to come, with an R&D expenditure of more than four billion euros and a strong portfolio of recent acquisitions. Global corporate software spending has steadily climbed over the last decade, and estimates indicate that this trend will continue in the future.

SAP is well positioned for success in a fast developing sector, with its popular SAP S/4HANA suite now having roughly 17,500 users.

According to HappyAR (2022), the SAP financial accounting system has several advantages as follows:

- It is a well-designed system with limitless potential, it is also readily integrated with other software and apps. A variety of tools have been developed to assist SAP users with specific needs.

- Outstanding audit trail: The system supports customizable business rules, which may be set up at the time of deployment or as needed. Certain procedures, such as cash collection in a bank account, may be automated by these rules.

- The system is extremely unified and modules are linked to each other, allowing for real-time data access by anyone that has permission. Each transaction is methodically integrated into the business modules. This automation enables a more efficient and speedier month-end closing procedure.

- The SAP system enables cross-jurisdictional tax rule optimization for improved compliance and automated operations.

- To personalize the system, users can employ a variety of third-party and SAP-designed software tools. An SAP professional may work along with the company to discuss several choices that may be suitable for the company, for example, SAP Concur is built for corporate travel expenditures; SAP Blackline is an account reconciliation tool.

There are also some drawbacks to adopting SAP:

- Not User-Friendly: SAP may be a challenging system to learn for those who are not technically proficient because it employs a code-based mechanism to access various application functionalities. Furthermore, companies need to rely on an SAP technical specialist to correctly install the system. Accountants who are not technically savvy may have difficulty understanding how to utilize it.

- Advanced payment & high price: SAP is a quote-based system, which implies that each firm is offered a price for the system based on their specific demands. If a firm decides to buy SAP, a specialist will work with them to analyze their existing financial system reporting procedures and pick the SAP modules and applications that are most suited to their needs. As a result, paying a fixed monthly charge for accounting software may not be possible. Depending on the price structure provided, companies may be required to pay in advance.

- Not suitable for smaller businesses: SAP is typically employed by very big corporations with a large volume of business activity and income. These corporations may have a variety of entities, goods, income sources, and inventory kinds. Their customer base might reach the tens of thousands. While SAP has grown in recent years to provide solutions to smaller firms, its primary concentration remains industry giants. If a firm is small or medium-sized, different ERP systems may be better appropriate for their needs rather than SAP.

f) Cloud-based software

There is 26% of the sample mentioned cloud-based software as demonstrated in figure 31 below. The most mentioned cloud-based software is QuickBooks.
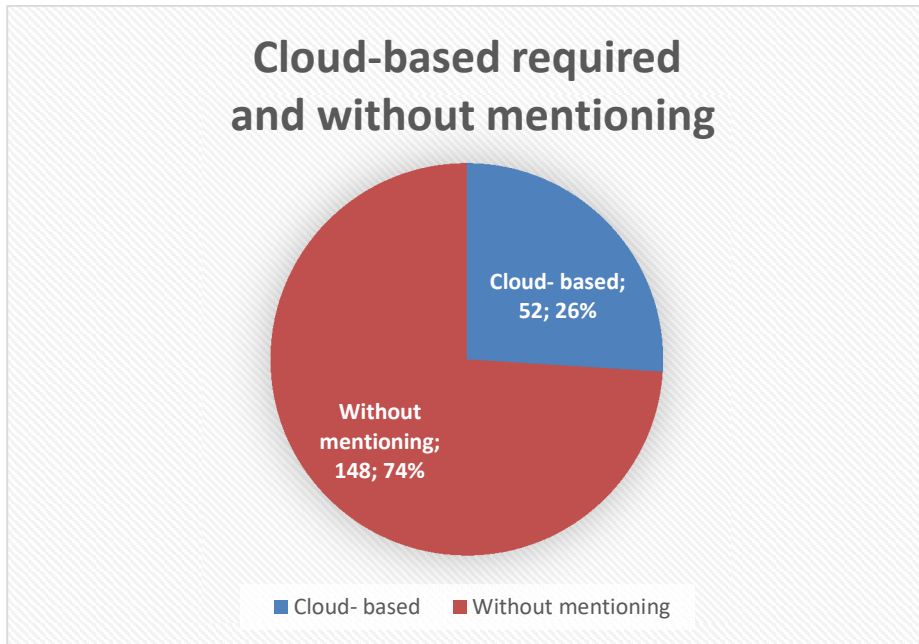
Figure 31: Cloud-based skills that were required
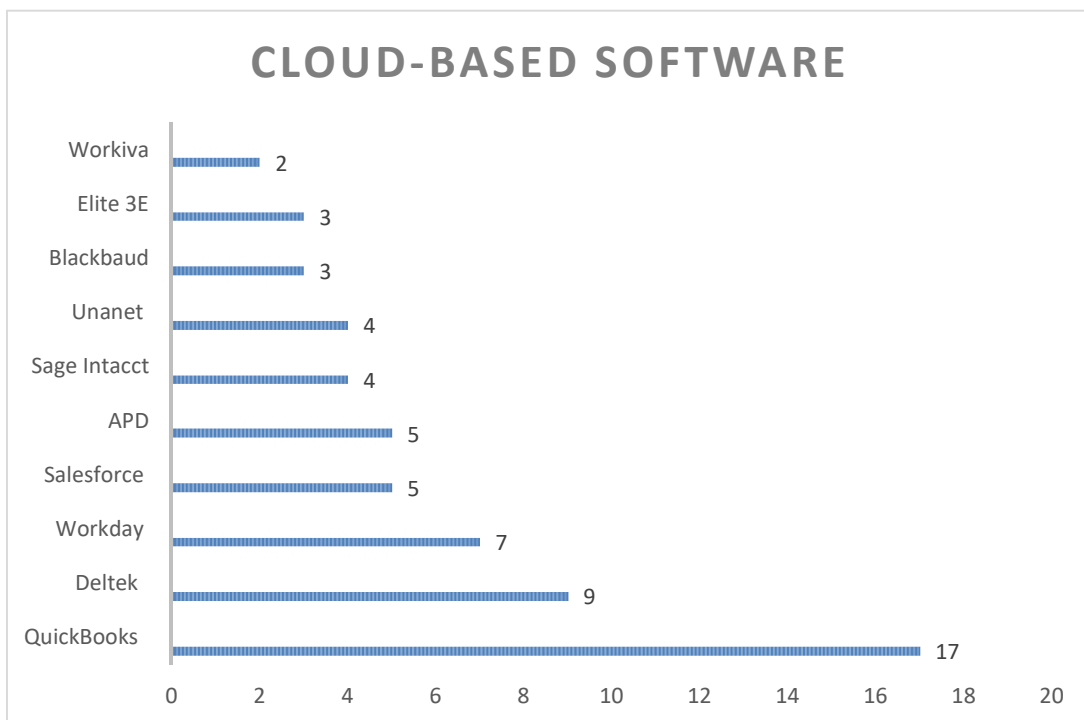
Figure 32: Name of cloud-based software

QuickBooks is a set of accounting software created and provided by Intuit. QuickBooks software, which was first presented in 1983, is primarily aimed at small and medium-sized businesses and provides both on-premises accounting software and cloud-based applications that handle business payments, track and pay bills, and perform payroll operations.

Accountants like working with QuickBooks because of its functionality and user-friendly layout. It has now been nearly two decades since its birth. However, its popularity among accountants throughout the world continues to grow with time (Watson, 2015).

After QuickBooks, there is other cloud-based software that was mentioned several times such as:

- Deltek is an easy-to-use, efficient system for managing project expenses, calculating earned value, and analyzing budgets, actuals, and forecasts ("Powering Project Success, ").

- Workday is a cloud-based software that focuses on solutions for human capital management and financial management (" What is Workday?").

- Salesforce is a customer relationship management (CRM) software. Salesforce has helped over 150,000 businesses, both large and small, thrive their businesses (" Why Salesforce Platform ").

g)   Coding

In the dataset of this dissertation, not many companies mentioned coding skills when they hire controllers. Some coding languages were mentioned such as VBA, SQL, Looker, and Python.

In general, coding skill doesn't seem to be a crucial skill that is required in the limit of the data sample of this dissertation.

Figure 33: Coding software that was mentioned

5.1.5   Soft skills

Figure 34: Soft skills required in the job posting for the controllers.
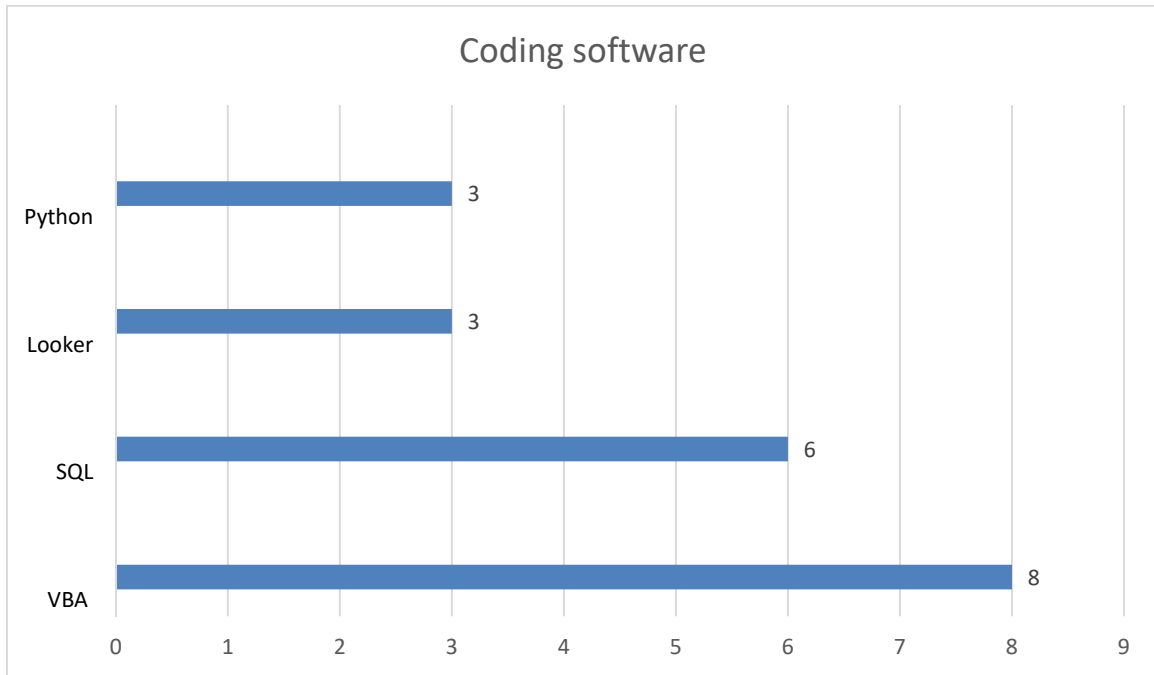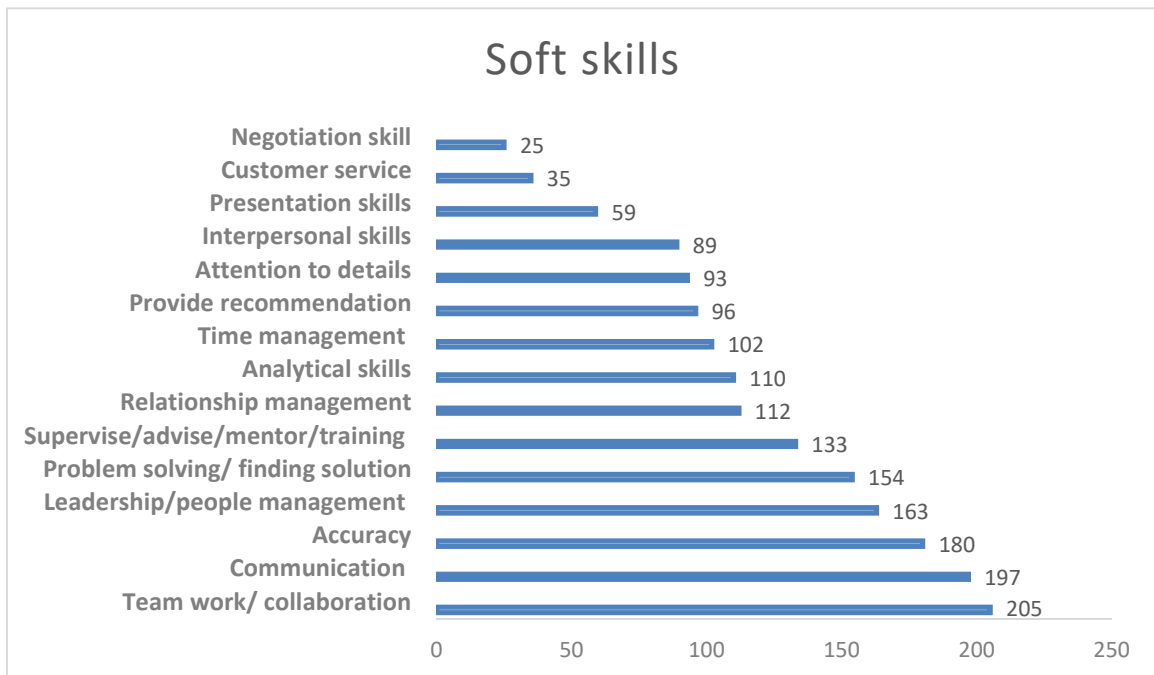
a)   Teamwork/Collaboration

Figure 34 illustrates the soft skills that are most frequently mentioned in the sample of this dissertation.

The most mentioned soft skill is "Teamwork and Collaboration". This was mentioned in 205 job postings over 300 job posting in total that this dissertation collected, which corresponded to 68.34%.

According to Broetje, 2018 "accounting is a team sport" from the author's experiences, accounting works best when it is collaborated with the management team, as the author learned throughout his 30+ years as a CFO, the manager will never be at their best if the accounting team operates in a silo.

The author outlined some of the benefits of teamwork/collaboration, especially in accounting for the company, which include:

- Better data: Accounting team members that collaborate and are willing to collaborate with other departments will create more precise data.

- Better decision-making: Data will not only be more precise but also be delivered quicker, allowing for timelier decision-making. The owner and CEO can seize opportunities or detect problems & make quick moves to mitigate a potential issue. And well-informed decisions, based on the finest information, provide the most confidence that supports the decision-making process.

- Better planning: A collaborative accounting system will also produce more precise and timely plans. This leads to maximizing budgets, cash flow estimations, and strategic plans. As a result, companies save money by improving inventory management, reducing loss, and purchasing more efficiently.

- Improved operational efficiency: teams are more effective than the individual that act independently. Team members may hold each other liable and encourage each other to work toward a mutual objective.

- Better profit margins: The better quality of data produced by the accounting team have a big influence on the organization. It helps in cutting costs, increasing revenues, and overall working more efficiently.

- Happier employees: Happy employees are more efficient and one approach to increase morale is to have everyone working together rather than individually.

The accounting team is more than the sum of software and accounting tasks (Broetje, 2018). Consider a sports team or an orchestra, where everyone has a specific role but they can't achieve their goal without the help of their team that is why teamwork and collaboration is the most mentioned soft

skill. Businesses that prosper have leaders and CEOs who understand the value of collaborating and working with the accounting staff and engaging the accounting stuff with each other and with the rest of the company and vice versa. This creates enormous value.

b) Communication

The second most mentioned soft skill in the dataset is "Communication". According to an article written by the University of North Dakota (UND Online,2019), accounting professionals that show good communication skills are more likely to be successful professionally. They are likely to play important role in the success of companies.

The website Small Business Trends highlighted that: The goal of working as a team is to share ideas and enhance productivity. When good communication at work is missing, the entire effort might be ruined. This is the reason why the concept of "good communication skill" is keep being repeated over and over again on the job posting dataset (there are 197 out of 300 job postings required their potential employees to have good communication skills).

According to the American Institute of CPAs, accountants must communicate with a wide range of people daily such as other accountants or managers from the accounting department or colleagues from other departments who need accounting information and help.

Accountants also communicate with corporate and individual clients, financial institutions, and governmental authorities.

In summary, an accountant communicates with any person or entity that has a need or a right to know about the financial elements and operations of a company.

According to the American Institute of CPAs, accounting communications skills fall into three categories:

- **Interpersonal communication**: The ability to speak with colleagues from different departments and able to collaborate with other team members.

- **Written communication:** the competence to communicate in written form such as financial reports, strategic plans, proposals, and letters among others.

- **Verbal communication**: the ability to explain complicated information and statistics in simple language that is easy to understand. This requires exceptional communication skills and an understanding of the audience.

The stereotype that accountants are introverts and people who work individually and don't like socializing is no more suitable for the economy nowadays. To be successful in their job, accountants especially MAs need to communicate and create a good relationship with many parties involved in the business.

There are repetitive tasks in accounting that will probably be replaced by machines in the future. But the question is: "Who can replace an accountant who has a good connection and good communication skills?" Would a business partner want to talk to a robot when they visit companies or a factory to look for collaboration? Soft skills certainly make each accountant different and unreplaceable.

c) Accuracy

"Accuracy" is the next component that was kept being requested by employers when they look for a new MA and controller. In the sample, there are 180 out of 300 jobs requested accuracy as an essential skill.

Without accurate accounting information, the management team cannot make the right decisions. The "accuracy" element affect directly to the company's financial health.

For example, accurate financial information helps the manager to understand how much money the company makes and which clients/areas of the business are successful, where they might need to relocate workers, and where they might be overspending. If the accountants themselves don't respect "accuracy" the company risk making the wrong decision, losing profit, making the wrong investment, or even going bankrupt.

A report by PwC (2022) identifies a few reasons why "Accuracy" in accounting is crucial for companies:

- The companies owe a fiduciary responsibility to their customers and business partners. That is why it's difficult to present themselves as reliable stakeholder when they're not in control of their finances.

- Accounting accuracy can help companies figure out the consumers they intend to attract. When they understand the profitability of each team, they can concentrate on growing the firm in those areas that will be the most beneficial to the total financial condition.

- Improving the negotiation position when negotiating conditions with a new customer, because if the company does not have an accurate picture of its financials they may be disadvantaged

while negotiating. One might enter a deal with a new customer or supplier that is only marginally profitable or even makes a loss if they don't have a strong insight into their company expenditures. Financial accuracy can assist in making sound judgments concerning business decisions.

- Improve efficiency: If a company does not need to bother with handling their bookkeeping and other financial information, they free up their personnel for more important work. Furthermore, "accuracy" aids in eliminating errors, which minimizes the amount of time spent examining and correcting accounts.

d) Leadership/People Management

The next important element is "leadership and people management"

According to Banham and He (2013), professional accounting firms all over the world are focusing on the growth of leadership skills and competencies for their personnel because professional accountants are progressively required to participate in the obstacles of changes in the management system inside the companies.

International Financial Reporting Standards (IFRS), private company accounting standards, technologies, global competition, and the rising complexity of businesses are all influencing the accounting profession (Nilsen, 2010). Accounting professionals must have excellent technical expertise as well as strong leadership talents to effectively adapt to these shifts.

According to Early and Davenport (2010), creating great leaders is crucial for professional accounting organizations. They further emphasized the importance for leaders to shift from transactional to transformational leadership behaviors, such as vision creation, intellectual stimulation, and becoming an agent of change.

Thomson (2008) identified communications, teamwork, influence and leading teams, and managing changes as critical skills for MAs and financial professionals as their careers progress to more senior positions.

Developing leadership abilities in public accountants is considered critical to promoting quality in services and the competitiveness of professional accounting companies (Werner, 2009).

Providing a pleasant place to work, developing a learning culture, and executing strategy are all critical components of successful professional accounting companies, and providing opportunities for learners that train future leaders is crucial for all sizes of businesses (Caragher, 2010).

The findings of Jansen (2011) show that successful organizational transformations began with management accounting changes tied to the style of leadership.

According to Viator (2001), transformational leadership has a significantly positive influence on role clarity, job satisfaction, and organizational commitment. Leadership means giving inspiration, intellectual stimulation, and personalized guidance to tackle the problems of growing economic competitiveness and the need for innovative solutions to changes in the industry.

e)   Problem-solving/ Finding solutions

In more than half of the jobs posting sample, there are154 out of 300 jobs mentioned the concept of "problem-solving/ finding solutions" as a requirement from employers when they look for controllers and MAs.

This is a common concept that appears in most job postings that remind the simplest answer to the question: why should companies hire anyone to work for them? The answer is that they have a problem that needs to be solved. Employers pay the employees that can solve a problem for them, the owner or founder of a business is not necessarily know how to perform all the tasks in the company which is why they look for the right person for the right task.

This is a very frank demand that is found in 51.34% of the sample being analyzed in this dissertation. This also recalls the basic concept in business: if one has a problem then he is willing to pay for someone else that can give him a solution. In the contact of accounting and business, this goes on a narrower view.

In the future when a computer will become so smart that it can find solutions and solve a problem for companies for a lower cost than hiring an MA or controllers, will the company still keep the employees that have performance as equally good as the computer but at a higher cost? The answer is most probably not.

That is why this dissertation tries to uncover what kind of problem the companies have that only humans can solve. If the accountants understand these key points that make them unreplaceable, their position will be secured.

Problem-solving, in general, is a person's capacity to properly handle and solve complicated and unexpected problems. Those with strong problem-solving capabilities have the analytical, creative, and critical thinking, as well as high attention to detail. They are at ease making judgments and are self-assured enough to face business problems. They can detect issues and find the most effective solutions quickly. According to an article published on TestGorilla, problem-solving skills

are crucial in the workforce because every business and job position has challenges. The article enumerates 6 key qualities to identify problem solvers:

- **Active listener**: These are very often excellent problem solvers. They receive information by listening and observing those around them. They realize the value of recognizing others' views and experiences, this helps them to understand the reason behind the problem and the best way to solve it.

- **Analytical thinker**: These can recognize the logical reasons why a problem arises, analyze the long-term consequences of the problem, and evaluate different solutions to find the most suitable one.

- **Creative thinker**: These people know how to balance analytical and creative. They can discover progressive and innovative solutions. They can provide fresh ideas and creative, unique solutions to a wide variety of problems.

- **Communication:** Problem solvers should be able to communicate effectively. The capacity to effectively present complicated information adequately but in a clear and easy-to-understand way. This skill helps employers to save time in attaining information and finding the best solution.

- **Decision maker**: Those with the ability to make a decision and are confident in their judgments. This is essential since most problem-solving procedures need making excellent judgments to achieve a good solution.

- **Teamwork**: While problem solvers must be independent thinkers, they must also be able to work collaboratively as part of a team. Finding the right solution frequently needs collaboration, thus applicants must show how they can motivate others to bring the best solutions and engage with them to help create and carry out solutions.

  ⇨ Problem solvers are mentally prepared to manage challenges at work. They are not afraid of the unknown, they can observe, analyze, and act quickly. These qualities are very valuable to businesses and can't be realized on machines.

f)   Other soft-skill requirements

- **Supervise/ advise/ mentor/ training (mentioned on 44.3% of the sample)**

Mentors are experienced people in the field and life- sharing their knowledge, experiences, skills, and advice with "mentees," who are less experienced.

This developmental partnership's purpose is not only to increase the mentees' performance but rather also to aid in their personal and professional growth.

Learning from a mentor help young accountants have a better understanding of how it is to work in a specific role and do specific tasks. These lessons are not usually taught in school.

Mentorship could be incredibly beneficial for accountants, but according to data from the Association of Accounting Technicians (AAT), there is a lack of mentoring in the finance and accounting sector (Carew, 2021).

Not only mentoring but this dissertation gathers all the activities of supervising, advising, mentoring, and training in the same group because they all reflect the similar act of helping junior accountants with fewer experiences in the field. This concept appears in 44.3% of the sample, mostly in the senior position, which means that training, and helping the young accountants at the technical level and personal level are expected from the senior controllers and MAs. Those that have mentoring, and training experiences in their Curriculum Vitae (CV) gain a significant advantage when applying for the job in controlling and managerial accounting.

- **Relationship management (mentioned in 37.3% of the sample)**

It is also very important for a controller to be able to create and maintain good relationships both with interior and exterior stakeholders. Having a good relationship with colleagues and business partners is a huge plus, alongside their technical skills, relationship management skills will make the controllers become a good match for the accounting and finance department and unreplaceable employees for the companies.

Imagine a computer can do the technical task as well as a controller but it is impossible to think of a company that will replace a controller who can build and maintain a solid relationship with their customers and business partners with a robot.

- **Analytical skill (mentioned in 36.7% of the sample)**

Not surprisingly, analytical skills are mentioned in 36.7% of the sample. It means that the controller candidate should be skilled and knowledgeable in analysis. Because they will be in charge of producing and approving financial reports, as well as breaking them down to insights ("6 Skills Every Financial Controller Should Have", 2020).

If the firm is public, these reports and data will be distributed to the executive team as well as shareholders. Depending on the firm structure, the controllers may also be in charge of cost analysis and possibly share this information with the executive team and shareholders. And this analysis will

also be used to improve overall performance and to assess the effectiveness of the company's financial plan.

⇨ Therefore, a controller having expertise in analysis and analytical skills will be the optimal match for the job's tasks and duties.

- **Time management (mentioned in 34% of the sample)**

Time management skill is important for every employee in every profession. Without time management skills one can constantly feel busy and overwhelmed with the workload. Even if there is plenty of time but if the amount of time is not well distributed to each task one still can't manage to meet the deadline.

In the sample that this dissertation analyzes, the employers mentioned quite often the concept of "time management" as they explain further the capacity to meet deadlines and even tight deadlines. Having to work with a tight deadline is a familiar concept in accounting when accountants can have tasks that they need to deliver with little time due to the need of the client or the company.

When the accountant needs to deliver financial reports or auditing due to the client's need or the companies' demand, they can be asked to work a huge amount of hours, working until late or working at the weekend.

Time management tends to address the ability of meeting deadlines, being able to work with tight deadlines, and resistance to stress due to limited time.

Accountants are known for working long and intensive hours throughout the tax season (approximately February to April) before taking a break during the spring and summer. During this period, it's common to work more than 10 hours a day, six days a week (Ross, 2021).

According to the article named " Time Management In Accounting," (2022), when the accountants and their teams are busy, it is a good sign of a company's success. Even so, such fast-paced work may frequently become too stressful, which makes it difficult to provide high-quality work on time. That's why it's crucial to master time management in accounting.

- **Provide recommendations (mentioned in 32% of the sample)**

There is 32% of the sample mentioned providing recommendations as one of the expectations from controllers. The recommendation is mostly to the management to improvement in processes, for optimizing profitability, and provide recommendations for policies and changes to procedures, also on strategy.

The controllers are expected to give recommendations to the President, COO, and Management Team.

- **Attention to detail (mentioned in 31% of the sample)**

The candidate for the controller position must also be detail-oriented. Maintaining a company's finances involves a large amount of data. This huge amount of data is kept in complicated spreadsheets.

Attention to detail assures that the spreadsheets will be precisely and carefully created. It also implies that the controllers will be able to communicate financial data details to others in a comprehensible way ("6 Skills Every Financial Controller Should Have", 2020).

⇨ Attention to detail is a crucial skill for the controllers which is why it was specifically requested in a third of the job posting sample that this dissertation analyzes.

- **Interpersonal skills (mentioned in 29.7% of the sample)**

When a company is searching for a job candidate, they often search for someone who has strong communication and interpersonal skills (Hub, 2022). These two skills can be confused as the same because of their overlapping conception but there is a distinction between the two.

Interpersonal skill is the skill to communicate, connect and interact with others. It consists of both communication and attitude. It emphasizes interacting with others on a personal level while keeping professional respect.

Communication skills, on the other hand, are abilities to communicate with others, including listening, reading, writing, and speaking skills.

Employers must acquire interpersonal skills to properly connect and communicate with team members. These skills also enable employers to engage with stakeholders professionally.

People with interpersonal skills are valued because they get along well with everyone. Such individuals have a chance of performing well in the company.

⇨ In summary, interpersonal skills help to develop confidence and lead to improving decision-making and problem-solving skills. This is a valuable skill set for employees in an organizational environment and the data set of this dissertation support this conclusion.

- **Presentation skills (mentioned in 19.7 % of the sample)**

A competent controller must understand financial concepts and statements, therefore numerous technical skills are essential to be a qualified controller.

But no matter how good a controller is at analyzing data and how much data and energy is put into preparing a report, it might be considered pointless if the controller does not manage to present his finding clearly and understandably to the superior or the public. This means that he fails to persuade management or employees to act and change.

So the responsibility of a controller doesn't stop from creating reports but also convincing people to act in a beneficial way for the company. That is why presentation skill is among the important soft skill that is crucial to being a good controller.

- **Customer service (mentioned in 11.7% of the sample)**

A successful firm, despite of its kind or size, must be able to provide good customer service.

Profits are not the only thing that matter but having a good reputation keeps the companies prospering in the long run. Both ethics and technical expertise are critical in distinguishing one company from another in the same business.

The accounting sector is transforming as technologies simplify tasks and eliminate paperwork, the accountant's role is becoming more of an advisor.

In the accounting world, honesty is highly valued. Accountants and companies take pride in keeping the highest ethical standards and servicing their clients with honesty and integrity. It is critical to be open and honest while making judgments, giving advice, and performing tasks.

Every sort of business is urged to build genuine relationships with its customers. This relationship must be built on trust and must prioritize fulfilling the needs of the customers over closing sales.

⇨ Provide a high quality of customer service that encourages customers to remain loyal and have a long-term relationship with the company. It also produces remarkable word-of-mouth among happy customers who are eager to share their pleasant experiences with others.

- **Negotiation skills (mentioned in 8.3% of the sample)**

Negotiation skill is important for MAs as well because they impact their capability to perform the work effectively, develop connections, and fulfill the company's goals. Accountants need to negotiate terms and conditions with suppliers, customers, regulators, or with colleagues. But in the

limit of this dissertation, negotiation skill was mentioned only in 8.3% of the job posting that was collected.

5.2 Insights

5.2.1 What kind of opportunities and challenges do the new technology and AI present?

According to Bhimani and Willcocks (2014), new possibilities for digitally enabled businesses present information challenges, opening opportunities for accounting and finance practitioners to use Big Data analytics and play a more strategic role in the future.

Emerging technologies such as data and business analytics are projected to revolutionize the data-intensive tasks of both controller and MA in enhancing management decision-making (Brands and Holtzblatt, 2015).

Business analytics (BA) and information technology (IT) skills have become one of the key competencies that the controller and MA must have. Therefore, the controller and MA roles are likely to move in a data scientist direction with strong systematic and mathematical-statistical expertise, along with business analytics capabilities (Oesterreich and Teuteberg, 2019).

From the literature review, the replacement of human activities with machines and robotics in repetitive tasks in accounting is expected, especially for financial accounting. Even if blockchain technology has the potential to automate audit and assurance operations, auditors' professional judgment is still required to evaluate complicated accounting cases and manage the evaluations of the financial statements. Auditors will still need to collect proof of the presence of transactions recorded on the blockchain and validate the coherence of recorded data with the real world (Atanasovski, Bozhinovska Lazarevska and Trpeska, 2020).

AI and machine learning technologies are more likely to replace certain repetitive tasks performed by accountants than to result in significant cuts in accounting-related job employment over time. However, in the future, the technology will be increasingly exploited, putting more pressure on accountants to develop skills to work alongside AI and machine learning software to conduct a more effective assessment, oversee technology-enabled external and internal audit processes, and collaborate with technology developers for new AI-enabled tools.

The future auditors will have a different role in terms of data and information analysis. They will need to go from fact-checking to massive and unstructured data analysis, displaying competence in in-depth regression analysis and predictive statistics (Krahel and Titera, 2015).

Many organizations, governments, and regulators have undoubtedly grasped the promise of blockchain technology, and there is investment enthusiasm among tech company executives. However, there are several constraints to wider and faster adoption across a variety of companies and uses. Among the technology's flaws are its lack of scale, the requirement for processing power, and high transaction costs, as well as compatibility and secrecy (Atanasovski, Bozhinovska Lazarevska and Trpeska, 2020).

Companies will need to establish IT infrastructure and systems for continuous monitoring, analysis, and interpretation of data acquired both internally and externally because of the potential of the Internet of Things and Industry 4.0 to revolutionize manufacturing and logistics businesses.

5.2.2 How can accounting educators prepare their students for the future?

It is evident that there is a global lack of Big Data expertise, and every country will confront a similar issue. The shortage of competent Big Data practitioners constrains businesses' capacity to gain value from Big Data.

There is an expertise shortage supply in data strategy and a wide variety of technical data management jobs, mainly because of a shortage in university, professional, and executive education programs designed to produce the skill set needed to fill the rising demands for Big Data specialists (Gamage, 2016).

In 2016, there was a rise in demand for data scientists, ML, and AI expertise (Plavljanić, 2019). Tech firms keep on hiring data scientists and data analysts (Beck, 2020). However, with companies across industries seeking to hire AI expertise and improve their core decision-making driven by data, the need for data analysis specialists will certainly exceed the supply of talents on the market for some time (Jarvis, 2020).

Tech firms may manage this complicated personnel market by employing various strategies, including a targeted strategy to recruiting fresh analytical talent, maximizing the potential of existing employees, and developing collaborations.

The digitization of the profession will have a significant impact on the skills and knowledge required of fresh graduates joining the industry. Graduates must get training in IT such as automated identification systems, analytical programs, and data mining (Kruskopf *et al.*, 2020).

Students should seek to study how to engage with data analytics software and tools and become familiar with cloud computing solutions, AI, and ML ideally through schooling or otherwise by internships.

Educators must act proactively by collaborating with industries to guarantee that the students they educate have the skills needed for the Big Data age. Griffin and Wright (2015) emphasize the necessity of Big Data in accounting education, stating that academics, as educators, must rethink their accounting and auditing programs to teach the requisite skills for Big Data in the accounting sector.

An integrated way to incorporate data analytics topics into existing courses in the Accounting program such as Business Statistics, Accounting Information Systems, Financial Accounting, Management Accounting, Auditing, and Taxation is recommended to adequately address 'Big Data' in the accounting curriculum is suggested.

Accounting educators should encourage accounting and finance students to sign up for alternate units in the accounting degree program such as Introduction to Database Design and Management, Database Systems, Fundamentals of Business Analytics, Business Intelligence, Applied Statistics, and Enterprise Modelling (Gamage, 2016). Data analytics shall be included in accounting education (Davis and Williams, 2015).

5.2.3 What do the managerial accounting job advertisements tell us?

In the sample of this dissertation, there are 184 out of 300 job postings, equal to 61% of the sample which mentioned the name of specific software that expected the candidates to be familiar with or to have experience working with. This indicates the importance of software in accounting nowadays. To acquire a job in accounting, accountants and controllers must have knowledge and experience working with the software.

There is 52% of the sample required skill and experience in working with data, including data collection, data validation, data analysis, and data interpretation among others. The ability to properly track and evaluate data is critical that financial controllers must be cultivated over time.

Although advanced technologies such as SQL and Python exist, Microsoft excel is the most mentioned data analysis tool in the sample of this dissertation. According to the article " How

Important Is Excel in Business?" (2022), spreadsheets are one of the most extensively utilized business tools.

Excel remains the most user-friendly and commonly utilized data analytics tool. But when a company wants to apply complex statistical approaches like machine learning or predictive analytics, it's advisable to use more advanced tools like Python.

In the sample, not many companies mentioned coding skills when they hire controllers. Some coding languages were mentioned such as VBA, SQL, Looker, and Python. Probably, it is still in the early stage of applying advanced information technology in accounting, therefore not many companies expect their candidates to be able to code. However, more firms emphasize the importance of learning programming languages such as Python to gain employment.

The accounting team is more than the sum of software and accounting tasks (Broetje, 2018). Teamwork and collaboration is the most mentioned soft skill. Businesses that prosper have leaders and CEOs who understand the value of collaborating with and between the accounting staff and engaging the accounting staff with the rest of the company and vice versa. This creates enormous value.

Accounting professionals that show good communication skills are more likely to be successful professionally. They are likely to play important role in the success of companies.

Problem-solving is another important soft skill and is a very valuable asset for companies that can't be realized on machines.

Alongside technical skills, relationship management skills make the controllers very important to the company, and the competence in building and maintaining a solid relationship with their customers and business partners makes an individual difficult to be replaced.

When a company is searching for a job candidate, they often search for someone who has strong communication and interpersonal skills (Hub, 2022). People with interpersonal skills are valued because they get along well with everyone. Such individuals have a chance of performing well in businesses.

Communication and presentation skills are crucial because no matter how good a controller is at analyzing data and how much data and energy is put into preparing a report, it might be considered pointless if the controller does not manage to present his finding clearly and understandably.

The accounting sector is transforming as technologies simplify tasks and eliminate paperwork, the accountant's role is becoming more of an advisor. That is why customer service skill is very

important for accountants nowadays. A successful firm must be able to provide good customer service. Profits are not the only thing that matter but having a good reputation keeps the companies prospering in the long run. Both ethics and technical expertise are critical in distinguishing one company from another in the same business.

5.3 Limitations and Future directions

Some limitations must be considered, as in any exploratory study such as this.

The data sample used for this study is limited to job ads for controllers and MAs from three US states. The insights gained from job advertising only reflect the skills needed by controllers in the location from which the sample was drawn; it does not offer any insights into the competencies asked by employers in other locations. To extend and validate the conclusions of this research with findings based on data from different geographic locations, additional study is required.

The findings of this study need to be expanded upon and evaluated by other research that uses data from various geographical regions.

Comparing and contrasting the demands for IT skills and soft skills when hiring controllers and MAs can be done by looking at job listings for MA professionals from both English-speaking and non-English speaking regions. This will give a fairer and more reliable conclusion.

The size of the data sample is a second drawback. In this dissertation, 300 job advertisements were manually evaluated due to a large amount of time required. The sample size is not so large to reach a solid conclusion.

The other research scholars may consider using this dissertation as an initial idea, combining it with their coding expertise or creating a model to enable them to extract a larger data collection. The results are more reliable when the sample size is larger.

6. Conclusion

Big Data and digitization have a lot of potential to increase value for companies. Therefore, MAs must adjust to the change in demand for skill sets in the digital environment. To gain insightful knowledge from Big Data, the ability to work with new technologies and mathematical tools will become crucial. Additionally, the company must develop a digital strategy to prevent harm from future cyber-attacks and the digital strategy should also cover data security (Karenfort, 2017).

The value of Big Data is not defined by the amount of data a company has. Its value comes from how the firm uses the data they gather. The more successfully a firm uses its data, the faster it develops. AI and IoT technologies generate an escalating amount of data, but those data are meaningless if firms can't properly use it—one of the reasons why the industry has actively recruited analysts.

The invention of information technology has sifted the roles of accounting managers and controllers, accounting professionals can no longer conduct their job as before. Information technology has the power to substitute or devalue existing skills while also helping to build new ones. Big data will open up new chances for MAs and controllers to play a more strategic, forward-thinking, and proactive role in organizations.

Accountants worry that accounting jobs will be taken over by smart technology and tools. And the findings of this dissertation is in line with the literature review, showing that MAs and controllers who stand out are those that can use big data to create insight and widen their analytical skill, those who recognize innovation through new business models and use information technology to enhance the quality of their planning and forecasting. Employers are looking for accountants who can contribute to business-critical strategy and investment decisions based on employing Industry 4.0 technology.

An accountant who knows "accounting" and is skilled in software technologies such as NetSuite, SAP, ERP, and coding is in high demand in the market. This dissertation also listed the most mentioned soft-skill on the job posting sample. Soft skill makes every individual different and unique. Apart from technical skills, soft-skill is also very important to secure the accountant position in the company.

The accounting profession's future resides at the crossroads of finance, technology, and information as shown in Figure 35 below. This study suggests an integrated method to incorporate data analytics and information technology subjects into accounting curricula.

Universities also need to collaborate with companies to provide internships, and mentorship to their students as only the theoretical preparation won't be enough to help the students join the current and future markets. Communication between educators and employers is beneficial for both sides. Universities can adjust their course according to the demand of the companies and as a result, the companies can hire accountants who are well-equipped to work, thus saving time on training staffs.

Accounting educators will need to change their mindset to train students for success in this data-driven and analytics-enabled future.
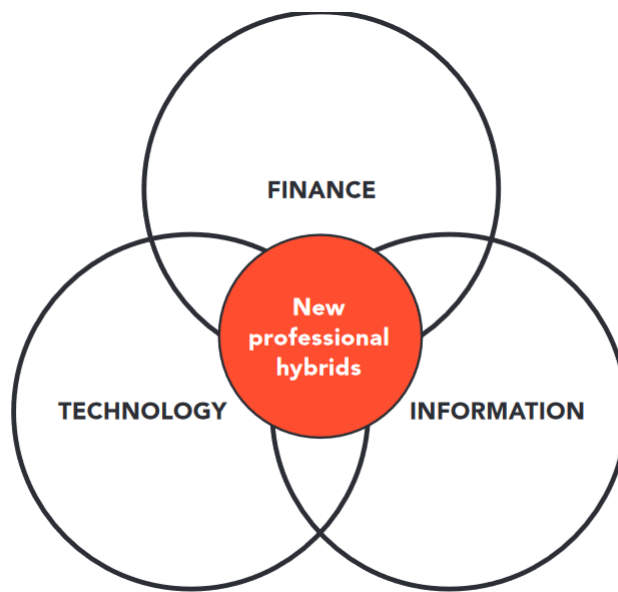

Figure 35: New accounting and finance professional hybrids. Source: www.accaglobal.com

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