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INDUSTRY 4.0'S EFFECT ON THE ACCOUNTING PROFESSION: A REVIEW OF LITERATURE

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Abstract: This research investigates the impact of Industry 4.0 on the accounting profession, focusing on the opportunities and challenges it brings. It examines the positive and negative implications of this technological shift and the skills accountants need to succeed in an increasingly digital landscape. Through a comprehensive literature review, this study highlights how Industry 4.0 is reshaping traditional accounting practices, requiring accountants to develop new competencies to meet evolving professional demands. By synthesising relevant studies, this review contributes to the existing knowledge of Industry 4.0's influence, offering insights into the expertise needed in the field and the potential challenges and opportunities smart technology introduces for accountants.

Keywords: Industry 4.0, Accounting Profession, Big Data, Cloud Computing, Accountant's Skills, Artificial Intelligence

1. INTRODUCTION

Industry 4.0 is significantly transforming numerous other industries, including accounting. Smart technology, a key component of Industry 4.0, is modifying the roles and expectations of accountants; therefore, adjustments need to be made to traditional accounting procedures and techniques (Herath & Herath, 2024).

The paper examines the effects of Industry 4.0 on the accounting field by reviewing pertinent literature and examining the knowledge and skills

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that accountants will require to be successful in this new era. In Industry 4.0, machines will be able to control more complex tasks with the aid of machine-to-machines (M2M) with the fundamental requirement that they can interact with one another with human assistance leading to increased production levels. In the future, automation should be able to manage most economic processes. Companies can become digital companies with the aid of automated processes and machine learning. Newer ideas like the Internet of Things, the Industrial Internet, Cloud-based Manufacturing, Big Analytics and Cutting-edge techniques, Artificial Intelligence, and Advanced Manufacturing reflect this vision of future production that is enabled by technology, and they are frequently grouped under the ambitious idea of The Fourth Industrial Revolution. Digitalisation and Industry 4.0 have the potential to bring about even more significant upgrades and improvements in the accounting sector. The necessity for prompt adaptation and change in corporate policies and operations while maintaining fundamental accounting principles and standards reflects the difficulties facing the accounting profession. This study aims to review and analyse key changes and challenges that Industry 4.0 will bring to the field of accounting. The basis for the research is a review of the pertinent literature in academic and professional fields that is currently available.

2. LITERATURE REVIEW

German scholars Kagerman *et al.* (2011) coined the term "Industry 4.0," to explain the future of the German economy through automation, data exchange, and actual production process optimisation. Its fundamental tenet is that cyber-physical systems enable real-time monitoring, management, and control of physical processes. The digitalisation of the economy gave the idea more traction. It is common for Industry 4.0 to use the Internet of Things (IoT) and Cyber-Physical Systems (CPS) to connect people and numerous resources with products and services. The term "Industry 4.0" is related to a broad range of ideas, professions, business operations, and technological advances.

Industry 4.0 is viewed as a vital model for businesses worldwide because of the vertical integration of intellectual product lines, resources, and machines into adaptable manufacturing technologies as well as its interconnection to interdisciplinary value chains that can be streamlined based on distinct elements like cost, accessibility, and consumption of resources (Kagermann *et al.*, 2016).

2.1. The Accounting Profession in the Age of Industry 4.0

Industry 4.0 connects numerous cutting-edge technologies to provide value. Cyber-physical systems have a high degree of autonomy and the capacity to independently make decentralised decisions. Digital solutions are becoming increasingly common in every aspect of daily life worldwide. Many view adjusting to new technologies as a critical prerequisite for remaining in business. Digitalisation can streamline daily tasks and enhance efficient communication techniques. Generation Y was born into a society where understanding the relevance of IT was practically assumed. The difficulty of learning new skills must be overcome by older age groups. Businesses strive to use Industry 4.0 to increase output and profitability. Artificial intelligence (AI), cloud computing (CC), big data (BD) and blockchain (BC) are some of Industry 4.0's most recent advancements in technology. One of the numerous industries where these innovative technologies were applied is accounting (Milian, *et al.* 2019; Rikhardsson & Yigitbasioglu, 2018).

Accounting will likely be greatly affected by Industry 4.0. By 2025, there will be significant changes in the accounting sector because of advancements in politics, business, and technology, most notably, in terms of what the public expects from the accounting profession (Raporu, 2016). Technological advancements, which also influence the professional lives of millions worldwide, are changing how accountants carry out their everyday work. The development of communication and information technology, which helped shorten travel times and distances, was unquestionably the most important contributor until 2010. Industry 4.0 is improving our ability to share knowledge and ideas, giving rise to the idea of the innovation process (Pazaitis, 2020). The effect of the Industry 4 era on science and technology altered organisational practices and commercial models while also creating new ones (Vărzaru, 2022). Similarly, accounting has undergone and continues to undergo a full reinvention because of the threats, difficulties, and opportunities as the complexity and volume of data increased due to the advances in technology for obtaining and processing data.

To evaluate the extent of automated accounting procedures and processes, it is essential to make a distinction between routine tasks that are straightforward to automate and difficult and demanding tasks that are comparatively hard to automate. According to Oschinski *et al.*, jobs and tasks requiring complex creativity, critical analysis, instruction, and human touch will never be automated (2017). However, regular tasks that demand little human communication, and

low degrees of expertise and training can be mechanised. When data collection, processing, and interpreting becomes faster because of automation, the level of information quality may suffer due to a lack of confidence because of the lack of human oversight (Bromwicha & Scapens, 2016). The corporate environment, how people work, what companies can accomplish, and CEOs' responsibilities are all drastically changing because of these emerging digital trends. Social networking, mobile web applications, Cloud Computing, and communication networks are a few examples. These trends encourage advancement in industries beyond technology as they promote collaboration, knowledge exchange, access to global markets, and novel commercial strategies.

Many organisations, especially large businesses, have already automated a few accounting operations. Procedures including billing, payroll, and bookkeeping, are automated as they include recurring and routine activities. According to Moudud-Ul-Huq (2014), automated activities include materiality assessment, audit preparation; preliminary analytical techniques, risk assessment, internal controls evaluation, and continuous judgments, hence, the methods and operations of accountants were impacted by innovative technology. The realisation of implementing cutting-edge technology has quickened, particularly after the turmoil of COVID-19. To stay competitive, each of the mentioned activities should be consistently reevaluated.

Industry 4.0 can replace antiquated processes with sophisticated, contemporary ones. The accounting profession needs to switch from traditional procedures to computerised and methodical procedures for most of its functions to reap the most benefits from Industry 4.0's advancements. A major digital and technical convergence is required. The use of artificial intelligence in the accounting sector is a crucial development that will encourage advancement and creativity in the industry. The fourth industrial revolution can electronically arrange and evaluate financial information, and accountants' duties could be to appraise the information produced by technologies (Kruskopf *et al.*, 2020).

We discovered several papers about accounting approaches that will be reinterpreted and reinvented because of the use of contemporary information technologies after researching specialised literature.

A few studies examine how many businesses now utilise Industry 4.0 digital solutions and what they anticipate using in the upcoming periods. The largest audit firms are primarily responsible for initiating and carrying out these studies.

In the report "Digital Darwinism", the Institute of Management Accounting (IMA) and the Association of Chartered Certified Accountants

(ACCA) describe the technological developments that could affect management accounting including artificial intelligence, mobile technologies, Big Data, Cloud Computing, digital shipping and payment methods, and augmented and virtual reality. When the accounting industry transitions to Industry 4.0 digitalisation, the nature of accountants' tasks could drastically change, becoming increasingly dependent on the advancement of cutting-edge tools and technology. Many studies were conducted on technical developments in accounting, especially in the last ten years (Craft, 2011), with an emphasis on the challenges that arose.

Technical improvements linked to Industry 4.0 that the profession embraced were investigated in prior, more current investigations. Updated accounting and financial reporting, according to Hoffman (2017), reflects the development of technology in accounting. Modern technological innovations, such as knowledge-based systems, blockchain-based distributed ledger technology, and XBLR-based structural digital financial analysis, are used to construct financial reports (Hoffman, 2017). As stated by Leitner-Hanetseder *et al.*, business intelligence and artificial intelligence-based technology will replace current accounting procedures, which are routine and repetitive tasks (2021). Robotic Process Automation (RPA) intends to automate basic accounting tasks, increasing the effectiveness of financial management. Accountants should be able to use their skills elsewhere by employing Industry 4.0.

Using intelligent digital and technological improvements would considerably increase the efficacy and efficiency of the accounting profession. For example, one monotonous and routine task that AI-based technology can complete is data processing. Accountants will therefore have more time to devote to duties like financial advising, in-depth research, and data analytics (Akhter & Sultana, 2018).

If accountants focus more on managing the organisation as a whole and less on accounting challenges, they can provide value to the organisation by considering its long-term goals. As a result, accountants will be held more accountable for making and assessing significant enterprise choices that will benefit the company. Nevertheless, these technological advancements will not replace the demand for accountants.

For these sophisticated technologies to correctly process the proper and high-quality data, accountants must monitor the accuracy and dependability of the data used (Surianti, 2020). Professional accountants must assess the results of the data processing using professional judgment. Technology cannot

replace human knowledge and experience, which are the sources of valuable decision-making (Omar & Hasbolah, 2018). Additionally, Rosi and Mahyuni (2021) required that accountants oversee the work that these advanced and intelligent technologies were performing. Leitner-Hanetseder *et al.* (2021) and Losbichler and Lehner (2021) also pointed out the need for human-machine collaboration in tasks that require human involvement in decision-making and exercising judgment. Professionals and technologies work together as actors in some procedures that cannot be completed by technology alone, such as forecasting procedures (Losbichler & Lehner, 2021), management of performance and evaluation endeavours (Moll & Yigitbasioglu, 2019), and other conventional processes.

Accounting documents can be made simpler by adopting Cloud Computing, and users can access them right away, which lowers operating costs. Digital technologies have the potential to improve decision-making quality, communication transparency and speed inside and across organisations, and eliminate asynchronous data. Thanks to AI technology, accountants may now focus on jobs of higher benefit, analysis, resolving issues, deciding, strategy formulation, and leadership. AI boosts productivity, efficiency, and accuracy while decreasing costs and operational times. Management accounting enables machine learning to generate information that is more relevant by providing reliable accounting data (Vărzaru, 2022).

As technology introduces fundamental changes in the function of accounting professionals, a new generation of accountants who will be capable of working in the new virtual environment because of applying modern information technologies is needed. For all its welcoming attitude towards technology, there is still not a complete understanding of the accounting industry for technological change; there needs to be a "technological leveraging" (Carlin, 2019). The expectations, jobs, and tasks of accounting experts are drastically altered by AI-based technology (Moll & Yigitbasioglu, 2019) demanding the creation of new paradigms to understand these new realities.

Previous research investigates the current usage and future intent of firms about digital applications. Some research done in the last year regarding the progress of technological integration in accounting (Arnold, 2018; Dos Santos *et al.*, 2020) points out domains which are expected to see technological interventions in the near future.

As is the case with most study initiations and conducts, the leading big audit firms are the principal actors (Gulin *et al.*, 2019). Firms of auditors and

accountants including KPMG and PwC among others have been keen on exploring the use of new Information technologies. However, there has been literature research on the dynamic competencies of accountants and the amount of concentration has been mainly on Blockchain technology. Blockchain could demand a new wave of Accounting and Finance professionals who can work in the current blockchain development environment (George & Patatoukas, 2020).

Prevailing research suggests that firms are actively planning for digitalisation and the successive transformations within their industries. Performing new software support solutions, especially when building internal solutions, involves significant time and investment. This presents a significant opportunity for many companies offering services and developing cutting-edge accounting system solutions. Due to the high costs, involved, large corporations are often the early adopters of innovative solutions. This technological shift will fundamentally transform the accounting industry, as we know it in the coming years. While these developments may be disruptive, they also offer considerable potential opportunities (Demirkan *et al.*, 2020).

3. RESEARCH METHODOLOGY

To fulfil the objectives of the research, relevant literature was evaluated and examined. According to Gheondea (2015), the literature review method consists mostly of two parts: a literature search and an examination of the results. In addition, using the Sulong *et al.* (2021) study's search methodology, the literary search will consist of a general database search and a specialised search.

For the general database search, prior research on Industry 4.0 and the accounting profession was searched through several databases including ScienceDirect, Google Scholar, Web of Science, SAGE Journals, ProQuest, and Research Gate among other sources. The specialised search extracted articles on Industry 4.0's impact on accounting and Industry 4.0-relevant skills. Search terms were selected to refer to "accountants" and "the accounting sector to cutting-edge technology". Search phrases used included: "4.0-relevant skills", "Cloud Computing," "Blockchain technology," artificial intelligence," "Big Data", and "accounting industry advances and trends". We selected English-language publications with complete papers. Professional papers were retrieved from the websites of the biggest audit firms and organisations for auditors and accountants. The evaluation and classification of the literature as per the key findings are discussed in the following section.

4. INDUSTRY 4.0'S EFFECT ON THE ACCOUNTING PROFESSION

There are several reasons why current digital technology should be embraced and used by accountants. The need to complete accounting tasks in such a short amount of time and the significance of providing better and more timely data to a variety of users can both have a significant impact and act as catalysts for technological change, according to research by Wilson *et al.* (1992) among some of the UK accounting profession. According to research by Al-Htaybat and von Alberti-Alhtaybat (2017), implementing technology will improve the usefulness, accuracy, and accessibility of accounting data while requiring less preparation time. As accounting procedures become computerised and less time-consuming, accountants are getting closer to their clients and offering more advising services for ongoing business operations. Many of the articles we found through our search centre were on three technological advancements: data analytics, the blockchain, and artificial intelligence.

'Data' is defined as assets that are best described as big, born rapidly, or both; requiring sophisticated information management to spur innovation in automation, decisions, and analytical processes. "Big Data" refers to large, complicated data collections from various sources that require sophisticated administration, storage, processing, and visualisation techniques (Chen *et al.*, 2012). The term "big data analytics" is used to explain modern methodologies and instruments used to process huge amounts of data. Big Data analytics is a subset of a broader discipline that encompasses several concepts that are closely related and are commonly used simultaneously, such as real-time analytics, data analytics, business analytics, predictive analytics, or business analytics (Chen *et al.*, (2012). Owais & Hussein (2016) identify big data as a group of data that involves careful examination and is dependent on cutting-edge technology, techniques, and numerous resources.

Because of the growing reliance on digitalisation and automation as well as the growing amounts of data available, Big Data and data analytics have recently gained a lot of popularity (Herath & Joshi, 2023; Herath & Herath, 2022). Because of their ability to integrate and assess a variety of data, such as Facebook, many methods and analytical techniques are used in a wide range of industries. These methodologies have drawn attention in academic research because they improve decision-making (Elgendy, Elragal, & Päivärinta, 2021). Herbert *et al.*, (2016) examined how automation and digitalisation are used to eliminate or reduce boring and repetitive work so that accountants can

concentrate on more imaginative, unorthodox, and unstructured occupations that need in-depth analysis and specialist knowledge.

Big Data identification has enabled accounting and finance professionals to take on more significant roles in the collection of datasets that are so large and complicated that they are difficult to handle or may only be managed by traditional database management or traditional information application processing. This information is usually disorganised. Gandomi & Haider (2015) define big data as informational assets with enormous volume, speed, and variability that call for novel, reasonably priced information processing strategies for enhanced comprehension and decision-making. The Fourth Industrial Age via employing digital technologies has led to the increased size of data and the processing power, and immense processing and information storage space; technical methods and affordable costs in processing and measuring financial data have been made quick and accurate in this Age.

The Big Data Effect refers to the processing and transmission of a sizable data set such as an abundance of data with plenty of options for analysis. Data mining, which facilitates the analysis of massive volumes of data by identifying and showing the correlations between the data, aids with this. This will result in the complete revolution of the production processes, the deepening of the intertexture between information technology and automatisation, and the whole change of our economic existence. Big Data is unavoidable in the era of Industry 4.0. By eliminating numerous procedures like acquiring, classifying, converting, indexing, searching, and substituting numerous processes like gathering, sieving, synchronisation, preprocessing, and monitoring, they alter the information life cycle from conventional to modern (Coyne *et al.*, 2018).

The second most discussed technology is the blockchain. Originally when blockchain was conceptualised in 2009, it was Bitcoin's first and best use case (Tan & Low, 2019). According to Bonyuet, Blockchain is a distributed database that allows capturing real-time transactions between several parties and acts as a digital ledger where each participant keeps a replica of the record (2020). Due to its sequential significantly improved performance and cryptographic capabilities, blockchain has the advantage of being a system that "self-controls," making it possible to utilise it without the need for a reliable third-party intermediate (Bonyuet, 2020). Blockchain has the advantage of being a technology that "self-controls" because of its sequential communications architecture and cryptographic resources, enabling it to be used without the necessity for a trustworthy third-party mediator (Bonyuet, 2020).

Accounting has traditionally played a significant part in the system that supports socioeconomic processes, which is impacted by these developments. Accounting could gather, process, and present financial data relevant to the activities of economic entities. Deloitte asserts that businesses can capture all transaction records into a common register, creating a linked intranet of irreversible accounting records, as opposed to keeping separate documentation based on transaction receipts. Innovative tools of today, like cryptocurrency, already are seen as conditions necessary for a transition in accounting practices. It is practically impossible to falsify or remove any entries to conceal activity since they are distributed and cryptographically sealed. Bitcoin Magazine refers to "Triple-entry accounting" as a process parallel to a notary public verifying a contract, but electronically.

The field of accounting, primarily auditing, has witnessed a surge in artificial intelligence research. It is necessary to point out that AI covers a vast area of interest but not all the applications of AI are directly related to accounting. Artificial intelligence is mainly a working tool that is focused on replicating the work done manually in an organisation that does not need creativity and innovative ideas (Kokina & Davenport, 2017). Cooperating with technologies such as Blockchain and Big Data, AI can become the tool that helps in automating some accounting procedures (Marshall & Lambert, 2018).

Digital literacy relates to the ways through which people can use technologies for conveying as well as receiving information in the social and work contexts. A numerical analysis is one of the accounting and auditing basic operations. While it was previously used through an algebraic approach, accountants and auditors now use more of business analytics and visual analysis (Schneider *et al.*, 2015). Kokina and Davenport (2017) note that this type of analysis fits well when performed operationally and repetitively as a design for automating activities. However, some of the accounting firms have already implemented such automation in their auditing platforms although the process is still in its infancy stage (Kokina & Davenport, 2017, p. 117).

The AI and automation era is already here and chiefly it means that computer algorithms will eventually perform many tasks now done by humans. This will have a highly disruptive effect on labour employment, and the market (De Villiers, 2021). This makes it possible to foresee how the globalisation of digitalisation would affect the role of accountants as well as the process for gathering, analysing, and storing information in accounting.

Accounting professionals will need to change their mentality because of the electronic revolution as modern audiovisual communication and technologies continue to develop. Due to the quick advancement of AI-based technology, there have been various accounting breakthroughs. Solutions present options or take the decision when it comes to operational or recurring decisions. The goal of the human component is to control the precision of decisions made for diagnosis using deep learning and programming (D'Angelo & Palmieri, 2020). Higher-level judgments (tactical as well as strategic ones) will depend on the solutions provided by AI-based technology as it develops.

4.1. Impacts on Accountants' and Auditors' Roles

The accounting profession has changed over time because of the environment's natural evolution. Academics continue to monitor the effects of accounting firms' recent adoption of new technologies, despite the paucity of empirical research in this area. According to Coyne *et al.*, accountants are particularly skilled as business professionals (2018). As a result, accounting professionals are essential to the development and upkeep of information systems alongside information technology specialists, acting as both end users of corporate data and a spokesperson for other decision-makers on both an internal and external level. Data management and compliance requirements control difficulties, which many accountants are quite familiar with, and are additional significant elements of information management.

According to Richins *et al.* (2017), accountants have a unique opportunity to lead the analysis of both structured and unstructured data while working with data scientists to increase value through exploratory data analysis. To support their arguments, they contend that accountants are familiar with how businesses operate and are accustomed to conducting data analysis and working with organised data sets (Richins *et al.*, 2017). Like this, Pickard and Cokins (2015) claim that accountants are qualified due to their expertise in handling financial data, comprehending its origins, and knowing which models to utilise, they can accurately create data mining & predictive analysis models, perceive their outcomes, and base choices on them. Huerta and Jensen (2017) claim that by assisting their firms in becoming more data-driven, accountants can move from being an organisation's watchdog to a business partner who plays a strategic role. Because blockchain technology modifies accounting practices, the role of the accountant will change. The accuracy of the accounting data used to compile financial statements will be enhanced, claim Tan and Low (2019),

if the current verification methods are digitalised and accounting activities are stored on a blockchain system.

Because these breakthroughs only replace specific functions, rather than entire careers, Kokina and Davenport (2017) emphasise that, in the near term, employment losses owing to the adoption of technology based on artificial intelligence will be small and relatively slow. Accounting professionals will continue to design the rules of the digital method and verify the whole process, even though they may no longer be the accounting database's "owner" in the context of blockchain (Tan & Low, 2019). However, since these values and balances cannot be pulled directly from an accounting database supported by blockchain, the process of looking at and analysing the arbitrary sums and balances reported in the financial accounts from a blockchain-based accounting system is still required. From automated contract execution and payment to occurrences being recorded automatically in the corporate ledger, it is just a short distance for accountants to travel, as stated by Marrone and Hazelton (2019), which may reduce the accountant's job in bookkeeping to a footnote in the past. Focusing on the work that auditors do, according to Liu *et al.* (2019), auditing firms need to redouble their efforts to evaluate how well risk assessment works and offer guidance and guarantees for internal management. This change is feasible if auditors actively contribute to blockchain development, concentrate on risk management, and think about leading and influencing blockchain adoption (Liu *et al.*, 2019).

Blockchain technology may dramatically change the work of an accountant: the core job is switching from primarily entering numbers and preparing financial statements to assess and validating documentary proof and legitimising smart contracts registered in the company ledger. This could lead to minimising the function of an accountant in accounting systems to an artefact (Yu *et al.*, 2018; Secinaro *et al.*, 2021). Bonyuet (2020) probed into the effects of Blockchain on auditing and found that the technical accessibility of all the data, which is inherent to the Blockchain actually, dismisses the utilisation of Statistical sampling techniques. In such a scenario, auditors would have to be equipped to perform tests on the entire database using data analysis.

4.2. Impacts on Accountants' and Auditors' Skills

Most large corporations' senior accountants are aware that a future existence of accounting personnel will always be required (Kokina & Davenport, 2017). However, some people believe that the accounting and auditing skills that are

important for business functions are rather likely to vary in the future, and some recognise that there will be a lesser total demand for new entrant accountants in the upcoming years (Kokina & Davenport, 2017). Oesterreich and Teuteberg (2019) expect that the management accountant's function will change from being "traditionally the information service towards a data scientist with strong systematic and computational competencies" (p.335). Companies must consider this when adopting data analytics, whether it will be more beneficial to hire professionals, such as computer scientists, to carry out the new activities, or if they can reskill current employees. Al-Htaybat and von Alberti-Alhtaybat (2017) highlight the following abilities that accountants of the near future should hone: analytical skills, a creative and open mind (creativity), and the ability to communicate a story (communication skills). The general automation process may be one of the biggest challenges for the growth of accountancy.

Chur & Yap (2024) found that Industry 4.0 would benefit accounting firms and accountants, but accountants need to gain extra skills and understanding to adapt to Industry 4.0 and capitalise on the opportunities and new job roles it creates. Tiberius and Hirth (2019) reported that the emergence of new challenges demands advanced accounting practices.

Liu et al (2019)'s assertion that auditors should become proficient in blockchain technology and blockchain governance serves as an illustration of this. In this fashion, auditors would weigh the benefits and drawbacks of implementing a specific kind of blockchain and counsel their clients on doing the same. Nielsen (2018) focuses on a different reality about the rise in demand for finance executives and data scientists. More collaboration between data experts and other divisions can open new information channels, offering new perspectives on past outcomes as well as aiding in environment prediction. Yet, soft skills like knowledge, creativity, and communication are equally as important in technology in the modern environment, if not more so.

Because estimates are inevitable and influence some elements of financial statements, auditors need to conduct adequate procedures to assess them. The role of validation may gradually decrease whereas the role of judgment, supervision and insight will increase. Contemporary technology may emphasise systemic, risk, predictive, and fraudulent audits. One of the possible solutions to this challenge is the participation of auditors in the process of transaction validation on private or public blockchains (Bonyuet, 2020). Furthermore, management accountants should clarify their professional status and gain the skills required to keep pace with technological advancements.

Business analytics and IT abilities are anticipated to become more important as one of the new primary skill areas of the controller's and MA's skills profile, being a "must have" capability for both professionals to profit from business analytics, as per Oesterreich and Teuteberg (2019). According to Secinaro *et al.* (2021), accountants and auditors must increase their skill set and knowledge to keep up with changing client needs as their industry and role both transform. According to Nielsen (2018), there is a demand for greater depth in data management, business intelligence, programming, and IT. Nielsen (2018) claims that correlations and multiple regression are the most often used techniques in statistics and economics. Nevertheless, to perform at an advanced problem-solving level, management accountants must understand and use more sophisticated statistical approaches. The development of the management accounting profession was highlighted by the Institute of Management Accountants (IMA) most recent upgrade to its competency framework (CPA, 2019). According to the revised competency model, six essential skill domains are required for managerial accounting professionals to remain employed. The framework has undergone the most significant alteration with the creation of the Technology and Analytics domain. Although the previous framework had a domain for technology, the rapid advances in technology and the use of advanced analytics demanded that it be thoroughly reexamined. The capacity of management accountants to employ data extraction tools to mine both unstructured and structured information is referred to as technology and analytics skills. The ability to use data analysis technologies to collect, manage, and analyse this data, and to produce data visualisation and narrative, will be necessary for management accounting experts.

5. RESULTS & DISCUSSION

Technology adoption by businesses nowadays is influenced by a paradigm shift in which technology is seen as a complicated and interconnected ecosystem on a global scale. Emerging technologies have enormous prospects for the accounting industry. Marrone and Hazelton note that much more research must be done on the possible benefits and drawbacks of new technologies for accounting (2019). Tasks typically performed by accountants, such as adherence evaluation, analysis, and information display for decision-making and the resolution of accountant-specific challenges, can be aided by Big Data analytics, blockchain, and artificial intelligence. Accountants may be threatened by new technologies, but there are also many advantages.

The incorporation of intelligent technologies like Cloud Computing and blockchain technology in accountancy will have a significant impact on the duties and functions that accountants currently play. Big Data analytics, blockchain technology, and artificial intelligence can help tasks frequently carried out by accountants, such as compliance evaluation, information analysis, and presentation for decision-making and the resolution of challenges specific to the accountant's function. Although new technologies may pose a threat to professionals, they also present many opportunities. For instance, Marshall and Lambert (2018) discovered that augmented intelligence gives accountancy professionals additional opportunities to use their knowledge through federation, freeing them to engage in tasks that are more beneficial to the firm. According to Liu *et al.*, (2019), there are numerous advantages to using blockchain technology, including the possibility of accountants managing the blockchain as its administrator or serving as its planner and organiser. They also highlight additional potential activities including reviewing blockchain transaction logs, developing new audit methods for blockchain technology, and verifying the coherence between things on the blockchain and the actual world.

However, each innovation comes with its own set of challenges and risks. Many authors raised potential risks including the need for accountants to be flexible in their approach to practising (Burns & Igou, 2019; Feung & Thiruchelvam, 2020). In addition to being aware of these emerging fields, Feung and Thiruchelvam (2020) conclude that practitioners must be willing to adapt and adopt Big Data analytics. Practitioners cannot escape this transformation in the future because the real-time business environment primarily drives the demand for continuous auditing. Both auditing and financial accounting are hampered by the standards that should be applied to all situations. The development of auditing standards could significantly affect auditors' work in the field of Big Data analytics, claim Richins *et al.* (2017). Big Data must be incorporated into financial statement auditing standards to replace or improve the current techniques of evidence collecting. Similar information was acquired by Kend and Nguyen (2020), who used it to support the argument that auditing standards should be revised to meet the issues that automation is posing for auditors and their organisations.

Blockchain is another area where accountants would be able to add value. Businesses will still need the expertise to ensure that blockchains are running properly, especially technologically and in terms of providing the intended

advantages, even while blockchains will streamline and automate the recording of commercial transactions. Consider smart contracts, which automate the process of determining if a contract's requirements have been met, triggering payment, and are based on a particular type of blockchain. Accountants might play a crucial role in assessing the blockchain's performance to make sure that each smart contract functions as both contract's participants planned.

The role of external auditors will drastically change in the coming decade as automated methods gain traction. Customers of audits are expected to receive better customer service when technology analyses entire datasets rather than simply samples since professionals can provide extra insights based on the information analytics used in the engagement. Even if they are obtaining more information from auditors than ever, audit committees will see that the human cost of doing an audit is dropping as part of the personnel will be replaced by technology. This might lead to a downturn in audit fees, which audit firms might find challenging to manage.

The best course of action, according to experts, is to incorporate an ongoing, dynamic, and comprehensive enterprise risk assessment process that includes all key team members, as well as a technique of strategic planning that considers how to make the most of today's technology while also attempting to put the forward emphasis on both what is truly happening and what is yet to come, so they can be ready to act top player rather than responsively when the time comes. Within the next decade, the competencies required of auditors will evolve. Auditors must work with new technology, which will require assessing complicated analytics and interpreting guidance from cognitive tools. As a result, auditors will be able to provide the clients with more information to help them make judgments. Audit professionals must be skilled communicators in the ability to clarify data to clients and help them comprehend the facts. Accounting firms and business finance departments will run into problems as organisational structures shift to accommodate technology. These models have traditionally been pyramidal in design, with department or company leaders at the top and many employees with less experience at the bottom. A thorough risk management strategy will become more important than ever in the coming years due to the opportunities and risks that technology has created.

Academic accounting will alter as schools and universities continue to make modifications to their curricula to help students develop the skills that will be most useful to them in their vocation. As a part of that adaptation, the curricula will be updated to include technology abilities that are swiftly

turning into necessities in the field. The development of accounting course content will occur when instructors from all disciplines are forced to adapt to novel technology-enabled delivery systems, even though online degrees and classes seem to be gaining popularity. Although technology will constantly improve, the time we are in now is one of profound changes due to the transitions sparked by new technologies. There are fresh opportunities to leverage cutting-edge, algorithm-driven technologies. In the end, accountants and auditors will be better prepared to appreciate the benefits when cutting-edge technology becomes more prevalent, recognise the advantages of these novel technologies and assess their use and return on investment of paramount importance.

Without a doubt, the incorporation of technology into accountants' regular tasks and activities will highlight the need for new knowledge and skills to be developed in the accounting field (Rosi & Mahyuni, 2021). Knowledge advancements in accounting should follow trends in Industry 4.0, and with stronger abilities, accountants and auditors will do better in the fast-paced era. Industry 4.0 is genuinely being driven forward by the development of skilled intellectual and human resources, and the accounting area is no different (Li, 2020).

6. CONCLUSION

The accounting industry has changed over time because of the environment's natural evolution. Academics continue to monitor the impact of accounting practice's recent adoption of new technologies, despite the paucity of empirical research in this area. Industry 4.0 has raised awareness of the need for collaboration between humans and robots to improve decision-making speed as well as accuracy (Davenport *et al.*, 2019). Industry 4.0 has inadvertently changed the accounting system to operate in a more contemporary, digital fashion. The accounting system will progressively change from a conventional one to a technological one as a result (Damayanti, 2019). In the increasingly digitalised company environment, conventional accounting techniques, procedures, and methods will be obsolete. To support the goals of Industry 4.0, accountants must accept the automation of present accounting procedures. The labour market will face significant challenges because of the rapid digital era of Industry 4.0. In many industries, manual labour is now being replaced by automated technologies and equipment. Industry 4.0 has had certain effects on the accounting industry, including the following:

1. **Automation:** As was already said, the introduction of automation technologies has significantly decreased the need for human data entry and processing, freeing accountants to concentrate on more complex activities like analysis of data and strategic planning.
2. **Data analytics:** Considering the wealth of data readily accessible in the digital era, it is crucial for accountants to be able to analyse data and get insights from it. New data analysis tools and methodologies, such machine learning as well as predictive analytics, have been developed because of Industry 4.0 and are now being employed more frequently in the accounting industry.
3. **Cybersecurity:** As accounting uses digital technologies more frequently, cybersecurity has grown to be a serious issue. Accountants must be aware of the dangers and take precautions to safeguard sensitive financial data online.
4. **Collaboration:** Accounting professionals now find it simpler to work across time zones and geographic distances with clients and coworkers thanks to Industry 4.0. For instance, cloud-based accounting software enables real-time project collaboration and data sharing across accountants.
5. **Regulatory Compliance:** Industry 4.0 has resulted in the introduction of new rules and guidelines that accountants must be aware of and follow, including the GDPR (General Data Protection Regulation) and the International Financial Reporting Standards (IFRS).

Overall, we can conclude that Industry 4.0 is transforming the accounting profession, causing it to become more cost-efficient, data-driven, and collaborative. While technological improvements like automation are altering the nature of particular accounting activities, they are also giving accountants new opportunities to provide clients with value-added services. Pauceanu *et al.*, (2020) predict that by 2025, over half of the positions employed today will be replaced by cutting-edge technology and systems. In an era of human-machine collaboration, humans and computers collaborate to increase the efficacy and reliability of decision-making (Davenport *et al.*, 2019).

Even though computers "undoubtedly seem destined to take over increasingly more tasks over time," Martin Ford (2015, p. 263) said toward the end of his book "The Rise of Robots," that there is little doubt that the economy will continue to be significantly dependent on human labour for

the foreseeable future. Big data analytics, according to Richins *et al.* (2017), is designed to add to accountants' current knowledge and skill set rather than to replace it.

Similarly, our study elucidates that technology will not eliminate the accounting profession but rather reshape it with fresh duties. Artificial intelligence will transform the role of accountants as certain manual accounting jobs may be replaced by robotic automation and drones, but it is anticipated that there will be a rise in demand for qualified accountants. Intuitions and softer skills are required for decision-making and analysis, and these abilities can be developed without the use of compassionate treatments. The two biggest obstacles to the adoption of robotics and artificial intelligence are cost and security flaws. To thrive in the long term, accountants must acquire certain skills including:

1. **Flexibility:** accountants must learn to be flexible and adaptable to take on demanding new responsibilities that go above and beyond their traditional job requirements.
2. **Critical Thinking:** Rather than just entering data, accounts should concentrate on analysing data to make decisions.
3. **Technical aptitude:** Accountants and auditors must acquire technology expertise for data analytics and artificial intelligence.
4. **Communication skills**: Strong client relationships and good communication skills can help accountants build trust and stay in business; and
5. **Judgmental skills:** To create professional judgments, one must combine experience and innovative analysis skills.

In conclusion, routine jobs have grown increasingly automated, freeing accountants and auditors to concentrate their abilities and ideas on addressing more crucial issues and calling for important judgments (Kend & Nguyen, 2020). As companies look to academic institutions for qualified candidates, they should redefine the curriculum to align with Industry 4.0's characteristics, which will allow their graduates to assimilate and adapt to the working environment. In a fast-paced market, strong support from the accounting profession is essential for businesses to grow and expand internationally. Accountants need to evolve with the company as knowledgeable knowledge workers and professionals who can provide value to the company. Since they all have a stake in the accounting industry, professional organisations, authorities

on regulations, and educational institutions can all benefit from this study. Professional bodies and regulators must pay close attention to modifying their standards to the contemporary digital state, as noted in the results.

Experts without this change might not use many of the currently available tools. For educational institutions, it has already been determined that updated accounting programs are necessary to prepare students for their new jobs. A variety of restrictions must be considered while analysing the results of the current inquiry. First, only peer-reviewed literature was used to gather the research data. Second, items that had already been published in other languages were not included because the search parameters limited the language of the articles collected to English. Finally, the study's scope might have been constrained by the defined keywords. If other data sources, languages, countries, and keywords were considered, this evaluation may be more thorough from a completeness standpoint. Notwithstanding these drawbacks, the fundamental finding of this study is that there has not been enough empirical research linking developing technologies to accountants' roles or competencies in an open innovation framework over the years studied.

The main recommendation for future study is to develop, test, and validate conceptual models for research in this field to serve its stakeholders. New research must be created to advance and reinforce our understanding of this subject. Data security in the digital world is crucial to accounting. While we are eager to progress in technological innovation, we must also constantly evaluate whether those who must employ these advancements can fulfil this job or not. These actions must be thoroughly considered since they maintain our competitiveness. Table 1 shows the points of intersection between Industry 4.0 and digitisation. The existence of such data significantly alters the accounting process. Due to Big Data's predominance of unstructured data produced from sound, video, and photos, standard accounting software and systems of information cannot analyse the ensuing financial statements properly (Warren *et al.*, 2015). How accounting is viewed is changing because of Industry 4.0.

Table 1: Points of Intersection between Industry 4.0 and Digitisation in Accounting

Industry 4.0 Technology	*Accounting Implications*
Artificial Intelligence (AI)	Automated data entry, financial statement analysis, fraud detection, predictive analytics
Internet of Things (IoT)	Real-time data capture, supply chain visibility, asset tracking, inventory management

Blockchain	Transparent and secure transactions, smart contracts, cryptocurrency accounting, regulatory compliance
Cloud Computing	Scalable data storage, remote access, collaboration, cost reduction
Robotics and Automation	Process automation, repetitive tasks, error reduction, improved efficiency
Big Data	Data analytics, insights, decision-making, risk management
3D Printing	Inventory management, prototyping, cost reduction
Augmented Reality (AR) and Virtual Reality (VR)	Training, simulations, visualisation, remote audits

KEY AREAS OF INTERSECTION

1. Automation of routine tasks: AI, robotics, and automation can streamline processes like data entry, reconciliation, and report generation.
2. Enhanced data analysis: big data analytics, AI, and IoT can provide deeper insights into financial data, enabling better decision-making.
3. Improved transparency and security: Blockchain technology offers a transparent and secure way to record transactions, reducing fraud and errors.
4. Real-time information: IoT and cloud computing enable real-time access to data, facilitating timely decision-making and improved control.
5. New skill requirements: Accountants will need to develop skills in data analytics, technology implementation, and ethical considerations.
6. Overall, the convergence of Industry 4.0 and digitisation is transforming the accounting profession by automating tasks, improving data analysis, enhancing transparency, and creating new opportunities for accountants to add value to their organisations.

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