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The Impact of Industries 4.0 and 5.0 on the Professional Accountant and Auditor's Integrated Thinking Skills Skillset and Other Pervasive Skills

Erica du Toit[1,*], Ben Marx[2] and Rozanne Smith[3]

[1] University of Johannesburg, South Africa; ericadutoit@gmail.com
[2] University of Johannesburg, South Africa; benm@uj.ac.za
[3] University of Johannesburg, South Africa; rozannes@uj.ac.za
* Corresponding Author

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Abstract: Industry 4.0 and Industry 5.0 has brought about significant changes in the business world at large, the job market and more specifically on the role that the professional accountant is expected to play. As a result of the changing role of professional accountants, an altered and enhanced skillset is required with a much greater emphasis on pervasive skills. The objective of this study is to analyse the impact of Industry 4.0 and Industry 5.0 on the skillset required for professional accountants. In the study, emphasis is placed on the ability to think in an integrated manner as the modern business world is characterised by complex problems that can only be solved if professional accountants are able to think across disciplines and draw from non-financial, financial, internal, and external information. By using an archival research design, the study found that due to the complexities that Industry 4.0 and Industry 5.0 brought about in the business world, the role of the professional accountant has changed significantly and for this new role a new pervasive skillset is required. Especially integrated thinking skills are crucial for the professional accountant to possess.

Keywords: Industry 4.0; Industry 5.0; Integrated thinking; Pervasive skills; Professional accountant

1 Introduction

In order for the accounting profession to survive the demands of Industry 4.0 and Industry 5.0, innovation and change is required as literature is showing a worrying trend that large portions of the professional accounting and audit professions are in the process of being automated (Frey & Osborne, 2017; Lordan, 2018; World Economic Forum, 2020b). The role of the professional accountant and auditor must move away from the traditional number crunching and checkbox approach to that of a strategic business partner that continuously adds value to the business (Lawson, 2018). On the upside, the large amount of automation of the traditional role of the professional accountant and auditor provides space and availability for these professions to become more strategic and forward thinking in nature (AICPA, 2015; Tavares, Zimba & Azevedo, 2022). This study specifically addresses the gap in the literature of how Industry 4.0 and Industry 5.0 have necessitated professional accountants to be able to think in an integrated manner as both Industry 4.0 and Industry 5.0 have interconnected the business world at large. There no longer is a problem that is related to a singular discipline, rather it is the ability of the professional accountant to think across disciplines that enables business problems to be solved in an effective and interconnected manner. This study uses an archival research design for the creation of a systematic literature review.

Several pervasive skills are analysed and discussed in this study because of the interconnectedness and symbiotic relationship between the different pervasive skills (Rychen & Salganik, 2000) and integrated thinking is interwoven in these pervasive skills. The focus is however on the professional accountant's ability to think in an integrated manner. Much has been written about the general pervasive skillset that a professional accountant should have, but much less is known about specifically integrated thinking as pervasive skill. The International Integrated Reporting Council (IIRC) coined the skill of integrated thinking from an accounting perspective by seeing it as a precursor for integrated reporting and placed the concept of integrated thinking skills firmly on the global accounting map. The ability to conceive and comprehend situations that combine technical and non-technical concepts through the understanding of interconnected principles is referred to as integrated thinking (Barac, Plant, Kunz & Kirstein, 2020). Integrated thinking skills form part of both decision-making acumen and business acumen as both acumens require higher order thinking skills (Barac et al., 2020). Attention is also given to the fact that problem solving is one of the most important pervasive skills required by employers (Lamb, Maire & Doecke, 2017; Tsiligiris & Bowyer, 2021) and that problem solving has, as a result of Industry 4.0, Industry 5.0, and globalisation, become increasingly complex (Pincus, Stout, Sorensen, Stocks & Lawson, 2017). Complex problem solving requires of the professional accountant to simultaneously draw from non-financial, financial, internal, and external information to produce a viable solution (Stancheva-Todorova, 2019). Creativity is a vital ingredient for complex problem solving and the ability to think in an integrated manner (Birkey & Hausserman, 2019; McGuigan & Kern, 2016). From the above it is clear that integrated thinking skills are crucial to develop in order for professional accountants to have

the ability to solve highly complex problems for their employers and clients (Deloitte Global Business Coalition for Education, 2018).

This study contributes to the literature for both professional accountants and academics in that it examines the impact that Industry 4.0 and Industry 5.0 has had on the role of the professional accountant and auditor. The contribution that this study makes is to address the void in the literature on the latest pervasive skillset, with specific reference to integrated thinking, that is required of professional accountants and auditors as a result of the impact of Industry 4.0 and Industry 5.0. Whilst there is literature available on the impact of Industry 4.0 on the professional accountant and auditor, not much literature is available relating to the impact of Industry 5.0 on the professional accountant and auditor. The new pervasive skillset that a professional accountant needs to fulfil their new role is set out and emphasis is placed on the ability to think in an integrated manner. This study thus strives to create awareness of the new pervasive skillset required of the professional accountant and auditor, with special reference to integrated thinking skills, as a result of the impact of Industry 4.0 and Industry 5.0.

In order to ultimately understand the pervasive skillset required of professional accountants, it is important to understand the background against which the need for an enhanced pervasive skillset has developed. Section 3 and Section 4 analyse the impact of Industry 4.0 and Industry 5.0 on the world of business, the general job market, and more specifically the accounting and auditing professions. Section 5 sets out the new pervasive skillset that professional accountants should have in order to fulfil their new role in business society.

2 Methodology

An archival research design was used, and the approach for conducting and creating a systematic literature review offered by Schirmer (2018) was followed. The archival research design was selected as it provides a comprehensive overview and analysis of the subject matter. Integrated thinking skills are a crucial skill that professional accountants needs to possess, and it was important for the author to understand the background against which the need for integrated thinking skills in professional accountants developed. This could only be done by a thorough literature review. Pertinent theoretical and research literature was selected by searching the Google Scholar and ProQuest databases for material that was relevant to the study's subject. The following keywords and Boolean operators were used during the search:

Table 1. Keywords and Boolean operators

“Industry 4.0” AND “professional accountant” OR “auditor”
“Industry 5.0” AND “professional accountant” OR “auditor”
“integrated thinking” AND “professional accountant” OR “auditor”
“pervasive skills” AND “professional accountant”
“Industry 4.0” OR “Industry 5.0” AND “impact on business world”
“integrated thinking” AND “pervasive skills of accountants”
“development” AND “integrated thinking”

A wide variety of global literature was selected and studied, and preference was given to publications of authoritative institutions and authors who are regarded as experts in the field. No specific filters or advanced search options were used but preference was given to literature published since 2015 as the topic of the study is current and evolving and more recent literature thus contains the latest developments relating to the topic. As an inclusion criteria it was important for the author to review literature from a global perspective and not just from a specific geographic perspective in order to obtain a global view on the topic. Originally 173 sources were consulted but based on the above inclusion criteria and preference, some sources were excluded in this study. Ultimately 118 sources were selected to write up this study. The sources ultimately selected to perform this study includes journal articles (both peer reviewed and non-peer reviewed) (60), Master's dissertations (3), books (6), documents published on websites (46), and conference proceedings (3). The study was performed during the period June 2022 to July 2023 in South Africa.

3 The Impact of Industry 4.0 on the World of Business

3.1 Industry 4.0 and its Impact on the World of Business

The concept of Industry 4.0 originated in 2011 from a project initiated by the German government as part of their high-tech strategy towards manufacturing's digitalisation. Klaus Schwab first coined the term "fourth industrial revolution" in his book by the same name (Erboz, 2017; Schwab, 2017; Xu, Lu, Vogel-Heuser & Wang, 2021). Schwab explained that the term "fourth industrial revolution" (also known as 4IR or Industry 4.0) referred to a new type of workplace that was influenced by a wide range of new technologies that are integrating the physical, digital, and biological worlds, affecting many fields of study, as well as economies and industries. Some of these technologies are even questioning our conceptions of what it means to be human (Schwab, 2017). Industry 4.0 advanced Cyber Physical Systems (CPS) into Cyber Physical Production Systems (CPPS) and one of the major linked initiatives of Industry 4.0 was SmartFactory in which several technologies were combined to develop a production capability that was hyperflexible and self-adapting (Xu et al., 2021).

The phrase Industry 4.0 relates to a variety of modern technology related concepts and focuses on increasing network integration and digitalised system development (Erboz, 2017; Lasi, Fettke, Kemper, Feld & Hoffmann, 2014). According to the Industry 4.0 vision, all functions, sectors, and segments of the manufacturing industry, including economic (and macrosocial) action, are covered by the digitalisation, automation, and networking of processes. As a result, real-time access to all key metrics ensures complete transparency and enhances the decision-making process (KPMG, 2016). Industry 4.0 rests on the following nine pillars (Erboz, 2017; Lasi et al., 2014; Luis, Alcaraz, Gonzalez-Ramirez & Jamil, 2019):

- Big data and analytics;
- Autonomous robots;
- Simulation;

- Vertical and horizontal system integration;
- Internet of things;
- The Cloud;
- Additive manufacturing;
- Augmented and virtual reality; and
- Cyber security.

Alongside the technological impact of Industry 4.0, businesses are also faced with the following six megatrends (key forces of macroeconomic change) of this century (Chartered Accountants: Australia and New Zealand, 2017; Deloitte, 2017: Ernst & Young [EY], 2020; IIRC, 2020; PriceWaterhouseCoopers [PwC], 2015; PwC, 2018):

- Demographic shifts;
- Shift in global economic power;
- Resource scarcity and climate change;
- Urbanisation;
- Globalisation; and
- Technological breakthroughs.

Any industry-specific invention that fundamentally and permanently alters how all businesses in that industry conduct business is referred to as a business disruption. Clayton Christensen (1997:9), a late American professor, and business consultant, was credited with developing the phrase 'disruptive innovation'. Industry 4.0 most certainly caused a major disruption within the business world, changing the way in which business is conducted forever (Vaidya, Ambad & Bhosle, 2018). However, disruption is not only caused by technological advances but also by changes in the mentioned mega trends (EY, 2020; PwC, 2018). These mega trends place additional pressure on the business world and Chief Executive Officers believe that the corporate environment is becoming more complex and volatile (PwC, 2015). Each of these mega trends has the potential to add significant complexity to the business world and in combination even more so. For instance, it is estimated that by 2050, the number of people who age to 100 years (or even older) will increase tenfold and this will place even more pressure on the economies of the world to provide food in a time where natural resources are already scarce (PwC, 2015). To compound this problem, it is estimated that by 2050, 72% of the constantly increasing world population will have moved into cities, placing additional pressures on energy, infrastructure, expanding consumer markets, and healthcare (PwC, 2015). With further automation, as a result of Industry 4.0 leading to the loss of many jobs, the unemployment rate is also significantly impacted (Appelbaum, Budnik & Vasarhelyi, 2020).

3.2 Industry 4.0 and its Impact on the Future of Jobs and Skills in General

Industry 4.0 has brought about a significant amount of automation and digitalisation that has impacted the way in which people live, do business, and work (Goulart Liboni & Cezarino, 2022). All these technological changes have had a significant impact on the job

market (Vasilescu, Serban, Dimian, Aceleanu & Picatoste, 2020) and studies predicted that a great number of the work force would need to adapt and upskill in order to acquire the new skills that the job market would require (Spencer, 2018). With a significant amount of automation taking place because of Industry 4.0, many traditional jobs are being replaced by Artificial Intelligence (AI) and autonomous robots. Twenty-five years ago, there were less than 700 000 industrial robots worldwide (Chartered Accountants: Australia and New Zealand, 2017). In 2021 there were three million industrial robots (International Federation of Robotics, 2021), more than quadruple the number of industrial robots 25 years ago. There is a common fear by many workers that their jobs will be automated and will no longer need human intervention (European Commission, 2019; World Economic Forum, 2020b). According to The Future of Jobs Report issued by the World Economic Forum (2020b), machine hours will equal human hours by 2025. Although this outlook seems bleak, it is estimated that ultimately more jobs will be created (97 million) in the future than jobs will be destroyed (85 million) (World Economic Forum, 2020b). To obtain the skills for the jobs that will be created in future, significant upskilling is required by the existing workforce to remain relevant in the future business landscape (Barac, Plant & Olivier, 2021; McKinsey & Company, 2021; Tsiligiris & Bowyer, 2021).

It is argued in the literature and workplace that jobs that contain primarily standardised and predictable work are at a far higher risk of being replaced by machines (McKinsey Global Institute, 2018) and the most important skills for the work force to possess, are those that are less able to be replaced by technology in the future (Chartered Accountants: Australia and New Zealand, 2017; PwC, 2018). According to The Future of Jobs Report issued by the World Economic Forum (2020b), the top five skills for 2025 are listed as:

- Analytical thinking and innovation;
- Active learning and learning strategies;
- Complex problem-solving;
- Critical thinking and analysis; and
- Creativity, originality, and initiative.

Technology can never replace jobs that deal with unforeseen scenarios because these types of jobs require human innovation, coupled by critical and creative thinking (Harari, 2018; European Commission, 2019: OECD, 2018). Modern digital robots are capable of executing many jobs better than the human intellect, but they will never be able to think in an integrated manner (Martin, 2008). Rather than deep technical skills, which can be learned later by the right talent, employers are placing huge emphasis on cross-functional skills (such as creativity, innovation, and problem solving) (Chartered Accountants: Australia and New Zealand, 2017; World Economic Forum, 2020a). Creativity and creative thought are precursors for integrated thinking as it assists in the process of complex problem solving (European Commission, 2019; Martin, 2009; McGuigan & Kern, 2016; Sardar, 2010; Syolendra & Laksono, 2019).

The seven major professional clusters with the best net growth prospects for the period 2023 to 2027, as identified in the Jobs of Tomorrow Report (World Economic Forum, 2023), are as follows: AI and machine learning specialists, sustainability specialists, information security analysts, fintech engineers, data analysts and scientists, robotics engineers and big data specialists. A large number of new jobs are emerging as suggested by literature that were not around ten years ago, examples of which are: Chief Climate Response Leader and Human Network Analyst (Brown, Meister, Styr & Pring, 2020), Cloud Engineer and Talent Acquisition Specialist (World Economic Forum, 2020a), and Augmented Reality Journey Builder (Brown, 2017).

3.3 Industry 4.0 and its Impact on the Future of Accounting and Auditing Jobs

From a business finance perspective, a lot of change has taken place during the Industry 4.0 period as well. A significant shift has taken place from the traditional balance sheet accounting to that of multi-capitals thinking and value creation (IFAC, 2011, 2019a, 2019b). Integrated thinking is crucial to adopting a multi-capital approach (Association for International Certified Professional Accountants [AICPA], 2019). With the fast pace of digitalisation taking place in the business world, there is a move to a place in time where most of the value of companies are seen as intangible assets and not necessarily reflected on the balance sheet (IFAC, 2019a).

The Future of Jobs Report issued by the World Economic Forum (2023) listed jobs across industries with increasing and decreasing demand, and accountants and auditors were listed as jobs with decreasing demand. This desolate outlook is echoed by several other studies as well. According to a study published in 2017, 94% of the tasks performed by accountants and auditors could be automated (Frey & Osborne, 2017). Another study conducted in 2018 stated that the role fulfilled by accountants and auditors could be fully automated in the future (Lordan, 2018). There seems to be consensus that the accounting and auditing professions are targeted quite noticeably by automation, and this significantly challenges its employment growth (Bowles, Ghosh & Thomas, 2020; Tsiligiris & Bowyer, 2021). Professional accountants can no longer simply be score keepers and bean counters as the rate of automation is impacting the work of a professional accountant immensely. The automation is increasing and accelerating at a remarkable speed (Barac et al., 2021; Bellman & Göransson, 2019; Kokina & Davenport, 2017). To avoid being displaced by other professions, such as data scientists and technology experts, professional accountants and auditors are compelled to develop new abilities and skills (García & De los Ríos, 2021).

In contrast, other studies acknowledge that many workers in such highly exposed occupations also perform tasks that machines struggle with, such as problem-solving or influencing (Arntz, Gregory & Zierahn, 2016; European Commission, 2019). Despite the hard-hitting trends, which were predicted as explained above, ultimately there seems to be little interest in a human-free audit, and while automation would cut down on errors and help identify trends, the auditor's professional judgment, the way of thinking, and communication skills would always be safeguarded (ACCA, 2019). There is also optimism for the accounting and auditing profession as the disruption caused by Industry 4.0, has also

created opportunities for these professions (Tsiligiris & Bowyer, 2021). As the global market is evolving, so the accounting and auditing professions are evolving to firmly position itself in the modern environment (Almeida, 2021).

As accountants and auditors are freed from performing menial tasks (now taken over by technology and automation), they now have the time to step up and be business partners and perform audits with higher added value (Lawson, 2018; Manita, Elommal, Baudier & Hikkerova, 2020) with a far greater analytical perspective than before (Du Chenne, 2019). The technological changes during Industry 4.0 signalled the need for technological change in accounting and auditing as well (Stancheva-Todorova, 2019) and a proactive and forward-looking strategy to audit is required due to the rapidly rising data volume, shifting business models, and move toward automation (ACCA, 2019). Consider that two Zettabytes of data was created, enumerated, copied, and consumed during 2010 versus seventy-nine Zettabytes during 2021 (Statista Research Department, 2022). The traditional approach to auditing must change to deal with the rapid rise in data volume. A move away from the checkbox approach to a culture of constantly adding value by recommending improvements in clients' systems and procedures is required (Manita et al., 2020). Audit quality is also significantly improved by digitisation as auditors can now move away from a sampling method to analysing all the client's data (Lombardi, Bloch & Vasarhelyi, 2014; Tavares et al., 2022) and thereby being better enabled to detect anomalies (Cunningham & Stein, 2018). By incorporating cognitive technologies, auditors are gathering and evaluating business data from non-traditional sources, such as radio, internet, and social media and determining whether these sources may have an impact on the audit (Manita et al., 2020).

External auditors are regarded as professional accountants but not all professional accountants are external auditors as IFAC defines a professional accountant as a person who is a member of an IFAC member body (Rutherford, 2011). For completeness sake, it is important to also examine the impact that Industry 4.0 had on the auditing profession specifically. Industry 4.0 has had an impact on the auditing profession to a significant extent and the new generation of auditing is referred to as Audit 4.0 (Dai & Vasarhelyi, 2016). Audit 4.0 will piggyback on Industry 4.0's technology (Dai & Vasarhelyi, 2016) with an emphasis on continuous assurance with predictive value for the client (AICPA, 2015; Tavares et al., 2022). With the help of Industry 4.0-supported technology, such as the Internet of Things (IoT), Internet of Services (IoS), Cyber Physical System (CPS), big data analytics, and smart contracts, Audit 4.0 will be able to gather financial and operational data from an organisation and its associated parties, as well as other audit-related data (ACCA, 2019; Bruckner, 2022; Dai & Vasarhelyi, 2016). The use of the mentioned technologies will assist auditors in providing accurate and timely assurance, analyse models, visualise data to find patterns, and to spot anomalies (Dai & Vasarhelyi, 2016). Auditors will have the opportunity to integrate multiple data sets and use cutting-edge tools and approaches as a result of the new input devices (Rudman, 2020).

According to Rudman (2020), the auditing profession is unfortunately still stuck somewhere between Audit 2.0 and Audit 3.0. Much innovation and change thus lies ahead to fully embrace the Audit 4.0 principles. It goes without saying that the move towards Audit 4.0 demands a very different skillset from the current professional accountant than what was traditionally required (Almeida, 2021; Dai & Vasarhelyi, 2016). Table 2 below illustrates the four audit generations.

Table 2. Audit Generations

Audit generations			
Audit 1.0	**Audit 2.0**	**Audit 3.0**	**Audit 4.0**
Manual audit Tools: pencils and calculators	IT audit Tools: Excel, professional accountant software	Inclusion of Big Data in audit analytics Tools: Analytical applications	Semi- and progressive automation of audit Tools: CPS, IoT/IoS, Radio Frequency Identification (RFID), Global Positioning System (GPS)

Source: (Dai & Vasarhelyi, 2016:2)

4 Industry 5.0 and its Impact on the World of Business

Whilst many companies view Industry 4.0 as the next big thing and are still trying to get their minds fully around the concept, the next revolution is already well underway (Kraaijenbrink, 2022). Industry 5.0 has been the subject of scattered academic studies since 2017, but the European Commission did not explicitly endorse it until the publication of the study "Industry 5.0: Towards a sustainable, human-centric, and resilient European industry" on January 4, 2021 (Breque, De Nul & Petrides, 2021; Xu et al., 2021).

4.1 Industry 5.0 Paradigm

In the seminal work on Industry 5.0, Breque et al. (2021) express their belief that Industry 5.0 will be characterised by a rediscovered and broadened purposefulness that goes beyond the creation of goods and services for profit, and that Industry 5.0 has the following three core values: resilience, sustainability, and human centeredness (Breque et al., 2021). Where the focus of Industry 4.0 is driven by technology, digitalisation and AI, the focus of Industry 5.0 is value driven with a strong emphasis on social fairness and sustainability (Xu et al., 2021). Whilst Industry 4.0 places emphasis on welfare and economic value, Industry 5.0 enhances wellbeing and societal value (Kraaijenbrink, 2022). The call for a greater emphasis on sustainability and societal wellbeing is not a novel idea, Corporate Social Responsibility (CSR) and Environmental Social and Governance (ESG) have been part of the professional accountant's vocabulary for some time, but a renewed emphasis is being welcomed (Kraaijenbrink, 2022). The shift to a sustainable, human-centred, and resilient industry is driven by research and innovation in Industry 5.0, which is an extension of the

current Industry 4.0 paradigm (Xu et al., 2021). For the foreseeable future, the world will be co-occupied by both Industry 4.0 and Industry 5.0 (Xu et al., 2021).

Industry 5.0 is not limited to industry, its core values apply to all sectors and organisations and thus has a far wider impact than Industry 4.0 (Kraaijenbrink, 2022). Industry 5.0 moves away from mass production that Industry 4.0 allowed, towards mass personalisation that only the reintroduction of a human touch can provide (Østergaard, 2020). It is this human centric focus in Industry 5.0 that will ensure that humans will never be replaced by robots (Østergaard, 2020). Industry 5.0 enables a deep multilevel collaboration between robots and people and promotes innovation with purpose, as well as inclusivity (Regenesys, 2022). The rise of the digital economy in the current period of Industry 5.0 has increased risks but also opened up new opportunities and professional accountants will be significantly impacted by these changes (Soepriyanto & Maryani, 2023).

The evolution of Industry 1.0 to Industry 5.0 is set out in the table below.

Table 3. Industry 1.0 to Industry 5.0

vIndustry 1.0	**Industry 2.0**	**Industry 3.0**	**Industry 4.0**	**Industry 5.0**
Mechanisation	Electrification	Automation and globalisation	Digitalisation	Personalisation
End of 18th century	From the late 1800's to the start of World War One	From the 1970s	From the start of the 21st century	Second decade of the 21st century
Manual production replaced by machines powered by water and steam engines, industrialisation, urbanisation	Electricity, factories transformed into modern assembly lines, combustion engines and steel production	Internet, computers, and digitisation leading to automated production, renewable energy	Robotics, blockchain, Artificial Intelligence, Internet of Things and crypto, digitalisation, virtual augmented reality	Inclusivity and innovation purpose, power of industry used to achieve sustainability and social fairness

Source: (Deloitte Global Business Coalition for Education, 2018; Saraswati, Putri, Suprasto & Sari, 2020; Xu et al., 2021; Regenesys, 2022) These sources were combined and adapted by the author.

From the above table it is evident that the gaps between the Industrial Revolutions are decreasing at a fast pace; almost two centuries passed between Industry 1.0 and Industry 2.0 compared to only two decades between Industry 4.0 and Industry 5.0 (Regenesys, 2022). This trend is in line with the time it takes for a new technology to reach a significant proportion of the population. Compared to 16 years for personal computers and 35 years for telephones, it only took seven years for 25% of Americans to gain access to the internet (European Commission, 2019). We live in a time of constant change, and it seems as if the only thing that is predictable is that it is unpredictable and the pace of change will never

again be as slow as it is right now (ACCA, 2020; McKinsey, 2020). In a similar fashion, 52% of the Fortune 500 companies in the year 2000 are now extinct and where a Fortune 500 brand's life expectancy used to be 75 years, it is now less than 15 years (Berman, 2022). Business, financial, and accounting professionals are reportedly facing one of their most difficult periods since the Great Depression (Guthrie & Parker, 2016). Future professional accountants need to be educated in such a manner that they can cope with a highly complex and fast changing business environment (García & De los Ríos, 2021).

5 New Pervasive Skillset Required from Professional Accountants

This section presents the findings of the literature review in that it sets out the new pervasive skillset that is required of the professional accountant due to the changes that Industry 4.0 and Industry 5.0 have caused in the business world.

Industry 4.0 and Industry 5.0 undoubtedly caused a major disruption within the business world, changing the way in which companies conducted business forever (Vaidya et al., 2018). These companies are the clients or employers of professional accountants and therefore the major changes in the business world require a new approach by professional accountants which in turn requires a new skillset to cope with all these changes. Whilst strong technical skills remain important, there is no doubt that professional accountants' competencies in what is commonly referred to as pervasive skills need further development (Deloitte Global Business Coalition for Education, 2018). There is a multitude of publications setting out the required pervasive skillset for the professional accountant of today and tomorrow (Barac et al., 2020; Deloitte Global Business Coalition for Education, 2018; IFAC, 2019a, 2019b; Lestari & Santoso, 2019; Stancheva-Todorova, 2019; Tavares et al., 2022). Given the predicted impact of Industry 4.0 on the accountancy profession, the WEF forecasted that entry-level accountants with well-developed pervasive skills would be a key element for the success of world of work in 2025 (Marx, Mohammadali-Haji & Lansdell, 2020; Oliver, Whelan, Hunt & Hammer, 2011; World Economic Forum, 2016). Furthermore, the vast majority of the top skills identified in the Future of Jobs report are pervasive skills (World Economic Forum, 2023). The growing importance of pervasive skills cannot be ignored.

The technical skills that professional accountants should possess are undeniable and mentioned as critical skill but a detailed discussion falls outside the scope of this study. It is interesting though to note that there is a growing body of literature recommending moving away from the teaching of the current vast amount of technical skills at university level as it changes on a continuous basis (Bennett, 2019; Tsiligiris & Bowyer, 2021) and this information is readily available to professional accountants in the job market at the click of a button. Instead, a greater focus should be placed on teaching pervasive skills (Suleman, 2018; Tsiligiris & Bowyer, 2021) and teaching students how to learn instead of what to learn (Duff, 2004).

The subsections below are not a comprehensive list of the pervasive skills required of today's professional accountant but contain the most prominent skills available in the literature. One should also understand that pervasive skills often do not operate

independently, but often have a symbiotic relationship (Lawson et al., 2014; Rychen & Salganik, 2000). Professional accountants will need the acumen described below to collaborate with others and exhibit integrated thinking on strategy and traditional accounting in a broad management environment (Barac et al., 2020; Lawson, Blocher, Brewer, Cokins, Sorensen, Stout, Sundem, Wolcott & Wouters, 2014).

5.1 Decision Making Acumen: Integrated Thinking, Complex Problem Solving, Inter-disciplinarity, and Creativity

One of the initially lesser-known skills that is now crucial for a professional accountant to master, is that of integrated thinking. Integrated thinking consists of a variety of components, such as connecting knowledge and skills from multiple sources and experiences; applying theory to practice in different environments; using varied and sometimes conflicting viewpoints; and contextual recognition of issues and positions according to the Carnegie Foundation for the Advancement of Teaching and Association of American Colleges and Universities (Huber, Hutchings & Gale, 2005). The International Integrated Reporting Council (IIRC) coined the skill of integrated thinking from an accounting perspective by seeing it as a precursor for integrated reporting and placed the concept of integrated thinking skills firmly on the global accounting map. Integrated thinking skills forms part of decision making acumen (SAICA, 2021).

Living in post normal (also known as new normal) times, sparked by Industry 4.0 and Industry 5.0, there are central themes of complexity, chaos, and contradictions, with uncertainty being the only certain outcome (Sardar, 2010). Sardar (2010) further explains that post normal times are considered to be a transitional period in which old orthodoxies are inappropriate, new ones are emerging, and few things appear to make sense. In these post normal times, decision making has also changed significantly. In normal times, decision making is a lot simpler, where one identifies and isolates a problem, draws on trusted and tried methods and knowledge, and comes to an acceptable solution (Sardar, 2010). This approach simply does not work in these post normal times for a variety of reasons. Everything is connected due to globalisation and the digital age, and this interconnectedness makes isolating a problem almost impossible (Buckley, 2020). Problems seldom occur inside ordered disciplinary categories, and neither do their solutions in today's complex and globalised world (Palmer, 2001).

This leaves humanity in general, as well as professionals such as professional accountants specifically, with the conundrum of how to solve wicked problems. When new policy issues arose that did not cleanly fit into the traditional models of policy analysis in use at the time, the term ‘wicked problems’ was established in the planning literature in 1973 (Peters, 2017; Rittel & Webber, 1973). A wicked problem is onerous to solve due to insufficient, contradicting, and shifting requirements that are sometimes not easily identifiable (Drake & Reid, 2018; Lattemann & Fritz, 2014). Wickedness refers to a new kind of challenge where establishing a consensus on the issue takes precedence over exploring for potential solutions, even while complexity has not necessarily increased (Conklin, Basadur & Van Patter, 2007). Today, the use of the term wicked problems is widespread and

often used in sustainability literature (Lönngren & van Poeck, 2021), as well as the complex problems that integrated thinking and design thinking attempts to solve (Moldoveanu, 2007; Leavy, 2011). Much like the problems that professional accountants are often required to solve for clients. In his influential paper, Sardar (2010) is of the opinion that the most important components for coping in post normal times, is through use of creativity and imagination and that these two qualities lift us from reasoned and simple analysis to higher synthesis (Montuori, 2013; Sardar, 2010). Creativity is one of the crucial characteristics that need to be developed and embraced to enable integrated thinking.

The working environment of the professional accountant has become significantly more complex over time due to globalisation (Pincus et al., 2017), regulation (IFAC, 2019b; Thomson Reuters, 2018), technology developments brought forth by Industry 4.0 (Barac et al., 2021), and stakeholder demands (Malan & Van Dyk, 2021). All these complex variables create complex problems. One of the top qualities that companies value most is the ability to solve problems (Lamb et al., 2017; Tsiligiris & Bowyer, 2021). It is quite clear from literature that creativity is necessary for effective complex problem solving (Birkey & Hausserman, 2019; Deloitte Global Business Coalition for Education, 2018; Montuori, 2013; Sardar, 2010; Suto, 2013). Suto (2013) explains that creativity, innovation, critical thinking, and metacognition are the elements of thinking skills required in the 21st Century. The traditional profile of a professional accountant most certainly did not embrace creativity but had a rather rigorous and standardised approach in contrast. The professional accountants of today will be advising their clients tomorrow on problems that might not even have existed yesterday. It is essential for a professional accountant to approach complex problems in a creative manner. And this is exactly what integrated thinking is. Integrated thinkers consider causal relationships that are multidirectional and non-linear; they are able to keep the big picture in mind as they work on the specific aspects of a complex problem; and they come up with innovative solutions to the tensions that were present in the complex problem (Martin, 2007; Deloitte Global Business Coalition for Education, 2018).

As mentioned before, Audit 4.0 demands a very different skillset from an auditor than what was traditionally required (Almeida, 2021; Dai & Vasarhelyi, 2016). Auditors will need to integrate multiple data sets and use cutting-edge tools and approaches (Rudman, 2020). What is clearly required, is a multi-disciplinary professional with the ability to think across technical and technological fields (Stancheva-Todorova, 2019; Tavares et al., 2022). Big Data brings about huge amounts of information the professional accountant must simultaneously navigate. Big Data must be accompanied by "Big Judgment" to overcome an insight deficit (Shah, Horne & Capellá, 2012). In this era of Big Data professional accountants must become sceptical, have an enquiring mind (IAESB, 2014), and be able to ask the right questions (McKinney, Yoos & Snead, 2017) to support their complex decision making.

5.2 Digital Acumen

The vast technological strides made during the Industry 4.0 and Industry 5.0 periods have changed the way in which companies do business and also the way in which audits are performed. It goes without saying that the professional accountants of today need a significantly improved Information and Communications Technology (ICT) skillset and considerable research has been done to emphasise the importance of sound ICT skills for professional accountants (Barac et al., 2021; Gulin, Hladika & Valenta, 2019; Moll & Yigitbasioglu, 2019; Tavares et al., 2022). For professional accountants to remain relevant they need to 'outsmart the machine' (Barac et al., 2021:221).

5.3 Communication Skills

One of the core functions of the accounting profession is communication, which involves the art of storytelling from one person to another, from one organisation to another, as well as to the company's shareholders and other stakeholders (ACCA, 2021). In a digital environment, multi-channel and cross-unit communication replaces the role of the conventional top-down intra-company communication method (Tsiligiris & Bowyer, 2021). Additionally, with the utilisation of big data and advanced analytics, accountants are emerging as crucial sources of information for a variety of internal and external stakeholder groups (AICPA & CIMA, 2018). In all specialty areas of the professional accountant, communication skills (written as well as verbal) will be among the most crucial talents, and research has shown that there is a significant skills gap in this area (Deloitte, 2017; Jackling & De Lange: 2009; Lawson et al., 2014; Tsiligiris & Bowyer, 2021).

5.4 Ethical Behaviour and Citizenship

Behaving in an ethical manner is a core quality of a professional accountant (ACCA, 2017) and professional ethics is essential to establish trust between professional accountants and clients, as well as staff members (Deloitte, 2017). The adoption of new technologies sparked by Industry 4.0 imposes ethical implications for the professional accountant profession in that data can be abused (Tsiligiris & Bowyer, 2021). The need for professional accountants who can question the inputs and presumptions of automated processes increases because of technological improvements (Li & Zheng, 2018). By consistently updating and enforcing professional codes of ethics and conduct for their members, accounting professional bodies have responded to the expanding importance of ethics (International Ethics Standards Board for Accountants, 2018).

5.5 Business Acumen

In broad strokes, business acumen could be described as knowledge of the business world acquired from reading business news, networking, and work experience (Jewell, Reading, Clarke & Kippist, 2020). The South African Institute for Chartered Accountants (SAICA) describes business acumen as the capacity to make timely, accurate, and/or

strategic judgments that are centred on a particular business or business division (SAICA, 2021). In the fast-paced business world of today, it is crucial for the professional accountant to understand the context and environment in which businesses operate to provide sound advice and value-added services to their clients. Business acumen also relates to the future professional accountant roles that go beyond the finance function which will require business knowledge and in their role as leaders, professional accountants will need to be proactive in working together and networking to create partnerships and build and manage relationships with different stakeholders (Barac et al., 2020). Higher order thinking is regarded as essential for decision-making acumen, as well as business acumen (Barac et al., 2020) and from this point of view these two acumens are interrelated (Field, 2013). When a professional accountant has sound decision-making acumen as well as business acumen, they can persuade others and add value to businesses through their decision-making skills (Barac et al., 2020).

5.6 Growth and Change Mindset

With the rapid changes in the business environment, it is crucial for professional accountants to be mentally agile and to adjust to constantly changing variables (IFAC, 2019a). This skillset also underscores the importance of lifelong learning and the ability to unlearn and relearn (IFAC, 2019a, 2020; Tsiligiris & Bowyer, 2021). The professional accountant of today needs to constantly increase their knowledge to understand the changing needs of their clients and this requires a regular move beyond their comfort zone (ACCA, 2020).

6 Conclusion

As a result of the vast changes that Industry 4.0 and Industry 5.0 have made to the business world, the role and required skillset of professional accountants have changed significantly (IFAC, 2019a, 2019b; Lestari & Santoso, 2019). There is a strong move away from number crunching and the traditional checkbox approach of a professional accountant to that of a strategic business partner that endeavours to add value to the business (AICPA, 2015; Tavares et al., 2022). This new role requires a strong emphasis on pervasive skills. One of the pervasive skills that are in strong demand, is that of complex problem solving (Lamb et al., 2017; Tsiligiris & Bowyer, 2021). Complex problems, also known as wicked problems, have arisen in the business world due to globalisation, regulation, and Industry 4.0's automation and digitisation. To solve complex problems, the professional accountant must be multi-disciplinary and able to think across disciplines and incorporate external, as well as internal information from various stakeholders (Stancheva-Todorova, 2019; Tavares et al., 2022). This process requires integrated thinking. Literature also proves that creativity is an important component to the ability of solving complex problems. Whilst the impact of Industry 4.0 on the professional accountant has been researched, the originality of this study lies in the link that is made between the impact of Industry 4.0 on the professional accountant and auditor in general but also specifically on the new pervasive skillset required. This study strives to create awareness of the new pervasive skillset of the

professional accountant and auditor, with special reference to integrated thinking skills, as a result of the impact of Industry 4.0 and Industry 5.0.

6.1 Limitations and future areas for research

This study contributes to the literature for both professional accountants and academics in that it examines the impact that Industry 4.0 and Industry 5.0 has had on the role of the professional accountant. The new pervasive skillset that a professional accountant needs to fulfil their new role is set out and emphasis is placed on the ability to think in an integrated manner. The fact that this study consists only of a literature review presents limitations.

It is recommended that empirical studies are performed on a number of issues such as how integrated thinking skills can be developed in professional accountants the importance of being able to think in an integrated manner.

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