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# Digital Accounting and the Human Factor: Theory and Practice

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| ARTICLE INFO | ABSTRACT |
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| | This paper gives an overview of the current and future technologies impacting accounting and auditing fields. The aim is to present the technological disruptions shaping these fields and also look at how they might influence future jobs and required skills. Starting with a historical background check on how Industry 4.0 emerged, we survey four main areas of the topic: 1) current developments supported with real-life cases, 2) a literature review of on-going research, 3) possible future job descriptions, and 4) required skills and how to acquire them. |

## Introduction

In this paper we look at how current and future technologies are impacting the fields of accounting and audit which are thus shaping the future of new job descriptions and required skills in these fields. These fields are moving full force into the digital age, where many predict that in five to ten years humans will become obsolete in many areas in accounting and audit.

However, though many tasks will be automated, humans will still be able to create value for clients and for the way the business world is developing through continuous learning of new skills. Here we will discuss how humans can grow alongside advancing technologies to keep up with the demand that will be present in a few short years. To do this we will first introduce the fourth industrial revolution and its advancements. Next, we will review how this revolution is changing the worlds of accounting and audit, presenting which technologies and advances are relevant to the fields and are creating the largest impacts. In addition, we will review on-going research from (e.g. Zhang, Dai & Vasarhelyi, 2018, Pan & Seow, 2016, and others) and how it is affecting the fields, jobs, and the skills required to adapt. Once we set up this potential future, we will go through additional demands that will be placed on employees of the fields. Next, a detailed list of what the most valuable skills going into the future will be analyzed. We will then discuss an overview of the critiques that are forming due to the rapid changes occurring in the fields and employment opportunities. Lastly, we will predict how the future will evolve in our view and from the view of on-going research.

While there are many predictions of how the future will be, many reports do not focus on what will be required of employees going forward to add value to clients. This report gives an in-depth analysis of new job descriptions and which skills will be potentially needed to survive in digital future and thus allowing for further research on which of these skills are the most useful going forward.

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## Theoretical frames

The revolution in which we are now has many names, such as the 4th industrial revolution, Industry 4.0 (which we will use in our paper), the digital revolution and the artificial intelligence revolution (Hoffman, 2017). The McKinsey Global institute estimates that "It´s happening 10 times faster and at 300 times the scale than the Industrial Revolution in the early 19th century" (Hoffman, 2017). In order to understand the potential future in accounting and auditing, we first must understand the revolution we are in now. In this section we will discuss what Industry 4.0 is, how it will change the future and how it will specifically change accounting and audit.

The fourth industrial revolution is a continuation of the third revolution, in which we started to use computers and automation to improve upon it with autonomous and smart systems driven by data and machine learning. In the current revolution and when Industry 4.0 evolves further, computers will be interconnected and communicate to make decisions without humans. The combination of Internet of Things, Internet of Systems and cyber-physical systems, makes Industry 4.0 possible. The power in the Industry 4.0 lays in the network of smart machines that are interconnected and can create, analyse and share information. (Marr, 2018a) In other words, Industry 4.0 is about the ways smart, connected technology will be embedded in companies, assets and people, and is marked by the development of analytics, robotics, cognitive technologies, artificial intelligence, quantum computing, the Internet of things amongst others. One of the most important parts of these new technologies is that they will change the way data and information is used and how this will allow companies to become more efficient. (Cotteleer & Sniderman, 2017) Overall, Industry 4.0 is changing every aspect of the business world and has become an inevitable topic of discussion, next we move on to the specifics that are changing the fields of accounting and audit.

The accounting and audit professions are evolving, and everyone is talking about the digital revolution. The revolution is growing fast and there are still many aspects that are unclear about the future. These changes will lead to the disappearance of many jobs, but at the same time it will allow for many new opportunities not only for the newly graduated, but also for those who are eager to develop new skills. Information technology is nowadays part of every business and companies that can´t keep up with the new technologies will slowly fade away. Just like every other field in business, accounting and audit will benefit immensely when using digitalization to organize, process and evaluate financial data which will improve productivity and save on both cost and time. These changes will affect essentially every business as accounting is a crucial and core part of the success of a company and we have seen how failures in this area have wiped out large and bustling companies such as Enron and WorldCom. (Edupristine, 2018). For those legally required to participate in audits, these improving technologies will also affect them and help them to uncover fraud, inconsistences, and other faults that could topple a business. A further subset of these companies that will be affected immensely are the accounting firms, from the top four to the smallest and everything company in-between.

As the digital revolution is shaping the field of accounting and auditing it means that this topic is relevant for both current accounting and auditing professionals as well as for students and professors at universities as they are the ones that have the knowledge required to develop these sophisticated accounting information systems. We already know that many of the current accounting processes are being done by machines such as expense management, accounts receivable and payable processing, artificial intelligence powered invoice management and supplier onboarding. Thus, we can predict enormous changes in jobs in the future, but the role of bookkeepers and auditors will remain important. One of the most important discussion currently open is how there are a lot of tasks that machines can perform much better and faster than humans such as structured problem solving and routine tasks but then again, they don't have the skills of improvising and using imagination (Hoffman, 2017). We will further discuss how humans can adapt to stay competitive and add value in the fields mentioned in subsequent sections. To sum up, these current advancements are making it necessary for businesses, accounting and audit professionals, upcoming graduates, and universities, to adapt to technology and figure out the best way to interact with it going forward.

## Current developments

Businesses have gone through three different waves of transformation up to present day. From the first wave of standardized processes of automobiles on assembly lines to the second wave of automated processes including computers, information technology, databases and software. Built on these two, the third wave includes adaptive processes. This wave initiates new ways of doing business. Based on real-time data these processes are more adaptive and flexible and give the possibility to reimagine innovative and more individualized products and services. (Daugherty & Wilson, 2018) According to Charles Hoffman (2017) There are three technological innovations that

are primarily driving the changes of the current accounting practices, methods and procedures and which can noticeably modernize and improve accounting and auditing. These are XBLR-based structured digital financial reporting, knowledge-based systems and other application of artificial intelligence and blockchain-based distributed ledgers.

XBLR-based structured digital financial reporting stands for eXtensible Business Reporting Language, which is a global framework for exchanging business information and it is freely available for everyone. In the past, financial reports were readable only by humans, but in the future, they will be both human – and machine-readable (Hoffman, 2017).

The second innovative driver in the field are knowledge-based systems and other applications of artificial intelligence (Hoffman, 2017). Robotics and artificial intelligence are at the center of the technological disruption. Robotic Process Automation, RPA, is about automating structured and rule-based tasks. RPA is not intelligent in the sense that it cannot adjust to changes or make complicated decisions (Zhang, 2018). In the area of RPA, accounting firms and RPA companies are collaborating. All big four accounting firms, Accenture, Capgemini, and others are working with Robotic Process Automation companies such as UiPath and Blue Prism (Tadros, 2016). AI research has reached a new level of development and understanding of machine intelligence. The current approach has focused on letting the system learn rules by itself from observations collected from real-life data, instead of teaching the system a wide range of rules. (ICAEW, 2018) Going forward, AI will reduce costs and time for accountants and auditors as it works in the background enhancing already existing cloud computing and increasing productivity (G2 Crowd, 2018).

The third technological innovation driving the fields and affecting future jobs is blockchain-based distributed ledgers. Blockchain is a shared database with a series of data that is time-stamped and immutable so no one can tamper with the data. The blockchain is a decentralized system – it has no master. The records are tied together into blocks and then they are added to the chain one by one. No transaction costs arise when using Blockchain, because no intermediaries are needed. It is an easy way to pass information from one person to another in a completely automated way. The blockchain is hosted by millions of computers at the same time, so the data is open for anyone on internet (Blockgeeks, 2019). Although it is at an early stage, Blockchain is changing the accounting and audit world. Companies are already testing the new technology. New opportunities and challenges for professionals in accounting and auditing will arise due to the blockchain. Blockchain is best known as the technology behind cryptocurrencies, such as Bitcoin, but is has many other potential uses and benefits in addition to that (Half, 2018). Examples on potential uses are; property records, banking, supply chain auditing, Anti-money laundering (AML), Know your customer (KYC), stock trading, smart contracts and crowd funding (Blockgeeks, 2019). The main advantages of Blockchain in accounting and auditing is that it enables more efficient asset and data transfers, privacy and security will increase, time-consuming tasks can be removed, and financial records will become more comprehensive and precise. Blockchain may also open up new job tasks for auditors, such as, cyber auditing (Half, 2018).

As it can be seen around us and as we have talked about in this paper, the trend is that data and operational processes are more and more transferred into digital form. Unfortunately, new technology and processes bring new forms of corruption and fraud. Cybersecurity is therefore an inevitable part of strategy planning right now and in the future. Companies have to invest and manage these new risks of cybercrimes. (Gupta, 2015) Accounting firms are doing their best to protect their businesses. A rapidly evolving feature of AI is anomaly detection. Accounting firms uses this application of machine learning to prevent cybercrimes and to identify outliers in the data, such as in cases of identification of false invoices for their clients. For example, Ernst & Young's (EY) anomaly detection program has an accuracy of 97 % and is a valuable tool in everyday work for accountants and auditors (Zhou, 2017) in order to protect both the assets, reputation and staff of the accounting firms, but also their customers (Gupta, 2015).

According to Daugherty & Wilson (2018) it is a misconception to think that machines will gradually replace humans in labour markets. They think the man-versus-machine view is old-fashioned and short-sighted. Instead we should start to think about it as a collaboration between humans and machines. They emphasize that even though technology will probably replace certain jobs and certain functions, the main power of the technology is in complementing human capabilities. Many leading firms have begun exploiting the potentials of AI in their businesses and have started to realize that organic teams including humans partnering with machines are the future. Humans and machines, each have their own strengths. The areas where each party are most capable and in which areas, they complement each other are represented in table 1. Many of these human-only activities and skills will be explained later in the article. The important part of the table is to see and acknowledge the "missing middle", as Daugherty & Wilson (2018) explains it, where humans and machines complete each other. This middle is often forgotten, when we compare human and machine activities as excluding each other.

**Table 1.** Human-Machine teamwork (modified Daugherty & Wilson, 2018, p. 5 and Marr, 2018b)

| Lead | Understand beahviour and culturism | Judge | Train | Explain | Sustain | Amplify | Interact | Embody | Transact | Iterate | Predict | Adapt |
|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Human-only activity | | | Humans complete machines | | | Machines complete humans | | | Machine-only activity | | | |
| Human-only activity | | | Human-machine hybrid activities | | | | | | Machine-only activity | | | |

Apart from these three innovative drivers in the field, there are expanding industries that will now and also in the future affect accounting and auditing. Two of these new industries are FinTech and RegTech. FinTech stands for Financial technology and it describes the businesses that use modern technology and software to provide financial services. Fintech companies are competing with the banking sector. They provide different digital solutions in daily banking, such as robo-advisors and different apps. This enables, for example, faster and easier transactions without intermediaries. (FinTech Weekly, 2019) RegTech, Regulation Technology, addresses regulatory challenges by simplifying the increasing legal requirements within the financial industry. (W. Arner et al. 2017) RegTech companies use, for example, AI and machine learning to come up with new regulatory solutions. (ComplyAdvantage, 2018) These new technological approaches save accountants' and auditors' time in mundane tasks in areas of compliance and managing money (G2 Crowd, 2018). This has and will result in changes in job tasks and skills needed by employees.

## Current real-life cases

Many of the top players in accounting and auditing have been exploiting and investing into different innovative areas to stay relevant in the field. As it was presented in the previous part, the main buzzwords disrupting the nature of accounting and auditing work now and in the near future are robotic process automation, artificial intelligence, blockchain, human-machine teamworking and new security issues. While many of these technologies are still in their infancies, they are already creating a lot of value for the investors. In addition, many of these technologies are allowing companies, accountants, and auditors to take on more global clients without as many limitations as before. In this section we look at some current examples of development affecting the work of the future accountant and auditor.

*Case: PwC Digital Accelerator Program*

In order to train their employees and keep them on top of the development, PwC (PricewaterhouseCoopers) launched a 2-year Digital Accelerator Program for 1,000 employees to boost their digital skills in 2018. The aim with the Digital Accelerator program is to train the employees in-house in three areas; data analytics, automation and AI, including machine learning. The program includes courses from data cleansing, blockchain, cybersecurity to drones and 3D printing. Instead of doing their usual work, the participants in the program get "digital-heavy" projects, client work to solve and attend weekly classes. The Digital talent leader and the head of the Digital Accelerator program, Sarah McEnaneuy says that the aim with the program is that the employees get more technology skills so that PwC can remain competitive in the market. The program is also an attempt to reduce costs for clients. The costs can be reduced thanks to the new technology that enables job tasks to be done faster. PwC did not reveal how much they are spending on the project, but did tell that it was one of the largest investment areas in 2018 (Liffreing, 2018).

*Case: Deloitte US Blockchain Lab*

Deloitte has dedicated a whole division to blockchain research and development. The US Blockchain lab is located in New York and is one of the many blockchain labs that Deloitte has around the world. Deloitte´s blockchain community consists of over 800 professionals in 20 countries. The aim with the lab is to support clients in utilizing the capabilities and opportunities that the blockchain technology can offer. The lab is a place for education, ideas, development, strategy and prototyping. The team in US consist of more than 20 committed designers and developers in Blockchain. The US Blockchain team works together with specialist from other countries and with more than 20 technology companies. The lab has already developed over 30 prototypes that are Blockchain-related, covering a variety area of applications, such as trade finance, cross-border payments, digital identity, fraud detection, reward programs and a lot has also been done in the investment management and insurance sectors. As an example of a blockchain solution that can be of great benefit in the accounting and audit field, is the fraud detection solution, that is blockchain and machine learning based. This solution facilitates fraud detection in real-time. If anomalies are detected in the transactions, they are captured and get a risk score created based on the matching transaction IDs in the blockchain (Deloitte, 2019).

*Case: The EY Blockchain Analyzer*

EY has started to use blockchain technology in their audit process. It was in April 2018 that EY announced the pilot of the EY Blockchain Analyzer, which is a technology that is created to help auditors to collect a company´s transaction data from various blockchain ledgers. When the data is collected, auditors can examine the data, analyse the transactions and identify outliers. The technology makes it possible to do a thorough analysis of the business transactions in cryptocurrency. The technology is specifically created to support auditors when they audit companies that use cryptocurrencies. Cryptocurrencies such as BitCoin, Ether, LiteCoin, BitCoin cash and a few other crypto-assets are being tested with this technology. When the Blockchain analyser has been developed, they have used experience acquired when working with clients around the world, with technologies such as wallet providers, investment funds, exchange platforms among others. The development of this new technology is an answer to the customer's changing needs and to improve the audit process as a whole. As the EY Global Assurance Innovation leader, Jeanne Boillet, says: "As digital technology continues to advance, we are focused on developing innovative approaches to the audit process and providing confidence and trust to the capital markets. As companies are also focusing on how they embed technologies like blockchain into their financial processes, we are innovating the audit to meet their evolving needs and those of investors" (Thomas, 2018).

*Case: PwC and ABBYY*

PwC has started to automate their financial documentation processing in cooperation with ABBYY. Auditing requires dealing with a large quantity of documents and verifying that the content correlates with the information in the customer´s accounting system. In the past, the employees at PwC have manually keyed in the data into the system. This required of course a lot of time, when they had to analyse every document for important information. PwC did, in order to increase the efficiency and automate the data transfer, implement the ABBYY FlexiCapture intelligent solution for automated data collection and document processing. ABBYY uses artificial intelligence to provide content intelligence solutions and services. This technology makes the data transfer from invoices, contracts and other structured and unstructured documents much faster. When, for example, an auditor uploads documents to the ABBYY server, the ABBYY FlexiCapture can automatically identify document types and improve images. It can also identify which documents should be dealt with and can extract the required data and further transfer the data into a master spreadsheet. The auditors benefit from this because they can spend a lot more time with their customer instead of doing paperwork (ABBYY, 2019).

*Case: Natural Language Processing in the leading accounting firms*

Natural Language Processing, NLP, is a form of AI, that plays a big part of the ongoing developments in accounting and auditing. In its simplest form NLP is the technology behind tools such as spellcheck, autocorrect and in the Google search function that tries to figure out what you are going to say (Mills, 2019). This efficient form of AI combines both computers and linguistics (Mills, 2019), and it is guided by deep-learning, that learns from examples

and automatically obtains useful information for its user. From this extracted data, an accountant or auditor can acquire practical insights to use in one's work (Onyshkevych, 2018). Here we will look at how EY, Deloitte and PwC embody AI at the moment. Each of them has a somewhat different approach to the development. EY addresses it from a business value perspective, by doing small things and aiming to get in this way an immediate ROI. EY uses NLP in reviewing lease accounting standards in cases when the IRS issues new regulations. Previously they had to go through tens of thousands contract, but now NLP does this faster and humans only have to validate the results from the automatically extracted information. PwC employs AI as short AI sprints, where they develop quickly, in four weeks, a functioning model for a client. If approved they refine it to provide better accuracy for the client. These sprints include teams of two or three people, and PwC holds approximately 80 sprints a year. Deloitte also takes its own approach in deploying AI in the company's operations. They have an internal innovation team, that focuses on every angle of new technology and devotes 80 % of their time to AI. Their NLP system can, for example, look through hundreds of thousands legal documents in different client cases, and this way save months of time from humans (Zhou, 2017).

Next, we will look into on-going research in these topics to provide a link between the practical and theoretical.

## Ongoing research

From on-going research, we have found many papers referring to the need for accountants and auditors to improve their skills. For example, according to Greenman's paper *"Exploring the Impact of Artificial Intelligence on the Accounting Profession"*, research shows that employees need to up their skills because of the changes occurring in the fields. Accountants are being forced to adapt or risk losing their jobs. The good news is that while there will be job disruptions, there will be new jobs being continuously created. According the paper and referencing the US Bureau of Labor and Statistics, *"the accounting profession is projected to grow at a rate of 11 percent over the next 10 years, an increase of over 142,000 new accounting and auditing jobs"*, (Greenman, 2017). Greenman speculates that there are most likely many factors contributing to this growth in the US, but a large amount will be due to the technology advances that need accountants to have the right knowledge to make the advances work successfully. This paper shows that, yes, the accounting and auditing roles are changing, but from recent technological advancements they have not made all jobs obsolete. On the contrary, individuals with the right skills have used these technologies such as tax filing software to increase the number of clients they can take on. This further proves that with the right skills, the future will be bright.

Looking further into research done in the fields we can already see that there is a huge lack of IT knowledge in the accounting and auditing professions and that the need for these skills are becoming more important than ever before. There is already a need for professionals who have IT knowledge in auditing, data analytics and people who can handle these sophisticated IT services and programs. In Pan & Seow´s (2016) article they critically review the competencies and skills that the future accounting graduates need to prepare for. It is shown that the use of cloud computing, eXtensible business reporting language and business analytics have already set some changes in how companies do their financial reporting. The emerging use of information technology in almost every part of the accounting field have made the demand for accounting graduates to have advanced IT skills even more critical. The conclusion from the research is that it is crucial that accounting students have proper training in IT tools such as automatic identification systems, XBRL, analytical programming and data mining because this is what the future in the field will be all about, analysing and developing these IT accounting systems. This means that the education and courses in the universities need to be more focused on IT related topics. (Pan & Seow, 2016) Further evidence from research in the topic is that accounting education is lacking the depth and breadth of the current evolving accounting practices. The author is reflecting the situation by the fact that the role of technology and information systems are not embraced enough in the current accounting textbooks (Wells, 2018).

In another research recently done by Zhang, Dai and Vasarhelyi (2018) the focus is on the impacts of disruptive technologies and how it will change the accounting and auditing profession as well as the education. As for to today there is still a lack of Information technology in the education which means that the students aren't prepared for the accounting workplace of the future. The most important question is about how the profession is going to adapt to the technological changes and how it will change the traditional procedures. One thing that is certain is that the automation will result in substantial reduction of staff especially from the traditional tasks. Automated processes mean that the accountants and auditors will need to focus on the technical maintenance of the systems and more analytical work, while repetitive and mundane tasks will disappear. Mentioned here again, the technologies that are

reshaping the accounting business models are robotic process automation, artificial intelligence, advanced analytics programs and blockchain and these require more sophisticated education that will focus on these high-level skills. These changes will mean that the educators at the business schools will have to use new teaching models that could include, for example, cybersecurity and audit data analytics classes. All in all, the future of the accounting and auditing profession will require a philosophy of lifelong learning and ongoing adaption to the changing environment (Zhang et al. 2018).

Lastly, we focus on audit processes, the research again goes through the disruptive technologies and how they will affect accounting and audit. In this paper the focus is on audit and how AI is changing what parts humans play in the in audits. To begin, there are already many advancements that have taken over certain tasks, this is due to the sheer amount of data, structured and unstructured, that companies process. In Kokina and Davenport's, *"The emergence of artificial intelligence: How automation is changing auditing"* research they explain how due to the requirements of audits, AI technology is a perfect fit. Yet the advancements will reduce many entry level audit jobs, which is where many accountants start their careers. This will take away a learning opportunity for many new graduates as they won't have a job waiting for them. The next step already being foreseen by the big four accounting firms is *"making increasing use of audit platforms and predictive analytics, but not the higher levels of intelligence and cognitive capability".* They have used technology to reduce repetitive tasks, but still cannot take the emotional intelligence side and fit it into new technologies. Thus, while current entry level jobs may be replaced, we are moving towards a combination of human, machine work, rather than full automation. With Kokina and Davenport predicting that, *"Since AI technologies replace specific tasks rather than entire jobs, loss of employment in the short term is likely to be relatively slow and to be marginal rather than dramatic.".* This research opens further questions about, *"bias in AI and whether humans using AI applications can engage in appropriate judgment and decision-making."* and how transparent it is to use AI if humans are not interpreting the results correctly (Kokina & Davenport, 2017).

## Future job descriptions

There is no doubt that the accounting and auditing professions will change sooner rather than later because of the digital revolution that we are presently in. When time-consuming tasks are done by machines, professionals can focus on adding more value to their customers which will reduce both cost and time spent on the given tasks. The automation of regular accounting processes will lead to accountants and auditors being able to focus on more specific tasks because many of the earlier tasks will be done by computers. Traditional accounting procedures such as inhouse invoicing and travel invoicing will be replaced by computers. Auditing processes will be automated and there will be advanced tools to detect risk and fraud. Future auditors will be able to focus on analysing the outputs instead of using several hours on collecting information from financial statements (Forbes, 2018).

The future jobs of accountants and auditors will be all about using sophisticated information systems and artificial intelligence to analyse, report and develop wanted outputs. Sophisticated information systems will take care of handling data security, connecting different parts of the financials which will become part of the big data. The revolution is changing the tasks related to management accounting and financial accounting. In the future the management accounting tasks will be more precise and detailed because of the computer's abilities to collect and gather the information that is needed for managers to make the right decisions. Accountants in the field can then focus more specifically on preparing and analysing the data for those who are interested. The problem that accountants might face is the overwhelming amount of information that will be available. This means that the accountants' jobs will be about recognizing the relevant and important information to be able to make decisions. These tasks require strong communication skills to be able to share the most important results in a clear way. Although computers are taking over, one important fact is that the quality of the data will remain important. To be able to produce quality data there is a need for someone who can transfer the information and serve as a service agent when working on transferring knowledge to the systems. This task can't be done without an expert in the field. As time passes and robots are part of the daily tasks of accounting and audit professions there is going to be a need for someone at the user level support as well as someone who is capable of solving the technological problems related to the systems. We don't know the specific job descriptions of the future accountant and auditor, but from existing information we have gathered a list of potential future job descriptions titles presented in the following table.

**Table 2.** Examples of future job titles (source authors based on literature review)

| | | |
|---|---|---|
| Blockchain Accountant | Analytics Guru | Historical Accounting Analyst |
| Healthcare Accountant | Cloud Accounting specialist | Systems Integrator |
| Cybercrime Accountant | Fintech City planner accountant | Strategic Accounting Analyst |
| Fintech Accountant | Data Security Accountant | |

Now that we have seen what kind of jobs might be offered in the future, we need to figure out how we can adapt and overcome to be the kind of employee companies will be looking for. To start, base knowledge of accounting and audit will always be necessary thus the skills mentioned here are ones that are needed in addition to what accountants/auditors should already somewhat know. To conquer this topic, we have broken the skills down into more technical skills/ "hard skills" and then so called "soft" skills, which are not always taught in conventional education.

**Table 3.** Potential required skills now and in the future, source: authors based on the literature review

| Technical skills | | Social skills | |
|---|---|---|---|
| Understanding the capabilities of software | Basics of coding | Strong communication | Emotional intelligence, ethical |
| Analysis skills | Fintech software knowledge | Conflict solving | Adaptability, tolerant of uncertainty |
| Data visualization | Data security, forensic tools | Leadership skills | Sales knowledge |
| Knowledge of International Standard | Data warehouse management | Risk management | Innovative/creative |
| Knowledge of industry specific regulations | ERP (Enterprise resource planning) experience | Strategic decision making | Customer service orientation |

The technical or "hard" skills include analysis, understanding of software and its capabilities, and data security knowledge amongst others, mentioned in Table 3. These are more about learning how to interact with programs, AI, robotics, and generally with the digitalization process that will take over mundane tasks. As mentioned before, many tasks will become hybrid human-robot tasks, there will be the need for people who know who to interact with the machines (Daugherty & Wilson, 2018).

As for the social or "soft" skills, these are generally harder to learn in a class, they take patience, understanding, and the ability to adapt. While the technical skills have always been deemed important, these soft skills are becoming equally valuable because they will allow individuals to bridge the gap between machines and people. As the accountancy and audit professions moves towards a more strategic and insights-based fields, these soft skills will become even more necessary. The individuals who master these skills will be immensely better off when dealing with clients, who will no longer look at their accountant/auditor as a source for just financial statements, but as someone who knows their business inside and out and can provide valuable knowledge. Thus, gone will be the days of the quiet, back office accountant, so expect to have employers increasingly ask for adaptability, innovativeness, sales skills, effective communication, and customer-oriented support capabilities (Marr, 2018b).

While the thought of needing so many skills may seem overwhelming, it is not necessary nor expected that every employee will be competent in all these areas. As mentioned earlier, jobs will most likely take a turn towards more specialized roles thus requiring employees to develop skills in certain areas. The advice here would be to explore many areas, select the top most interesting ones but only specialize in a selected few that show a promising future.

*How to acquire the necessary skills?*

Now that we know what kind of skills will be required, we can move on to where to acquire these skills. Due to the technological advances of the last 25 or so years, the way to gain knowledge has expanded increasingly. No longer do you need to attend a physical class when almost everything is online. Presented here are some of the best ways to expand your skill set for the future. Starting with online courses, these are offered on platforms such as edX.com, Coursera.com, in these websites you can take courses from the Arts & Humanities, social sciences, business, to languages. The variety on these websites is increasing rapidly. In addition to just taking one or two classes, they offer fully online master's degrees from accredited universities. They also offer certifications in different professional areas such as data science, cybersecurity, deep learning, and many other beneficial skills. Many of the courses are free, but to have them recognized you need to pay a fee, while a masters may set you back about 10-25k€ depending on the program (edX.com). This may seem like a lot to spend, but compared to a campus master's degrees, the cost is relatively cheaper.

In addition to online courses, you can still attend class at a university, for example through open university, where you only pay per credit. This offers face to face interaction with professors and other students. Here is where you can learn the material taught in class, but also how to work better in teams.

Both options mentioned are especially great for people who are already working to be able to continue learning. In addition to seeking outside learning, it may be possible to ask your own organization to provide further in-house training. This shows employee initiative to progress in their career but is also a way to help the company grow in the inevitable digital future.

Moving on to possible quick learnings solutions, there are other options such as YouTube, where knowledgeable individuals can share their insight in different areas and the same with Podcasts. Beware with these though as there could be some misleading or incorrect information. There are also plenty of LinkedIn trainings that are specifically geared towards accounting and audit. Lastly, while not the most conventional way to learn, take a chance and volunteer for leadership or teamwork experiences to build up technical skills, but also some of the interpersonal skills mentioned previously.

**Table 4.** Examples of ways to expand one´s skillset, source: authors

| | |
|---|---|
| • Online courses: | • Training courses offered by own company |
|   • EdX- Universities like Harvard, MIT, Brown offer courses here | • YouTube- channels: |
|   • Coursera |   • "Executive Finance" |
|   • Udemy |   • "CPA Strength" |
|   • Codecademy | • LinkedIn trainings |
|   • Hour of code | • Podcasts |
|   • Khan Academy | • Volunteering for leadership or teamwork positions |
|   • Code.org | |
|   • Small Biz U | |
|   • Alison | |
| • Open university | |

There are endless ways to acquire the skills needed for the future and many of these are even free. Accounting and audit will be changing and moving forward so now is not the time to rest on what you know, but to start the habit of continuous learning which will be necessary to keep up in these fields.

## Critical voices from society

Although the overall opinion from the top players is positive regarding the Industry 4.0, there are still some critical and worried attitudes towards the future of accounting and auditing and how it will affect future jobs and professionals in the fields. Changes in the workforce and labour markets are often viewed with doubt and fear. Some of these concerns towards the digital revolution are, however, the same as they were already in the First Industrial Revolution (Najjar, 2019). The most common fears and threats circle around questions of jobs, security and needed skills of employees. Also, comes the fact that our current society may not be ready for all the changes Industry 4.0 brings and big changes to our society´s structure cannot be avoided (Marr, 2016).

Another thing that many in the field are wondering about is how to teach those entering the accounting and audit field? The entry-level accountants will most likely be the ones most affected on the labour market, due to the automatization. The reason for that is that they are usually performing the basic accounting and audit tasks, that will be automated. Consequently, some fear that entry level workers will not be able to get appropriate hands on experience early in their careers (Kokina & Davenport, 2017).

In addition, many older workers feel that they are being left behind in the transition to the digital age. They fear not being able to retrain enough to stay competitive in the field. Employees older than 50 years of age are on average facing challenges associated with new technology and automation, and therefore fear that younger people will overtake their jobs. In addition to this, it has been discovered that employers do not give the older workforce the same opportunities to receive training to enhance their skills in the digital era. The biggest uncertainty arises from not having any insight of the future role in their company. (Recruitment Revolution, 2018) This does not only include the older workers, the younger ones will also need to retrain their skills, due to the increasing change and automatization in the society. The future will require the average person to adapt to new changes "that would have previously taken several generations" (Dickinson, 2018).

Professor Klaus Schwab outlines in his book "The fourth industrial revolution", the potential risks with the revolution we are in. He points out that organisations can be unwilling or not able to adjust to the changes and that governments can fail in the application and regulation of the new technology (Marr, 2016). The implementation of new technology is complex, time consuming and under some circumstances expensive. This can be a problem for smaller firms, they may not have the capability to implement new technology to the same extent as for example the Big 4 accounting firms, and therefore not able to keep up with the changes. (Caramela, 2018) Further, Schwab assumes that there will pop up new security concerns and that inequalities can increase if things are not handled properly. When automation increases, a lot of jobs will be lost across many industries, due to that workers are replaced by computers and machines. According to an estimate, as much as 47% of the U.S jobs will be in the risk zone (Marr, 2016). We should, however, keep in mind that, although some jobs disappear, new ones will emerge.

CFOs are under a lot of pressure from all the challenges in the digital age. The concern in the CFO's responsibilities is on the ever-broadening areas in their tasks. Their role has never been more difficult that it is now. They are under the demand to obtain and analyse real-time data all the time, have the right skillset to understand the new technology, support the correct training of their staff and also hire new employees with the appropriate skills (Ernst & Young 2016).

Risk management will continue to be an issue and constant topic as technology may advance faster than companies and employees are able to keep up with. Related to CFO's responsibilities in the on-going technological disruption, CFOs reported in a survey of more than 700 CFOs in 2018, that the cybersecurity breaches are among the most critical things that keep them up at night (Korn Ferry, 2018).

## Conclusions and future outlook

These are exciting times, the financial world as we know it is being turned upside down. With continuous digitalization and innovation, it is hard to predict with certainty how the affected fields will look in 10 to 15 years. Yet through our research we have presented which potential tools and skills will mostly likely be needed and useful to have a successful and long career in either accounting or audit. To do this we reviewed the sector's current and upcoming advancements, the potential job descriptions that will shape who gets employed, and finally how to potentially acquire the knowledge needed.

What do we expect from the future then? After all our research, we know that robotics and AI are at the center of the change, and therefore humans will need to adapt to the changes coming with this. As we mentioned previously, many fear that these changes will make humans obsolete, but the further we research, the less we find this to be true. We have entered an age of human-machine cooperation that will continue as far as we can currently predict. At this point, many organisations still do not know how the Industry 4.0 impacts their business or are struggling with other things, such as how to find the right talent and knowledge to know how to adopt to the changes. Thus, it is necessary and inevitable that many organisations are implementing changes and preparing for a different future with new technology that will improve their business. Industry 4.0 is still developing, and we cannot probably see the complete picture until many years in the future. However, the companies that adopt new technologies, are realizing the potential future. The same companies are also dealing with how to educate their current workforce, so that they can handle the new job tasks that Industry 4.0 brings and to recruit new employees with the right skills (Marr, 2018a).

Specifically, the future of the accounting and audit professions, it has become abundantly clear that the role of accountants and auditors are changing. Time consuming and repetitive work will be automated, and the future

accountant and auditor will perform higher value work, while transforming into more advisor roles in finance and business, with more specific expertise (Forbes, 2018). This will allow for these individuals to focus their brain power on more fulfilling tasks, but those that do not adapt will not make it through the next rounds of advancement. Thus, we know that now is the time for those interested in staying in these fields to push themselves to keep learning and improving because there will be no other choice.
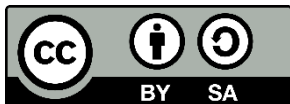
From on-going research, we see a shortage in required skills, especially with new graduates whose knowledge is coming directly from universities (Pan & Seow, 2016). While it might be a slow change due to bureaucracy, we see education systems, specifically universities, changing their programs to be more technology- oriented and forward looking. In addition to universities, we know companies will need to invest in technology and in their employees' skillsets. We predict that while investment may be expensive, it will be more expensive to lose out on business and risk bankruptcy.

Overall, we expect a promising and innovative future, where human-machine cooperation will be key and the individuals with the right skillsets will be set to prosper in this future. Yet, as we know the future is unpredictable so further research will be needed to guide businesses, accounting and audit professional, and society at large into the right direction.

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