POSITION PAPER ON THOUGHT LEADERSHIP - IMPACT ON SKILLS DEVELOPMENT AND TRAINING OF THE FINANCIAL AND ACCOUNTING SERVICES SECTOR IN THE MIDST OF EMERGING TECHNOLOGIES

FINAL REPORT

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FASSET

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POSITION PAPER ON THOUGHT LEADERSHIP - IMPACT ON SKILLS DEVELOPMENT AND TRAINING OF THE FINANCIAL AND ACCOUNTING SERVICES SECTOR IN THE MIDST OF EMERGING TECHNOLOGIES

Research by:

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

1IR	First Industrial Revolution
2IR	Second Industrial Revolution
3IR	Third Industrial Revolution
4IR	Fourth Industrial Revolution
ACCA	Association of Chartered Certified Accountants
AI	Artificial Intelligence
BANKSETA	Banking Sector Education and Training Authority
CIMA	Chartered Institute of Management Accountants
CIPC	Companies and Intellectual Property Commission
COEFS	Centre of Excellence in Financial Services
CPD	Continuous Professional Development
CSSA	Chartered Secretaries South Africa
DHET	Department of Higher Education and Training
DTPS	Department of Telecommunications and Postal Services
ETs	Emerging Technologies
FAS	Finance and Accounting Services Sector
FASSET	Finance and Accounting Services Sector Education and Training Authority
FGDs	Focus Group Discussions
FSB	Financial Services Board
HEIs	Higher Education Institutions
IAC	Institute of Accounting and Commerce
ICT	Information and Communications Technology
INSETA	Insurance Sector Education and Training Authority
JCPS	Justice, Crime Prevention and Security
KIIs	Key Informant Interviews
NQF	National Qualifications Framework
POPI	Protection of Personal Information
SAIBA	Southern African Institute for Business Accountants
SAICA	South African Institute of Chartered Accountants
SAIPA	The South African Institute of Professional Accountants
SAIS	South African Institute of Stockbrokers
SAIT	South African Institute of Tax Professionals
SARS	South African Revenue Service
SDL	Skills Development Levy
SIC	Standard Industrial Classification
SSP	Sector Skills Plan
STEM	Science, Technology, Engineering and Mathematics
TVET	Technical Vocational Education and Training Colleges
UJ	University of Johannesburg
SAQA	South African Qualifications Authority

EXECUTIVE SUMMARY

1. Introduction

The world is currently undergoing major changes perpetuated by Emerging Technologies (ETs). Technology innovation is taking place at unprecedented speed and is often manifested in the Fourth Industrial Revolution (4IR) discourse. The signs of existence of the emerging technologies relate to the various deployment of sophisticated ways of work such as the application of Artificial Intelligence (AI), Robotics, big data analytics, augmented reality, blockchain, cloud computing, the Internet of Things (IoT) and 3D printing to name a few. ETs brought about by the 4IR have enabled organisations to perform activities that were previously exclusive to human beings, raising the fear that many workers will be replaced by machines. Some scholars however are of the view that ETs will bring new opportunities.

The Finance and Accounting Services Sector Education and Training Authority (FASSET) commissioned Underhill Corporate Solutions (UCS) to carry out this study, aimed at investigating the potential impact of ETs on skills development and training in the Finance and Accounting Services (FAS).

2. Purpose and objectives of the study

The purpose of this study was to conduct research into emerging technologies and their implications for the Finance and Accounting Services (FAS) sector skills development and training. The primary focus of the study was to understand (broadly) the impact of emerging technologies in FAS sector skills development and training; and how employers gain competitive edge through its human capital implications.

The specific study objectives included to:

- Identify future skills needs in the FAS sector.
- Identify the skills and jobs that are impacted by ETs in order to provide input into the FAS skills development strategy.
- Investigate the implications of ETs on jobs in the FAS sector including implications for skills development and reskilling opportunities of the workforce.

3. Approach and methodology

In order to meet the research objectives, the study mainly utilised a qualitative research approach in the collection and analysis of data. For this research, a non-probability purposive sampling approach was used in the identification of respondents. The study population comprised of FAS sector employers, training providers and professional bodies in all major subsectors. Using a purposive sampling technique, 20 employers, 5 training providers and 14 professional bodies took part in the study through semi-structured in-depth interviews and focus group discussions (FGD). Due to the impact of the Covid-19 pandemic, all interviews and the FGDs with stakeholders were conducted remotely using Zoom, Microsoft Teams and teleconferencing. Thematic Content Analysis was used in the analysis of data collected from the study, and captured into the Atlas.ti version 8 software.

4. Main findings

The study findings cover areas such as:

- the level of understanding of the 4IR,
- ETs' implications for skills development and training,
- which occupations or jobs are likely to be impacted,
- challenges faced in implementing digital solutions, and
- the impact of Covid-19 on technology adoption and skills development.

The study also explored how factors such as the Covid-19 pandemic and the advent of emerging technologies impact on skills development for the FAS sector. The following were the key findings of the study:

4.1. The assessment of levels of understanding of the 4IR showed that the majority of employers understood what 4IR means; and were able to discuss its implications with reference to their organisational training needs. During the focus group discussion, stakeholders were in agreement that the advent of the 4IR has necessitated the need for skills development and training interventions focusing on enhancing employees' coexistence with emerging technologies.

4.2. A discussion into the adequacy of skill levels of current graduates in the FAS sector to handle existing technologies found that most training providers and employers were confident of their graduates and employees' abilities respectively. However, there was a general consensus that to stay abreast of emerging technologies, employees require constant training and continuing professional development (CPD).

4.3. The FAS sector's capacity to prepare for, and to manage emerging technologies was found to be constrained by a mismatch between employer skills demand and skills supply by training providers and (to an extent) professional bodies. While employers had a long list of necessary skills (inclusive of soft skills such as: emotional intelligence, change agility & flexibility, problem solving, critical thinking and communication; as well as technical skills such as data mining, data analytics, cloud computing, database management and cybersecurity) that they require their employees to possess in the wake of changing technology, training providers were found to have no skills programmes in the pipeline targeting such demands. Most professional bodies however, were found to be making an effort to close these skills gaps. Examples of professional body interventions include; providing qualifications in digital auditing, ICT courses in programming and application building, business risk and cybersecurity, and remote working as well as soft skills in critical thinking and business acumen.

4.4. The study found that the occupations likely to be impacted by ETs (at-risk occupations) include accountants, auditors, bookkeepers, tax practitioners and data capturers.

4.5. It was also found that there are a number of emerging occupations in the FAS sector as a result of ETs, namely information security officers and cybersecurity specialists.

4.6. The Focus Group Discussion (FGD) revealed that there were several soft skills whose demand has now increased as a result of emerging technology. It was noted that while several occupations appear to be under threat at face value, investment in soft skills such as problem solving, communication and critical thinking would likely enhance the competitiveness of employees. With sufficient CPD in key occupations and soft skills, it was found that employees would likely remain competitive and coexist

with emerging technologies. Meanwhile, for lower level qualifications such as bookkeepers, CPD interventions were found to be necessary in technical skills (such as coding, data mining and data analysis) that unlock options for work diversification. However, the ability to diversify skills will be subject to limitations such as the persons' capacity to implement drastic change into their professional life as well as the person's intellectual capacity to grasp new concepts.

4.7. The major challenges impacting skills development in the FAS sector which came to light were; the lengthy time it takes for curriculum development by training providers, budget limitations and resistance to change in terms of adjusting to emerging technologies.

4.8. It was found that the Covid-19 pandemic had accelerated technology adoption for several FAS sector employers, resulting in both successes (such as cost savings, improvement in digital skills and productivity increase) and challenges (such as employee wellness, poor connectivity/ slow internet speeds and challenges resulting from load shedding). On skills development, it was found that the pandemic had transformed the way in which training is administered; with the new focus now on electronic learning (e-learning) and assessments; a tool that has been found to be highly instrumental and easy to implement in the current Covid-19 environment. As a result, stakeholders suggested the need for investment in tools that improve employee access to remote training and assessments.

4.9. The study aimed to investigate a number of assumption made about emerging technologies, skills development and jobs in the FAS sector. Findings on these assumptions were as follows:

4.9.1. The first assumption that, "emerging technologies in the FAS sector are/ will be displacing jobs, resulting in retrechments", was only partially affirmed. While it was noted that some employees doing repetitive jobs may lose their work to automation, it was found that with sufficient CPD, most workers are likely to retain their jobs. In fact, it was found that due to emerging occupations, several jobs will likely be created as a result of the adoption of emerging technologies.

4.9.2. The second assumption that, "emerging technologies in the FAS sector are resulting in emerging (future) skills needs that are necessary for employee productivity and job retention" was affirmed. It was found that AI and machine learning, robotics, big data, cloud computing and IoT, have all resulted in future skills needs that include data analytics and cloud computing, among others.

4.9.3. The third assumption that, "emerging technologies in the FAS sector will create opportunities for new occupations or jobs" was also affirmed. Emerging occupations identified through stakeholder consultation include data scientists, product designers, AI & Robotics managers, cybersecurity specialists among others.

4.9.4. The fourth assumption that, "emerging technologies will necessitate a changed approach into skills development and training in the FAS sector" was also affirmed. The study established that in addition to remote training and examinations already being employed in the sector, training providers were exploring further options for immersive virtual training methods such as simulations and augmented reality.

4.10. As a result of skills development dynamics discussed, stakeholders suggested a number of key interventions such as the improvement of training at grassroot level, CPD for existing employees and partnerships with other entities and institutions for the development of ICT infrastructure in areas with low connectivity.

5. Recommendations

Based on the findings of the study and stakeholder suggestions, the following recommendations were made:

5.1. Recommendations for FASSET

5.1.1. FASSET should establish more effective partnerships with higher education institutions (HEIs) focusing on areas such curriculum development (for example new curriculums that intergrate ICT in day to day study), to ensure graduates are well prepared for emerging technological demands. FASSET should consider funding initiatives that seek to emphasise the application of practical learning (for example, auditors need to actively apply digital auditing skills while still in school) as well as soft skills within HEIs. Partnerships can also include institutions such as the Media, Information & Communication Technologies Sector Education and Training Authority (Mict SETA) that are more focused on skills development in the ICT space. FASSET's funding support will result in the development of a curriculum that better addresses the needs of the sector based on employer needs, hence leading to the closure of multiple skills gaps.

5.1.2. To further develop the emerging technologies skills base, FASSET should ensure (through partnerships with professional bodies and employers) that more resources are invested into an integrated skills programme (SP) system for sector employees. The SP system should ensure that employees receive periodic short courses focusing either on emerging technologies or on skills diversification yearly. Key soft skills that can be periodically offered include problem solving, change agility, flexibility, communication, people management and emotional intelligence. This intervention will result in the maintainance of job competitiveness for FAS sector employees, hence reducing the number of job losses due to ETs.

5.1.3. To effectively deal with skill requirements to support emerging technologies, a national collaborative effort is required. FASSET should therefore identify and collaborate with other partners that are considered vital in providing a broad supply of key skills. These partners may include other SETAs (such as BANKSETA and INSETA), local and international research institutions and other state entities. A model that negates partnerships will not be sustainable as skills developed by one sector will easily migrate to other sectors, thus eroding whatever gains could have been made through a single sector effort. An integrated intervention will unlock a skills supply pipeline between sectors that can result in the exchange of relevant skills programmes and courses as well as human resources from one sector that can close skills gaps in another sector.

5.1.4. FASSET should implement emerging technology awareness campaigns targeting all stakeholders, to promote culture change across the sector. Multiple studies have established that the adoption of 4IR technologies is likely to provide several new jobs, opportunities for large firms to outsource to smaller firms, and increased productivity. Instead of viewing AI as a threat to manual jobs, sector players should look into the possible opportunities that AI would bring both in productivity and job creation. This intervention will unlock sector awareness at all levels on the implications of emerging

technologies on jobs, hence promoting a harmonious and progressive relationship among employers, employees and FAS sector emerging technologies.

5.2. Recommendations for all sector stakeholders

5.2.1. FAS Sector should be involved in support programmes designed to encourage enrolment in and improve pass rates in science, technology, engineering, and mathematics (STEM) subjects in the schooling system. This may include initiatives such as adopting specific schools, support for STEM teacher development, development of relevent infrastructure such as laboratories and information and communication technology (ICT) hubs. The introduction of such support programmes will result in an increase in the pipeline supply of students that take up qualifications in emerging occupations, hence increasing the supply of relevant skilled personnel into the FAS sector.

5.2.2. For FAS sector occupations identified as 'in need of upskill' (such as those of accountanting technicians, bookkeepers, internal auditors, external auditors, taxation technicians, data capturers and debtors clerks) skills development and training should be focused ensuring job competitiveness in light of emerging technologies. For higher level occupations (such as accountants, internal auditors and external auditors) skills development can focus on soft skills that improve employees' analytical perfrormance. Specialised training can also be given in areas such as **business rescue** (a specialisation for accountants). In addition to soft skills, skills development for lower level occupations such as bookeepers, data capturers and taxation technicians, can focus on technical issues in their fields and skills diversification into areas such as data analytics and cloud computing. The upskilling initiatives for such occupations will result in a better skilled workforce that is able to maintain job competitiveness, thereby reducing the overall number of employees losing their jobs due to ETs.

5.2.3. FAS sector should promote and facilitate the establishment of Communities of Practice (CoP) across the sector, to encourage sharing of experiences on emerging technology skills development training and initiatives. This sharing of information and experience will result in a more informed sector thereby making it easier to come up with relevant interventions targeting occupations at risk and emerging occupations.

5.2.4. There is a need for a change management initiative on emerging technologies, which should be implemented across the sector in order to deal with issues around resistance to change by some stakeholders. Reducing or eliminating change resistance will result in a sector that is more receptive to emerging technologies. With training providers offering relevant courses, employers implementing technologies and employees getting upskilled will relate better with emerging technologies.

1. INTRODUCTION AND BACKGROUND

1.1. Introduction

The world is currently undergoing major changes perpetuated by emerging technologies. Technology innovation is taking place at unprecedented speed and is often manifested in the Fourth Industrial Revolution (4IR) discourse (Centre of Excellence in Financial Services (COEFS), 2017). The signs of existence of the emerging technologies relate to the various deployment of sophisticated ways of work such as the application of Artificial Intelligence (AI), Robotics, big data analytics, augmented reality, blockchain, cloud computing, the Internet of Things and 3D printing to name a few. Empirical studies show that ETs brought about by the 4IR have enabled organisations to perform activities that were previously exclusive to human beings, raising the fear that many workers will be replaced by machines. Some scholars, however, are of the view that ETs will bring new opportunities.

Rotolo *et al.* (2015), define emerging technologies as technologies whose development and applications are still largely unrealised, causing them to figuratively emerge into prominence from a background of nonexistence or obscurity. In additon, Rotolo *et al.* (2015) argue that emerging technologies are best described by their five attributes; radical novelty, fast growth, coherence, prominent impact, and uncertainty and ambiguity. Given their ability to transform the status quo, emerging technologies have been seen to be gaining relevance in the field of policy making (Rotolo *et al.,* 2015). According to West (2015), discussion on emerging technologies is gaining prominence in skills development given how the changing technological environment tends to make some jobs obsolete. While there is a diversity of views on what emerging technologies are, there seems to be consensus that such technologies have far-reaching consequences and implictions for skills development and training across different sectors.

In line with the purpose and objectives of this study, this report discusses the skills development implications of emerging technologies broadly and more specifically in the FAS sector. The report also identifies skills affected by such technologies and the impact on the employer competitive edge. The report concludes by highlighting research findings and making recommendations on how the sector should respond.

1.2. Overview of the FAS Sector

The Finance and Accounting Services (FAS) sector is comprised of 17 subsectors as per Standard Industrial Classification (SIC) code classification. Due to the broad similarity in the activities carried out by a number of these subsectors, the Finance and Accounting Services Sector Education and Training Authority (FASSET) has grouped the SIC codes into 7 broad subsectors. Information on this classification is presented in Table 1, and represents the general approach through which research data will be presented and discussions contextualised.

Table 1: Classification of FASSET subsectors

SIC Code	SIC Description	Subsector
81904	Investment Entities & Trusts	Investment Entities & Trusts
88103	Company Secretary Services	Company Secretary Services
83110	Administration of Financial Markets	Stockbroking & Financial Markets
83120	Security-dealing Activities	
83121	Stockbroking	
88102	Asset Portfolio Management	
83180	Development Corporations & Organisations	Development Organisations
88101	Tax Services	Accounting, Bookkeeping, Auditing & Tax Services
88120	Accounting, Bookkeeping & Auditing Activities	
88121	Tax Consultancy Activities of Accountants & Auditors registered in terms of the Public Accountants & Auditors Act	
88122	Activities of Cost & Management Accountants	
88123	Bookkeeping Activities, including Relevant Data Processing & Tabulating Activities	
83190	Activities Auxiliary to Financial Intermediation	Activities Auxiliary to Financial Intermediation
88140	Business & Management Consulting Services	Business & Management Consulting Services
91108	South African Revenue Service (SARS)	SARS & Government Departments
9110E	National Treasury	
	Provincial Treasuries	

Source: FASSET (2017b)

The FAS sector is made up of diverse role players conducting business in different subsectors. The main role players can be classified into employers, professional bodies, training providers and regulators. According to the FASSET (2021/22) Sector Skills Plan (SSP) update, there were at least 8 426 organisations who paid their Skills Development Levy (SDL) to FASSET by the end of the 2019/20 financial year. In the FAS sector, employers play a key role through the payment of levies and placement of students in work-based learning programmes. Grant analysis of the FAS sector suggests that the sector is made up of both very large and very small firms including one-person firms.

Professional bodies are also key role players in the FAS sector; and these set standards for education and training, set and maintain professional standards for ethical conduct, investigate complaints of unprofessional conduct by their members, hold disciplinary enquiries and impose sanctions against members found to have contravened the codes of professional conduct (FASSET, 2017a). Many FAS sector professional bodies facilitate training for their members, award them qualifications registered on the National Qualifications Framework (NQF) and also award them with progessional designations. Notable professional bodies in the FAS sector include the South African Institute of Chartered Accountants (SAICA), Association of Chartered Certified Accountants (ACCA), Chartered Secretaries Southern Africa (CSSA),

Institute of Internal Auditors of South Africa (IIASA), South African Institute of Tax Professionals (SAIT), the South African Institute of Professional Accountants (SAIPA) and the South African Institute of Stockbrokers (SAIS).

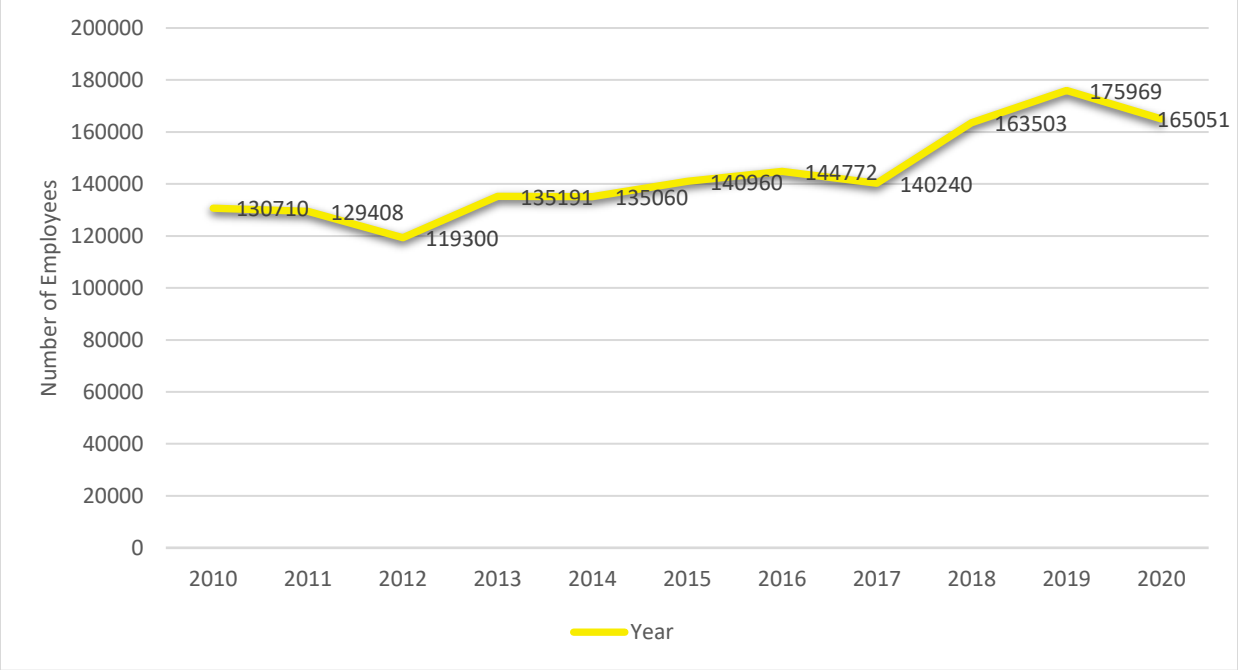
The FAS sector also includes regulators whose purpose is to set standards for conduct, investigate violations, conduct evaluations and other such functions. Regulators in the sector include the Independent Regulatory Board for Auditors (IRBA), South African Revenue Services (SARS) and the Financial Services Board (FSB).

Training providers in the sector include public Technical Vocational Education and Training (TVET) colleges, Higher Education Institutions (HEIs), and workplace training providers. According to FASSET (2017b), in 2017, the population of FAS sector training providers was as follows: 50 public TVET colleges, 23 HEIs, 15 professional bodies and 694 workplace training providers.

1.3. Trends in FAS sector employment

Available evidence from the FAS sector indicates that there has been a steady growth in employment headcount from the 2000/01 financial year to the year with latest statistics (2019/20) (FASSET, 2020a). Figure 1 visualises the trend in FAS sector employment.

Figure 1: Total employment in the Financial Services sector, 2010 – 2020



Source: FASSET (2020:23); Fasset 2020 WSP/ Organisational Huge File

Although statistics indicate fluctuating employment numbers on a year-on-year basis, the general trend between 2010 and 2019 demonstrates a notable increase from 130 710 jobs in 2010 to 175 969 jobs in 2019. However, in 2020, there was a marked decline in sector employment headcounts that was largely attributable to the Covid-19 pandemic (FASSET, 2020a).

In addition to the total employment statistics, a review of subsector employment statistics shows that some subsectors employ more people than others. Figure 2 shows the distribution of FAS sector employment headcounts by subsector, as per 2019/20 statistics.

Figure 2: Financial and Accounting Services sector employment by subsector

Source: FASSET (2020b)

As indicated on Figure 2 above, the Accounting, Bookkeeping, Auditing and Tax Services subsector had the highest employment numbers (55 523), followed by the Business and Management Consulting Services (27 034), and the Stockbroking and Financial Markets subsectors (24 189). The subsector of Development Organisations was the smallest in terms of employment headcounts (5 216).

1.4. Purpose of the study

The purpose of this study was to conduct research into emerging technologies and their implications for the Finance and Accounting Services (FAS) sector skills development and training. The study sought to explore the emerging skills trends for the FAS sector and its pace in closing the skills gaps amid the emerging technologies. The primary focus of the study was to understand (broadly) the impact of the emerging technologies in FAS sector skills development and training; and how employers are gaining a competitive edge through its human capital implications.

1.5. Study objectives

The study sought to address the following objectives:

- To identify future skills needs in the finance and accounting services sector.

- To identify the skills and jobs that are impacted by emerging technologies in order to provide input into the FAS skills development strategy.
- Investigate emerging technologies implications for jobs in the FAS sector and the implications for skills development including reskilling opportunities of the workforce.
- Make recommendations to FASSET and related stakeholders on the skills development interventions required to keep up with the 4IR.

1.6. Significance of the study

In the age of fast-moving technology and the advent of the 4IR, stakeholders in the FAS sector need research to unpack the implications of technology. From productivity implications to skills development and potential for job losses, the impact of 4IR technologies for the sector will likely be massive; whether positive or negative (Maisiri & van Dyk, 2019). This study used stakeholder input to shape a discussion into the perceived and experienced impact of emerging technologies in order to develop solid recommendations for the way forward.

1.7. Structure of the report

This report is structured as follows:

- Section 1 (this section) introduces and gives the background to the study. It also describes the FAS sector and includes the purpose, objectives, and significance of this study.
- Section 2 presents the review of international and domestic literature on the interaction between 4IR's emerging technologies and possible impact on skills development and jobs. The chapter also discusses possible enablers or conditions for the adoption of 4IR.
- Section 3 documents the methodology and approach used in this study, including how data was collected and analysed.
- Section 4 presents the main research findings. An attempt is made to answer all the research objectives, study hypothesis or assumptions.
- Section 5 concludes the study by summarizing the main study findings and offering policy or strategic recommendations.

2. LITERATURE REVIEW

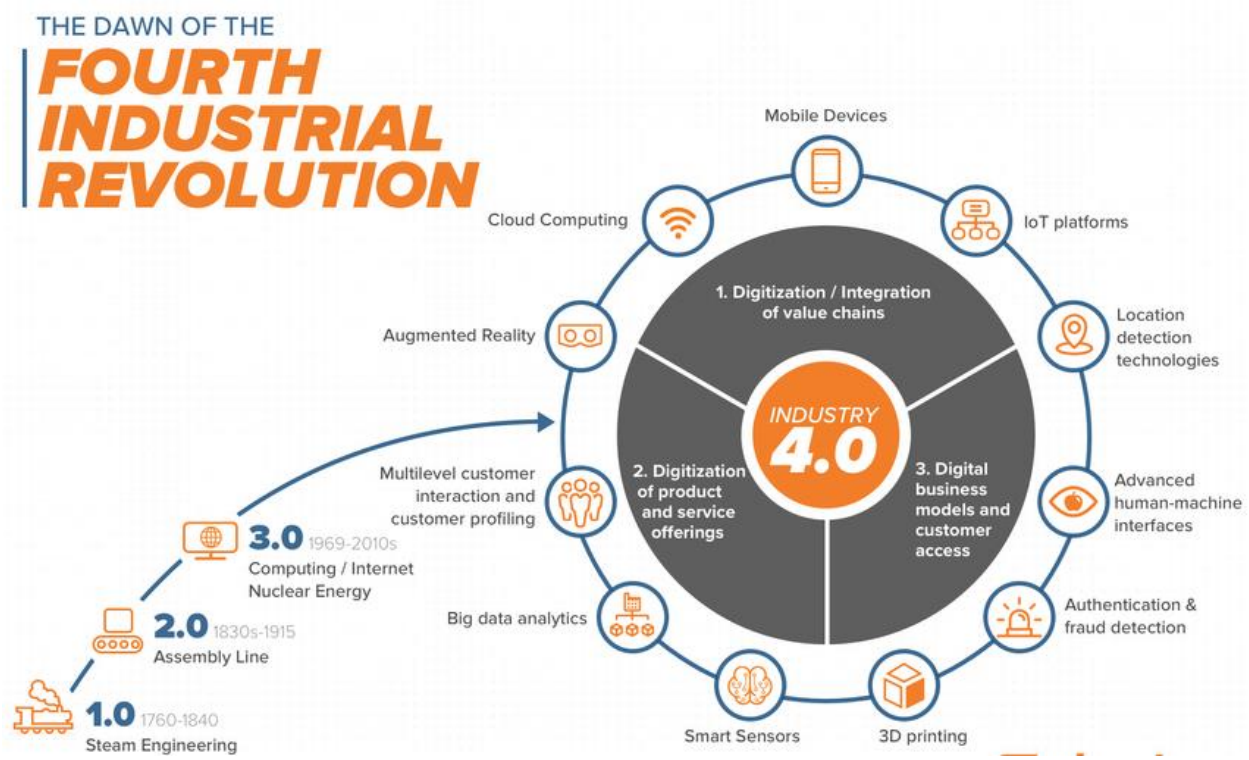
2.1. Introduction

This chapter provides a literature review into the field of emerging technology broadly and, more specifically, in the FAS sector. The purpose of the review is to identify emerging technologies in the FAS sector, discuss the impact of emerging technology on jobs in the sector and to provide context for an empirical study on the same issues.

2.2. Understanding the 4IR

Mohajan (2019) views an 'industrial revolution' as an occurance which defines a distinguishing turning point in human existence due to its ability to influence nearly every aspect of daily life. To understand the Fourth Industrial Revolution (4IR), Xu, David and Kim (2018) argue that it is necessary to appreciate what led humanity here – the move from the first to the Third Industrial Revolution (3IR). Figure 3 briefly illustrates the process flow, and expands on the current 4IR dynamics.

Figure 3: History of industrial revolutions and components of the 4IR



Source: World Economic Forum (2019: Online)

As shown on Figure 3, the First Industrial Revolution (1IR or 1.0) was brought about by the invention of the steam engine. This was able to transform millions of people's daily lives from simple village dwellers to residents in large urban settlements, raising their living standards in the process (Mohajan, 2019). The Second Industrial Revolution (2IR, 2.0) brought with it the invention of the assembly line, which drastically

changed the way in which goods were manufactured (Maisiri & van Dyk, 2019). Meanwhile, the Third Industrial Revolution (3IR, 3.0) brought Nuclear Energy (which hugely expanded power production) as well as computing and the internet. Furthermore, 3IR expanded the availability of the internet, concepts of globalisation, social media and streaming which revolutionised trade, relations and virtually all aspects of our lives (Wei, 2009).

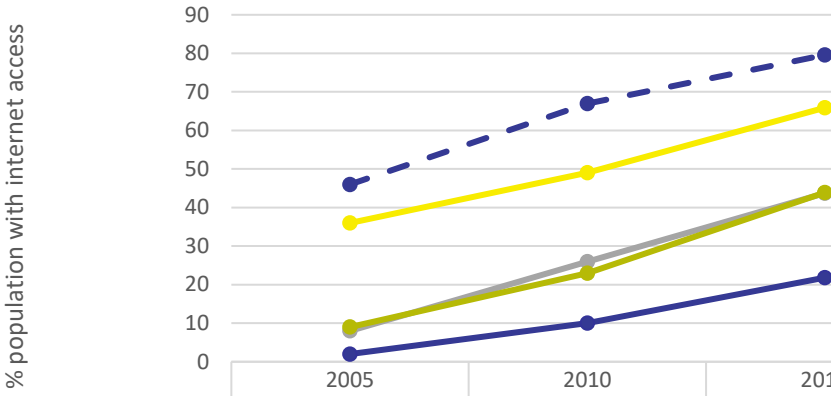
Now, the 4IR is a fusion of advances in artificial intelligence (AI), robotics, the Internet of Things (IoT), 3D printing, big data, genetic engineering, quantum computing, and other technologies which are set to further disrupt daily lives and the way of doing business. Chief among the disruptions will be the way various automations are expected to replace human labour (West, 2015), even though an industrial revolution's ability to result in jobs shedding is not a new occurrence (Deloitte, 2018).

2.3. Fourth Industrial Revolution key enablers for South Africa

It is important to note that the effectiveness of 4IR implementation in an economy depends on a set of pre-conditions that should create an enabling environment. According to Xu, David, and Kim (2018), it would be an over-estimation to assume that a country that is still reeling with the full implementation of 3IR technologies would be fully prepared to now implement 4IR technologies. In that regard, this section takes a brief look at the various pre-conditions/ factors needed to create an enabling environment for the implementation of emerging technologies in South Africa.

Myeong and Jung (2019) note that in understanding a country's readiness in implementing emerging technologies, it is necessary to understand current levels of penetration and usage of existing technology. Measures such as the level of internet usage, smart devices usage and social media presence help measure technology readiness (Myeong & Jung, 2019). According to the National Economic Development and Labour Council (2019:16), by the end of 2018, overall internet usage per total population in South Africa was 54.7%, which compares favorably to the worldwide average (53.6%) and well above the African average (28%) (International Telecommunications Union, 2020). Figure 2 shows the global comparison of internet usage statistics per continent.

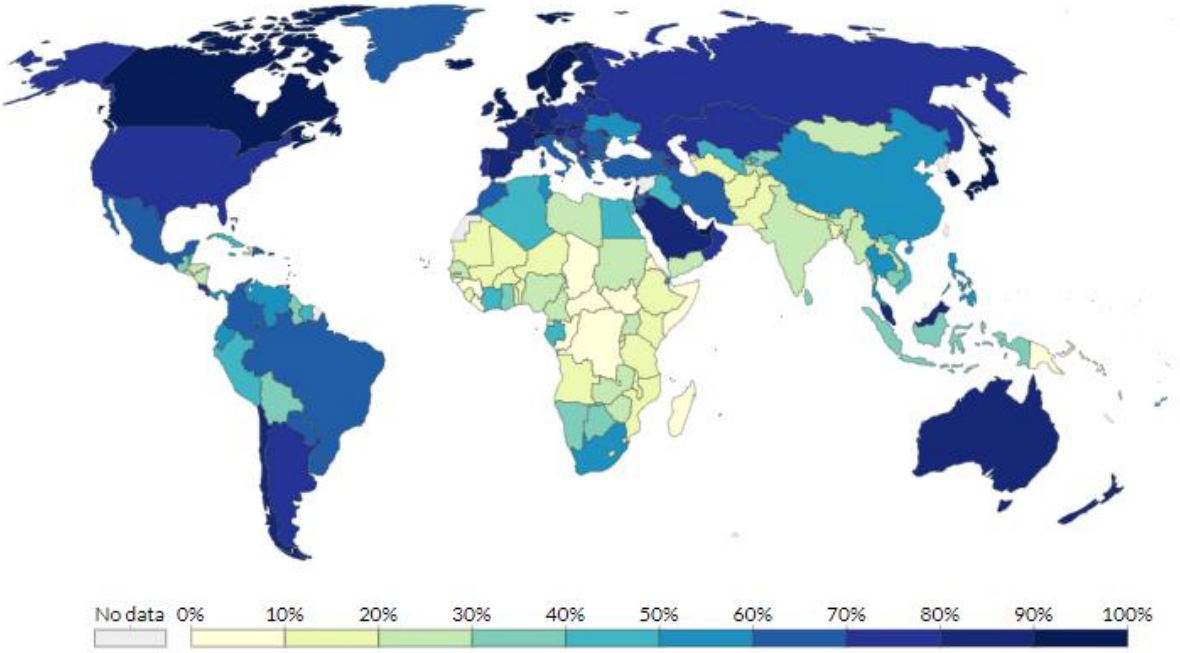
Figure 4a: Global internet access statistics per population



	2005	2010	2017	2019
Africa	2	10	21,8	28,2
Americas	36	49	65,9	77,2
Arab States	8	26	43,7	51,6
Asia & Pacific	9	23	43,9	48,4
Europe	46	67	79,6	82,7

Source: International Telecommunications Union (2020: Online)

Figure 5b: 2019 Global internet access statistics per country

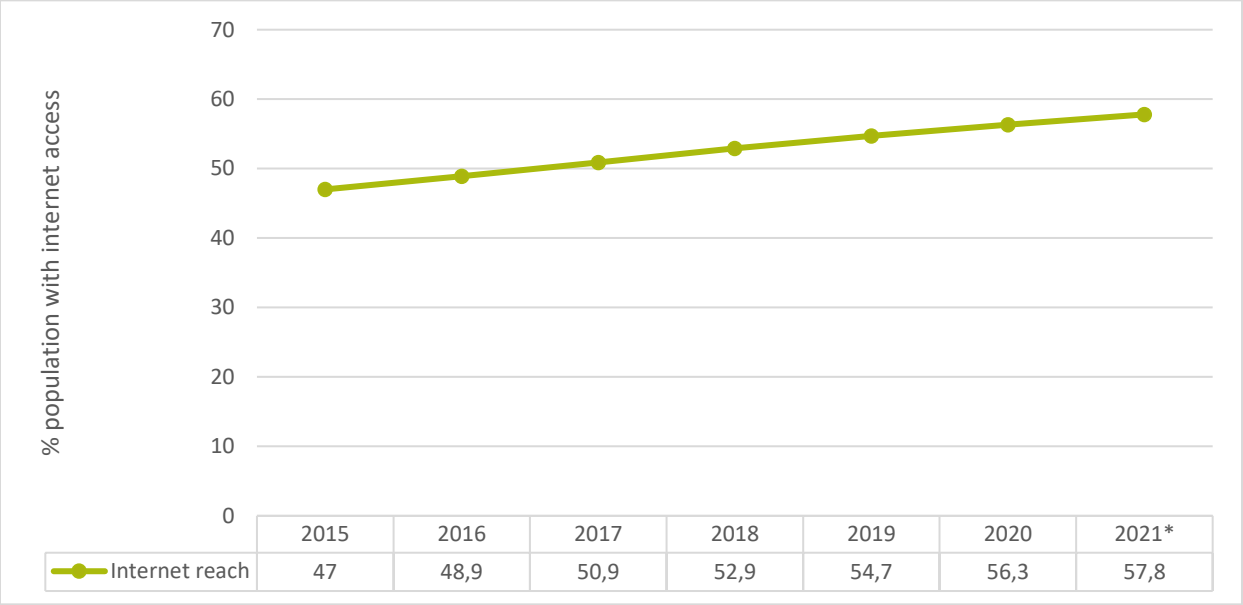


Source: International Telecommunications Union (2020: Online)

As shown on Figure 4a, internet usage as a percentage of population has remained consistently highest in Europe; with a low of 46% in 2005 and a high of 82.7% in 2019. The Americas region shows the second highest internet access statistics with a low of 36% in 2005 and a high of 77.2% in 2019. Africa however, has remained lowest performing in terms of internet usage with a low of 2% in 2005 and a high of 28.2% in 2019. Such usage statistics for Africa generally point to a continent that is generally still struggling with the

implementation of existing technologies, let alone emerging technologies. Since statistics specific to South Africa from 2005 were not found, Figure 5 presents the available statistics on internet access in South Africa from 2015. Literature on the adoption of emerging technologies by region or country were not found. However, Ritchie and Roser (2017) argue that internet usage statistics can be taken as a microcosm for the adoption of technology across the world. If that inference is made for this study, it can be seen that national usage statistics for South Africa compare favorably with regional statistics for Africa, Asia and the Pacific as well as Arab states. Using the 2019 usage statistics on Figure 4b, South Africa (54.7%) ranks 3rd behind Morocco (61.8%), and Tunisia (55.5%). Globally, according to the International Telecommunications Union (2020), South Africa currently ranks number 115 in terms of internet access per total population.

Figure 6: Trends in internet access for South Africa



	2015	2016	2017	2018	2019	2020	2021*
Internet reach	47	48,9	50,9	52,9	54,7	56,3	57,8

** projection*
Source: Clement (2015: Online)

On Figure 5, South Africa's internet access was 47% in 2015, 48.9% in 2016, 50.9% in 2017, 52.9% in 2018, 54.7% in 2019, 56.3% in 2020 and projected to be 57.8% in 2021. This shows that internet access by South Africans is expected to continue increasing into the near future, which is likely to also positively influence the adoption of emerging technologies.

With the internet usage statistics for South Africa still relatively lower than the European Union, Eastern Europe, South and North America, it is notable that more is still to be done to accelerate technology adoption. Stumke (2020) notes that South Africa is classified as one of the countries that are still yet to realise the effect of the 3IR and (to some extent) the 2IR; even though current conversation is already on the adoption of the 4IR technologies. As a result, it is important for countries still struggling with the full realisation of 3IR technologies to ensure they built an enabling environment for technology adoption. The National Planning Commission (2020) report on South Africa's readiness lists several pre-conditions

required to ensure emerging technologies can be implemented, and these are discussed in the following subsections.

2.3.1. Governance

There is need to balance the creation of an enabling environment for ICT investment while ensuring that citizens' rights to safe and secure participation is safeguarded. Regulatory tools such as the Cybercrimes and Cybersecurity Bill need to be robust to ensure the protection of internet users' data for the improvement in demand (National Economic Development and Labour Council, 2019). On the other hand, supply can be enhanced through the enhancement of ICT infrastructure across the country.

In addition, governance in the age of the 4IR is increasingly global, meaning that South Africa will need to integrate and align with international governing standards. According to Myeong and Jung (2019), the advent of technologies such as Blockchain has increasingly complicated governance, thus requiring increasingly innovative regulation methods and interventions to take advantage of such technologies in other areas of economic activity.

2.3.2. Key Enabling Infrastructure

For the smooth and reliable functioning of digital services that include base stations, data warehouses and cloud providers, there is need for high-quality and stable power supplies. Considering the current state of widespread load shedding in South Africa (Goldberg, 2015), this is one area in need of swift and decisive overhaul to prepare thr country, since 4IR technologies tend to have even greater power requirements (National Planning Commission, 2020). Infrastructure requirements do not end with availability and reliability, but also affordability to ensure wider usage (Wei, 2009). Multiple emerging technologies such as blockchain and cryptocurrency benefit from wide usage and adoption for them to have any real disruptive influence in an economy, thus the need for affordable data and reliable electricity.

2.3.3. Sector and Competition Regulation

For the most part, the advent of emerging technologies has made the static efficiency models of regulation previously used to become obsolete. Instead, the financial services sector now responds better to transparent accountability approaches with strong stakeholder participation (COEFS, 2017).

2.3.4. Data Governance and Data Justice

Recent empirical studies show that the governance of critical Information Communication Technology (ICT) infrastructure has to include data and privacy protection, cybersecurity, cybercrime and anti-surveillance measures, to create a user-trusted environment in which ecommerce, e-government, democratic engagement and personal communications can expand. Taylor (2017) notes that while data justice has been gradually increasing across the world, there is need for further interventions to protect vulnerable groups such as new internet users. In addition, new internet services need to be made accessible to all population groups especially inclusive of the visually and hearing impaired.

Bills such as the Protection of Personal Information (POPI) Act need to be fully implemented to ensure better protection such as the prevention of data breaches (National Planning Commission, 2020:61). Furthermore,

cybersecurity measures such as the National Cyber Policy Framework (NCPF) are key in setting mechanisms for better coordination across government. According to the Department of Telecommunications & Postal Services (DTPS) (2014), the crosscutting nature of cybersecurity led to the establishment of a system of integrated cooperation between departments. As a result, the following departments are involved in cybersecurity in South Africa: the Cabinet Justice, Crime Prevention and Security (JCPS) Cluster, the DTPS and the the State Security Agency. However, due to decentralisation of activities and inherent rivalries between departments, coordination among agencies can be challenging (National Planning Commission, 2020:62). The resulting challenge in the coordination of activities is one of the key red tape challenge resulting in the slow adoption and application of emerging technologies in South Africa (National Planning Commission, 2020).

2.3.5. Open data

Open data refers to the level of data available to the public for decisions to be made. As the world moves towards the 4IR, it is imperative that data sources be open to ensure access by multiple stakeholders for improvements in innovation. Data availability in a nonrivalrous, non-exclusionary basis allows for the symetrical access to information by new players entering markets, hence enhancing healthy competition (Cliff & Treleaven, 2010).

2.3.6. Public Sector Digitalisation

In South Africa, the public sector has always been slow in the adoption and use of ICT, especially when compared to the private sector (National Planning Commission, 2020:65). Continually falling below the global indicies for public sector ICT adoption, there is need for digital services to become more widely employed in public service provision.

2.3.7. Human Development

Most industries inclusive of manufacturing, financial services, construction, logistics, mining, agriculture and aerospace are likely to face intense pressure to adopt new technologies as they come, due to competition (Chan, 2017). As a result, drastic shifts in labour demands and skills requirements are to be expected, pointing to the need for a reskilled work force that provides relevant skills. This drastic labour market shift is highly required in South Africa, given how the country's labour and skills supply has been misaligned to even earlier digital demands of the 3IR (COEFS, 2017). A pipeline for future skills is hence required to ensure an alignment to future skills needs. This is achievable through a greater investment in Science, Technology, Engineering and Mathematics (STEM) education as a trade-off with education in the humanities fields.

2.4. Emerging technologies and future skills needs in the FAS sector

According to the COEFS (2017), innovation in the financial management and investment field has tipped the scales in terms of competitiveness. With most new entrants into the industry introducing newly adopted and disruptive technologies, they have become more competitive due to their low price offers. Worldwide, there are several technologies that can be classified as 'emerging' or '4IR' technologies. These include Artificial intelligence and machine learning, 3D printing, big data analytics, Gene therapy, In vitro meat, Nanotechnology, Stem-cell therapy, Robotics, Distributed ledger technology as well as Blockchain and cryptocurrency.

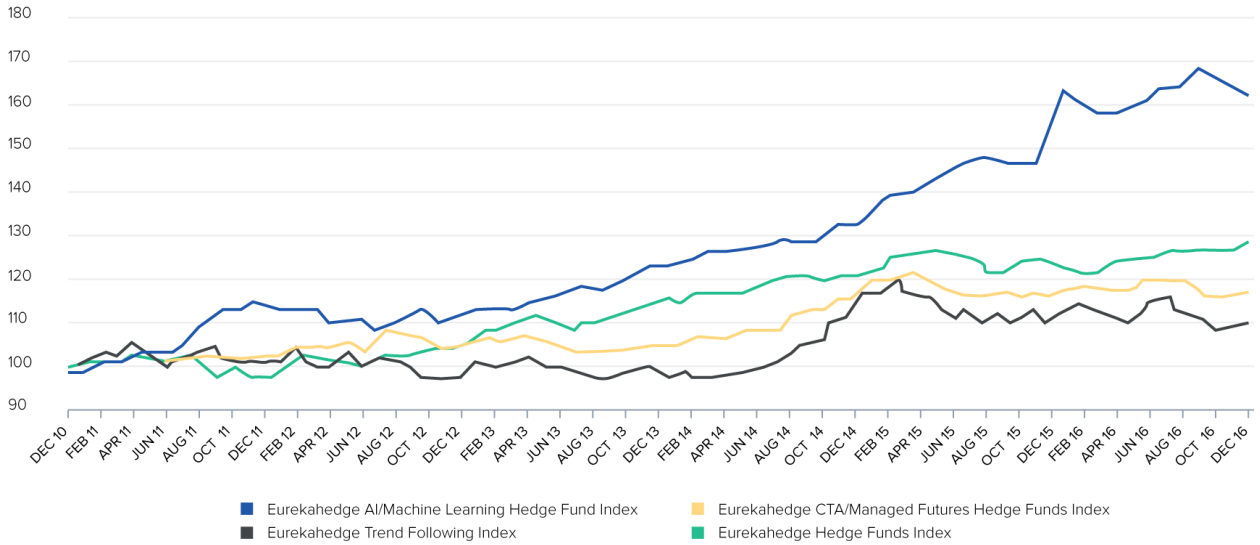
This section explores the meanings and implications on skills needs of some of these technologies, with specific emphasis on technologies applicable in the FAS sector.

2.4.1. Artificial intelligence

Lin (2017) notes that Artificial Intelligence (AI) has been exploding globally in terms of growth and applications, from driving revenues of $12.5 billion in 2017 to $47 billion in 2020. These increases in AI application are highest in industries such as banking, retail, healthcare and manufacturing sectors (Lin, 2017). AI usage has produced previously unseen cost-saving measures and profitability in multiple industries that have dared to early adopt the technology. For instance, Morisy (2016) notes that PayPal has been able to lower its fraud ration to 0.32% of revenue since employing deep learning technology, a figure which compares favorably to similar merchants (1.32% of revenue).

Meanwhile, in the field of stock trading and other trading, AI models have been rapidly replacing old computer statistical models built by data scientists (Chan, 2017). In contrast to old statistical models that are often static (Goertzel, 2015), new AI models are dynamic and respond much better to market changes with minimal to none human intervention (Chan, 2017; Lin, 2017). Figure 6 shows the time-lapse comparison of performance between Machine Learning Hedge Funds Index vs. Traditional Hedge Funds between 2010 and 2016.

Figure 7: AI/Machine learning Hedge Funds Index vs. Traditional Hedge Funds



Source: EurekaHedge (2017: Online)

As shown on Figure 6, global AI managed hedge funds from mid-2011 have been outperforming traditional and human-controlled hedge funds. The assumed implications of such trends will be the shift in investors' interests from human-run hedge funds to AI-run hedge funds (COEFS, 2017). This will have direct implications on the skills needs in financial markets through the increase in demand for AI development/ management skills while simultaneously unloading redundant traditional financial market jobs.

The widespread impact of AI is also being felt in industries such as bookkeeping and accountancy. According to Ovaska-Few (2017), while the notion that several thousands of accountants will be replaced by machines may be overstated, it is true that several jobs are being made obsolete as a result of the adoption of AI in the accounting field. Recently, large accounting firms such as Deloitte and top law firms have been seeing positive results through the use of AI in interpreting thousands of contracts or deeds (Ovaska-Few, 2017). Moreover, Griffin (2019) argues that while some in the accounting field may be encouraged by the fact that key high-level jobs will not be replaced by machines, at least 35% of skills are projected to transform in the near future. Accordingly, there is need to pursue future skills in accounting that focus on the integration of human and computer interfaces to ensure employment even in the age of AI.

2.4.2. Blockchain and cryptocurrency

Tschorsch and Scheuermann (2016:14) describe the blockchain model as follows: *"Bitcoin or other digital currency isn't saved in a file somewhere; it's represented by transactions recorded in blockchain. A blockchain is a kind of spreadsheet or leadger, which leverages the resources of a large peer-to-peer bitcoin network to verify and approve each bitcoin transaction. It allows participants to secure the settlement of transactions, to achieve the transaction, and to transfer the assets at a low-cost"*.

According to Knezevic (2018) blockchain technology has been revolutionising the financial industry, influencing several players in the financial industry that include banks, rating agencies, investment bankers and regulators. Beyond bitcoin and cryptocurrencies, blockchain has been found to be applicable in several other uses that include decentralization, security, transparency and anti-tampering (Polyviou, Velanas & Soldatos, 2019). Such developments are creating several opportunities for revolutionised trading as well as new jobs in the financial sector. Table 1 shows a summary of blockchain technology elements and their possible implications on relevant stakeholders in the FAS sector.

Table 2: How blockchain is transforming the financial sector

Function	Impact of blockchain	Stakeholders affected
Authenticating Identity and Value	Verifiable and robust identities, cryptographically assured	Consumer Data Analytics, Marketing, Retail Banking, Payment Card Networks, Regulators
Moving Value – make a - payment, transfer money, and purchase goods and services	Transfer of value in very large and very small increments without intermediary will dramatically reduce cost and speed up the payment	Retail Banking, Wholesale Banking, Money Transfer Services, Payment Card Networks, Telecommunications, Regulators
Storing Value – currencies, commodities, and financial assets are stores of value, Safety deposit box, a savings account etc.	Payment mechanism with a reliable and safe store of value reduces needs for financial services; ban savings and checking accounts will become obsolete	Retail Banking, Brokerages, Investment Banking, Asset Management, Telecommunications, Regulators

Function	Impact of blockchain	Stakeholders affected
Lending value – credit card debt, mortgages, corporate bonds, government bonds, asset backed securities, and other forms of credit	Debt can be issued, traded, and settled on the blockchain; increases efficiency, reduces friction, improves systemic risk. Consumers can use reputation to access loans from peers	Wholesale, Commercial, and Retail Banking, Public Finance, Credit Rating Agencies, Credit Score
Exchanging Value	Dramatic increases in speeds	All industries
Funding and Investing	New models of funding and investment	Investment Banking, Venture Capital, Audit, Stock Exchange, Regulators
Management of Risk	Lowering of various risks	Wholesale Banking, Brokerage, Clearinghouses, Regulators
Accounting for value	Dramatic improvements in reporting	Audit, Accounting, Taxation and Regulation

Source: Knezevic (2018:114) (modified)

As on Table 1, blockchain technology is impacting in various fields of financial services. As a result, such disruptions are resulting in labour market transformations which affect skills needs of relevant organisations. It is therefore necessary to introduce/ expand learning in blockchain to ensure the future South African workforce is well equipped to handle the disrupted financial industry (Courbe, 2020).

2.4.3. Robotics

In non-manufacturing fields such as the FAS sector, robotics technology is fairly similar to AI in applications and implications on jobs. In a study examining the impact of robotics in the Financial Sector, Nair (2018) found that the ability of robots to function 24/7, eliminate erroes and operate faster has made them fairly attractive in the financial sector. Robotic Process Automation (RPA) commonly referred to as *bots*, refers to applications configured to mimick a human worker (Nair, 2018).

2.4.4. Big data analytics

According to the European Commission (2016), the idea of big data relates to the increased availability and size of data on users, inclusive of user generated and uploaded data, as well as data generated by logging user behaviour. The increased application of big data analytics in financial services is leading to major cross-value chain cost savings, increased service speed, prevention of over-indebtedness (through te tracking of online spending), detection and prevention of fraud as well as the provision of tailored services (European Commission, 2016:3). With research into the influence of big data on finance only in its infancy, it is difficult to objectively ascertain the influence of big data analytics on jobs yet (Hasan, *et al.,* 2020). Recent empirical studies have estimated big data analytics' impact on the job market to be fairly minimal (Hasan, *et al.,* 2020). In a study by Fleming *et al.,* (2019), it was found that instead of changing overall employment, the application of big data has changed what workers are being asked to do. A trend review between 2010 to 2017 found that the average number of tasks performed by each employee decreased as a result of task

automation (such as the shift of credential onto new programs and technology) (Fleming *et al.,* 2019). Another angle to this discussion is the emergence of new jobs as a result of big data analytics. According to Pattabiraman (2019), the demand for data scientists on Linkedin grew by 56% from 2018 to 2019, signalling how people with big data skills are coming in demand as the technology expands. In addition, several professionals with cybersecurity, AI, Internet of Things (IoT), networking and others are increasingly required on the job market (Pattabiraman, 2019).

2.5. Overall Implications of emerging technologies on jobs and for skills development and training in the FAS sector

The previous section offered a discussion on examples of emerging technologies and how they relate to the financial sector, including implications on jobs. This section wraps up-the discussion on skills needs in the age of emerging technologies by taking a general look at the expected impact of emerging technologies.

A review of available literature shows that specific research into the impact of emerging technology on jobs is still limited (Deloitte, 2018). The main gaps in literature relate to the list of specific at-risk financial sector jobs as well as new and upcoming jobs. This area of literature is still limited, but very crucial since an understanding of at-risk jobs and future skills needs helps to provide evidence-based recommendations for stakeholders to implement (van Dam, 2017).

Placing the 4IR in context with previous industrial revolutions (1st, 2nd and 3rd) helps to understand the discussion of the impact on jobs (van Dam, 2017). Xu *et al.,* (2018) emphasize that the 4IR should be viewed fairly as having both opportunities and threats for businesses and workers in all industries. In addition to providing dramatic productivity improvements, Xu *et al.,* (2018:91) argue that the mordern worker in the age of emerging technologies provides focus, creativity, and leverage which lead to improved efficiency. To a significant extent, it is expected that the 4IR will lead to the creation of several jobs especially in the fields of cybersecurity, AI, Internet of Things (IoT) and networking (Pattabiraman, 2019).

However, the fact that several jobs will become obsolete with the advent of new technologies should not be understated (West, 2015; World Economic Forum, 2016). A balance will therefore need to be struck between the need for technology-driven economic growth and the safeguarding of jobs. Table 3 summarises the expected future enablers and inhibitors of business growth towards 2022.

Table 3: Future trends set to influence business growth

Trends set to positively influence business growth towards 2022	Trends set to negatively influence business growth towards 2022
Increasing adoption of new technology	Increasing protectionism
Increasing availability of big data	Increase in cyber threats
Advances in mobile internet	Shifts in government policy
Advances in artificial intelligence	Effects of climate change
Advances in cloud technology	Increasingly older societies
Shifts in national economic growth	Shifts in legislation on talent migration
Expansion of affluence in developing economies	Shifts in national economic growth
Expansion of education	Shifts in the mindset of the new generation
Advances in new energy supplies and technologies	Shifts in global macroeconomic growth
Expansion of the middle class	Advances in artificial intelligence

Source: National Economic Development and Labour Council (2019:59)

As shown on Table 3, emerging technologies are generally set to influence growth through the availability and adoption of big data, cloud computing, AI and other advancements. However, the shortage of required skills and other threats such as cyber-breaches are likely to inhibit business growth.

2.6. Summary and conclusion

The purpose of this literature review was to contextualise understanding of emerging technologies in South Africa, the enabling environment for technology adoption and expected impacts of emerging technologies on skills needs and jobs in the FAS sector. Through the review of literature on enablers and inhibitors of technology implementation, it was established that a discussion on the impact of emerging technologies is incomplete without considering whether an enabling environment is already available for the implementation of such technologies. The South African example shows that while internet penetration levels compare relatively well with several economies, there are still strides to be made in data affordability, education and governance/ regulation of ICT services. Issues such as proper governance and regulation are key in the adoption and use of technology since they help set a national mood and overall platform for technology usage. The discussion on emerging technologies mainly focused on the use of AI, robotics, blockchain and big data analytics in the FAS sector. Literature discussed on the subject unearthed a plethora of applications for such emerging technologies in South Africa; and the implications for the adoption of such technologies for skills development. Empirical evidence suggests that there are several opportunities for business and economic growth with the adoption of emerging technologies. However, massive labour cuts are to be expected as organisations retrench or redeploy workers in repetitive tasks and replace them with technologies such as bots and AI. The conclusion drawn is that, since job losses cannot be avoided, it is necessary for stakeholders involved to ensure the future labour force is equipped with futuristic skills to integrate into emerging technologies. These skills are inclusive of soft skills meant to enhance individual employees' analytical and critical thinking; for them to better coexist with emerging technologies.

3. APPROACH AND METHODOLOGY

3.1. Introduction

This chapter discusses the methodological approaches employed in the study into the skills development implications for emerging technologies in the FAS sector. The chapter includes a discussion of the approach, sampling processes, data collection, analysis and ethical considerations of the study.

3.2. Assumptions of the study

In conducting the study, the following assumptions (or hypothesis) were made:

1. Emerging technologies in the FAS sector will be displacing jobs, resulting in retrechments.
2. Emerging technologies in the FAS sector are resulting in emerging (future) skills needs that are necessary for employee productivity and job retention.
3. Emerging technologies in the FAS sector will create opportunities for new occupations or jobs.
4. Emerging technologies will necessitate a changed approach into skills development and training in the FAS sector.

3.3. Research approach

Implementation of the project proceeded in stages to allow for an evaluation of the deliverables due from each stage and capitalise on the resulting information and knowledge. The study employed a qualitative approach in the collection and analysis of data from training providers, employers and professional bodies in the FAS sector. Results from different stakeholders were triangulated as well as compared to findings from literature review, in order to produce a clearer picture of the implications of emerging technologies on jobs.

3.4. Methodology

Underhill Corporate Solutions (UCS) employed a qualitative research approach in the study. Qualitative Research is fundamentally exploratory research; and is used to obtain an understanding of underlying reasons, opinions, and motivations. It provides insights into the problem and helps to develop ideas or hypotheses for potential quantitative research. The study employed two data collection techniques which are Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs).

Due to the influence of the Covid-19 pandemic and lockdown restrictions, all interactions with participants were virtual. Researchers utilised different virtual meeting platforms such as Teams, Zoom and teleconferencing to conduct interviews with key informants. Stakeholders were then invited for a virtual FGD and validation workshop where training providers, employers and professional bodies in the FAS sector were all represented.

3.5. Sampling processes

The study population and participants were made up of employers, training providers and professional bodies in the 7 main subsectors of the FAS sector. UCS employed a purposive sampling technique to identify and engage stakeholders that are most relevant to participate. Bazeley (2013) posits that purposive

sampling enables researchers to meet the goals defined by the research aim in conjunction with controlling the level of variation among interviewees. Key to the sampling process was fair representation; and researchers made all efforts to ensure relevant stakeholders were given a chance to participate in each subsector. Table 4 shows the final sample sizes per stakeholder group.

Table 4: Sample sizes per stakeholder group

Stakeholder Group	Sample size
Employers	20
Training Providers (TVET colleges, Universities)	5
Professional bodies	14
TOTAL	**39 participants**

As shown on Table 4, 20 employers, 5 training providers and 14 professional bodies took part in the study. While some stakeholders took part in both interviews and the FGD, others participated in only the FGD or the interview.

3.6. Data collection

Research instruments for the study were designed based on the knowledge and information collected from document and literature review. Based on the understanding of different stakeholder groups, 4 separate research instruments were designed (3 separate interview guides for different stakeholder groups, and the FGD guide). Questions in each instrument were designed and customised to each participant group's unique role in the industry in terms of the production and consumption of skills. Blumberg *et al.* (2011) note that semi-structured interviews provide rich data collection, allowing for clarification and expansion of questions and answers during the interview, thus increasing internal validity. Meanwhile, the FGD guide was designed to solicit specific input on how each major form of emerging technology (such as AI, Robotics and Internet of Things) will impact jobs, and which jobs will likely become obsolete as a result; as well as which jobs will likely be created by the adoption of such technology.

3.7. Data analysis

Interview and FGD data were analysed through the use of a qualitative technique referred to as Thematic Content Analysis (TCA). The team sought to identify, classify and present main arguments arising as well as any other discussions on skills needs and implications of the 4IR in various subsectors. Data collected was entered into Atlas.ti version 8 software for analysis, where main themes as well as supporting quotes from the study were extracted and presented.

3.8. Ethical considerations

Researchers understood the importance of observing ethical considerations throughout the study process, and such considerations were made. In light of the Covid-19 pandemic, all data collection proceeded virtually, and at no point did the data collection team physically interact with a study participant. Participation in the study was emphasised to be voluntary, and noone was coerced into taking part in the study. Data collectors made sure to send initial emails inviting stakeholders to participate in the study, then sent reminders to non-responsive emails after two weeks of sending the initial email. In addition, no

personal information was collected in the study as data collection focused on key skills issues arising from the adoption of FAS sector emerging technologies.

4. RESEARCH RESULTS

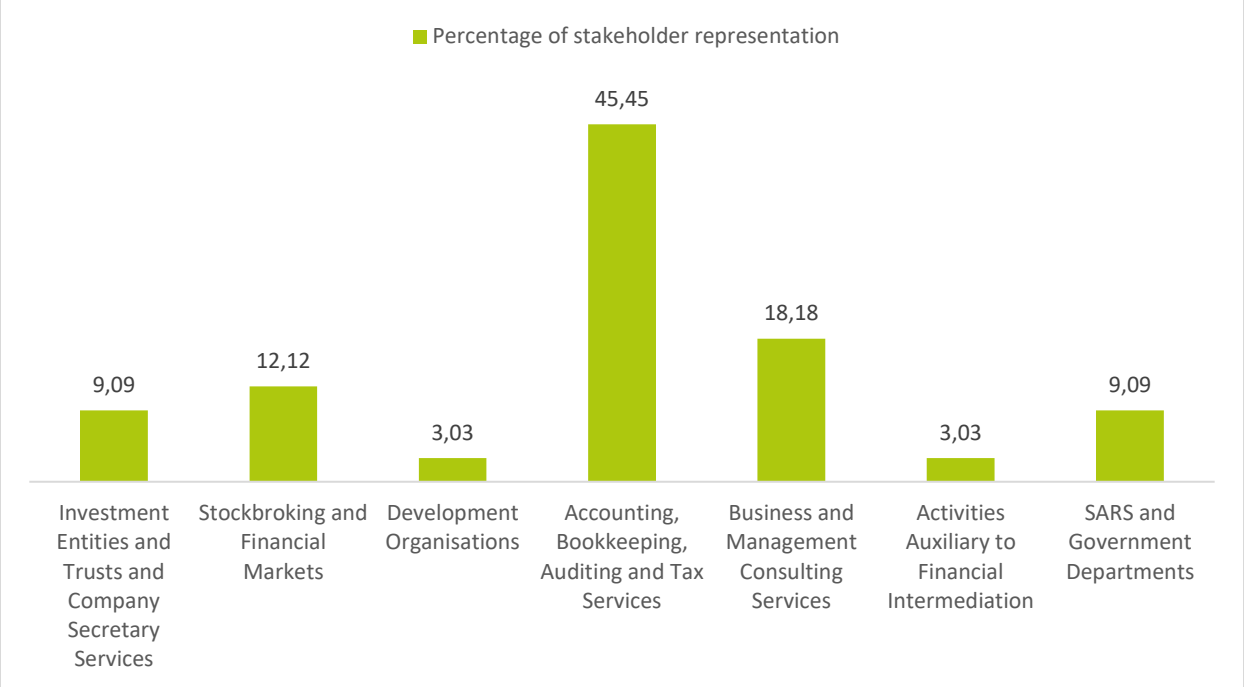
4.1. Introduction

This section presents results of the study, based on data collected from employers, trainining providers and professional bodies within the FAS sector. Through key informant interviews and focus group discussions, the study collected data on themes relating to the level of understanding of the 4IR, the adequacy of current graduates to survive in an environment of emerging technologies, impact of 4IR on skills development and jobs within the Finance and Accounting Services sector and other topics.

4.2. Stakeholder representation per subsector

Figure 7 shows the distribution of all study participants per the seven major subsectors of the FAS sector.

Figure 8: Distribution of stakeholders by subsector



As on Figure 7, most stakeholders (45.45%) were in the Accounting, Bookkeeping, Auditing and Tax Services, followed by 18.18% of stakeholders representing the Business and Management Consulting Services, followed by 12.12% representing the Stockbroking and Financial Markets subsector, 9.09% representing two subsectors; Investment Entities and Trusts and Company Secretary Services and SARS and Government

Departments. Subsectors with the lowest numbers of participating stakeholders were the Development Organisations and the Activities Auxiliary to Financial Intermediation subsectors with 3.03% representation.

4.3. Understanding of the 4IR

Maisiri and van Dyk (2019) note that in the assessment of an industry's readiness to implement 4IR technologies, it is important to ask a seemingly simple question of whether or not industry players know what is meant by the 4IR. This is because if an organisation does not know what is meant by the 4IR, it is more likely that such an organisation has not yet taken any steps to prepare for, or implement 4IR technologies (Maisiri & van Dyk, 2019).

In this study, the question on 4IR understanding was posed to employers; and the majority appeared to understand at least that the 4IR entails a period of ground breaking technological improvement which will influence everyday business operations. The lack of understanding of the 4IR was mostly apparent among small organisations. In the discussion of 4IR understanding, most employers were noted to correctly associate the 4IR with 'smart technologies', 'digital security', 'data analytics' and 'service intergration'. In addition, some employers were able to point out the key elements of the 4IR requiring organisational focus. One employer defined the 4IR as the interplay of emerging technologies such as "the internet of things, artificial intelligence, robots, drones, autonomous vehicles, 3D printing, cloud computing, nanotechnology, and more".

Another theme observed from the employers' understanding of the 4IR was the extent to which employers associated it with the emergence of opportunities for them and their customers. Most employers defined the 4IR in their organisational context; discussing what technologies are in the pipeline for implementation as well as existing technologies. In this regard, most employers emphasised how the 4IR will mean the importance of data in decision making, problem solving, marketing and the provision of virtual services as opposed to in-person interaction. In addition, the 4IR was discussed in terms of its implication for skills development among employers and professional bodies. In this discussion, it was found that the 4IR is interpreted as having necessitated the need for investment in soft skills that enhance employees' coexistence with emerging technologies. Instead of losing jobs to machines, stakeholders noted that critical thinking skills, communication skills, strong analytical skills and problem solving skills were among future skills that will enhance labour competitiveness in an environment of emerging technologies.

4.4. Adequacy of current skills in dealing with emerging technologies

In assessing the 4IR impact on jobs, this study sought to explore how the current graduates and employees' skills in organisations enable them to coexist with existing and emerging technologies. The question on current adequacies was posed to training providers, employers and professional bodies.

The majority of training providers defended their educational programmes, indicating that their graduate base not only possesses adequate skills but are also in high demand when it comes to working in organisations that implement existing 3IR technologies. However, when asked about the adequacy of current graduates to handle emerging technology, there was a general consensus among training providers that their graduates will need to be reskilled accordingly. Training providers expressed that their graduates,

with 'adequate induction' will be able to handle emerging technologies since they are taught to be 'lifelong learners'. In contrast to other views, one training provider argued that the current calibre of graduates mostly possess theoretical ICT skills with limited practical industry knowledge, meaning they will need exposure before getting aquainted with utilising emerging technologies.

Meanwhile, when the question on adequacy of human resources was posed to employers, the most popular emerging theme was the need for continuous employee training and development. Nearly all of the employers noted that while most of their employers are able to operate existing technologies, there will be need for constant reskilling to ensure they stay up-to-date with changing technology. Since training was found to be of key importance to employers in the FAS sector, there is hope for their respective employees to be exposed to training instead of job losses as technonoly advances.

Professional bodies also demonstrated their support and openness to the reskilling of their members to coexist with emerging technologies. Professional bodies in the Accounting and bookkeeping sector were found to be introducing new programmes to ensure their members/ practitioners can provide better service to their clients. For instance, the 'Zero system' (Institute of Accounting and Commerce, IAC), 'Business Rescue Practitioner' certification (South African Institute of Business Accountants, SAIBA) and 'Continuous Professional Development' courses (Institute of Certified Bookkeepers, ICB). Moreover, the South African Institute of Chartered Accountants (SAICA) is already running online modules through the University of Johannesburg (UJ) in Artificial intelligence and blockchain technologies. Several other professional bodies noted that they have existing programmes or plans to upskill their members and ensure their competitiveness in an environment of emerging technologies.

It can be seen that on the subject of skills adequacy, stakeholders are in general agreement that university qualifications are not enough to ensure labour competitiveness. Rather, through the use of CPD by employers, professional bodies and training providers, labour competitiveness can be ensured, thus safeguarding jobs.

4.5. Impact of emerging technologies on skills development

One of the key objectives of the study was to explore the skills development implications of emerging technologies in the FAS sector. This section, together with section 4.5 focus on this concept from an educational and employnent perspective respectively. This interrogates the possible existence of obsolete or emerging academic and professional programmes as a result of emerging technologies.

4.5.1. At-risk qualifications

During the discussions, training providers generally maintained that none of their educational programmes are at risk of becoming obsolete as a result of emerging technologies. In the FGD, it was found that training providers link the inadequacy of some graduates' skills to the poor calibre of students they receive from matric. Representatives from universities noted that while degree learning normally includes technology applications, it is challenging to bring students who have never used computers all their life in the loop with technology for workplace application.

Training providers that singled out programmes at risk mainly noted programmes such as Marketing, aspects of Accounting as well as aspects of Human Resource management. Of these skills, it should be noted that only Accounting is purely related to the FAS sector while others are cross-cutting. The main reasons why Accounting was seen as becoming obsolete are the repetitive nature of some of today's accounting tasks; as well as the incompleteness of a Bachelors in Accounting as a qualification in Accountancy. Since there are several professional qualification routes a Bachelors in Accounting graduate needs to take to become a certified accountant, completing the degree itself has become more of a starting point than the qualification for Accountancy.

Among professional bodies, the general emerging theme was the argument that instead of producing threats, emerging technologies are bringing with them opportunities for new skills and occupations. Top qualifications that were agreed to be under threat include bookkeeping, administration level clerks and accounting clerks; which were noted to be under threat as a result of their repetitive nature and potential for automation. Other professional bodies went further to point out that most of their qualifications will become obsolete in the future if not updated in accordance with changing industry needs.

4.5.2. Emerging qualifications

Training providers indicated they do not have any new programmes recently added/ to be added to their qualification list in response to changes in technology. Some indicated that this is because they are revamping existing qualifications instead of introducing new ones, while others lamented the slow progress at institutional levels to respond to changing industry needs. It was found through the FGD that training providers place their emphasis on what students can realistically learn in school without throwing multiple digitaisation buzzwords around. Universities noted that currently, their focus is to produce resourceful graduates that are flexible and can thrive even when introduced to different technologies, without a specific focus on one type of technology or skill.

Meanwhile, professional bodies were found to be highly active in the area of skill advancement in response to industry needs. Table 5 indicates some of the prominent interventions indicated by professional bodies to be recently active/ in the pipeline.

Table 5: Skills development interventions by FAS sector professional bodies

Professional body	Skills development intervention(s)
Institute of Accounting and Commerce	• Business rescue practitioner qualification[1], introduced with technology through CIPC • Opening of approved training centres (ATC) • Upskilling of members for remote service provision
South African Institute for Business Accountants	• Business rescue and independent reviews specialisation for Accountants • ICT related short courses in programming and app building

[1] This occupation has been emerging largely due to the current economic situation that has left various businesses in distress.

Professional body	Skills development intervention(s)
	• Memorandum of Understanding (MoU) with the Chartered Institute of Management Accountants (CIMA) for a host of short ICT courses for accountants • Business advisory courses in areas of strategy • Improving of members' risk management skills and Cybersecurity
Institute of Internal Auditors South Africa	• OC: Internal Auditor qualification • OC: Internal Audit Manager • OC: Internal Auditor (ICT Internal Auditor) • OC: Internal Audit Manager (Quality Assurer)
South African Institute of Tax Professionals	Updating designations with the requirements such as: • Future ready Tax Professional in terms of the technology • Change in tax legislation • Critical thinking skills • Business Acumen
South African Institute of Chartered Accountants	• Aligninment of teaching and learning methodologies in line with technological improvements

On the other hand, while some employers were of the view that their employees were adequately skilled, most employers indicated there was a need to upskill their employees with skills to support emerging technologies. Top skills mentioned by employers as key include computer skills (basic and advanced), communication skills (basic and advanced), database and cloud computing skills, data mining skills as well as several soft skills such as emotional intellingence, problem solving, critical thinking, change agility and flexibility.

As a result of the mismatch between skills supply and demand, there is need to reconcile skills demanded by industry with what is produced at academic and professional institutions. While most of the skills deemed necessary by employers may not require a full-time academic degree, they offer opportunities for stakeholder partnerships to develop appropriate skills to meet the new industry requirements. To ensure effective delivery, such partnerships should include FASSET, academic institutions, training providers, and employers.

4.6. Impact of emerging technologies on jobs

This section details the responses provided by employers[2] on the list of occupations/ jobs likely to be impacted by emerging technologies. Employers were asked to list any occupations they view to be at-risk of becoming obsolete as well as those that are upcoming in the wake of emerging technologies.

As noted from employer lists and the FGD, FAS sector jobs at risk of becoming obsolete include payroll administrators, taxation consultants, bookkeepers, debtors clerks, accountants and auditors. At face value, the list gives the impression that seemingly high profile occupations are becoming obsolete and will result

[2] This section is currently not exhaustive since, at the time of compilation of this draft, the FGD had not yet been held. The FGD was specifically designed to provide an exhaustive, multi-stakeholder look into this very important issue. The section hence will be finalised in the final report

in increased unemployment. However, the reason why occupations such as accountants and auditors were listed was because employers noted that such occupations include high rates of automation which require practitioners to stay abreast of. According to stakeholders, accountants, auditors, bookkeepers, tax practitioners and other professionals are likely to safeguard their jobs as long as they stay abreast of technological innovations and learn to coexist with emerging technology. This view was also corroborated by the majority of professional bodies, who argued that constant training as well as skill diversification are key in ensuring professionals in the FAS sector maintain their jobs.

On the other hand, the discussion on emerging occupations brought an unmistakable theme – the perceived impact of the 4IR on jobs. The general consensus on 4IR implications showed that employers and professional bodies in the FAS sector view emerging technologies in terms of opportunities that will be brought, instead of the threat on jobs. In particular, fields such as AI management, data verification and cybersecurity were seen as whole departments in waiting, if not already implemented by several organisations. Cybersecurity was found to be crucially important given the future heavy reliance on merged databases, cloud computing, IoT applications and several other technologies where security breaches can cripple the entire organisation or expose trade secrets.

The discussion of emerging technologies' impact on jobs is however an ongoing one, with consensus yet to be reached. In the South African case, this discussion appears to be still in its infancy as most organisations are still content with 3IR technologies (Maisiri & van Dyk, 2019). As more and more FAS sector employers adopt 4IR technologies, impacts on jobs will likely become more apparent, and consensus reached.

4.7. Skills development challenges for emerging technologies

This section presents results of the training providers and professional bodies' input on the skills development challenges arising from attempting to keep up with emerging technologies in the FAS sector.

Firstly, it was argued that the process of revising academic curriculums is fairly slow, while technology itself does not wait. While training providers and professional bodies go through their major red tape issues of curriculum generation, development and approval, employer demands will be constantly changing as the technological environment evolves. This view is corroborated by findings on skills needs of employers versus programme offerings by training providers in this study. While training providers had no ready programmes or courses meant to respond to changing industry needs, employers had a list of several skills they require their employers to possess both to handle existing and future technologies. As long as this mismatch exists, it will be challenging for industry skill needs to be met; a scenario that is especially detrimental for occupations at risk of becoming obsolete.

Secondly, resistance to change and low skills levels were also noted to be challenges in the implementation of skills development interventions. It was argued that while people need to be skilled accordingly with emerging technologies, some people especially on the lower level employeed are more difficult to train. They need more time to go through training which should take them from basic to advanced skills, which is costly. Also, some older individuals were reportedly still rigid and found it difficult to adopt technological

improvements. This resistance to change is a major factor especially at board level and management who have the power to certify the reskilling of employees, but also among staff.

Thirdly, it was noted that there are resource challenges to effectively invest in emerging technologies. Furthermore, there is need to ensure current graduates are offered adequate skills to function effectively in the new technology driven environment. According to professional bodies, Universities and SETAs are currently not fully equipped to ensure adequately developed graduates are produced. There is a value chain problem in identifying who in the pipeline is responsible for the refinement of graduates. Further complicating matters is the perception among some stakeholders that poor schooling system graduate output in Science and Mathematics is affecting the entire skills pipeline to support emerging technologies. Where students coming to university do not have the basics, universities now need to produce many bridging programmes to offer an introductory year and allow students to catch up, which can be costly. Budget challenges are further exacerbrated by the limitation of ICT infrastructure accessibility in some parts of the country, leading to the low skill levels of matric graduates going into universities or poorly trained university graduates.

Furthermore, it was noted that graduates need to bring more to the table in terms of technical skills beyond their degree qualification. Rather than focusing on accounting skills to the exclusion of other skills, graduates will be better equipped if they also acquired other critical skills such as, for example, problem solving skills. This provides a graduate who is more holistically qualified, is flexible in handling multiple responsibilities and is possibly better equipped to handle the demands of the new technologically driven environment.

4.8. Impact of Covid-19 pandemic on technology adoption and skills development

Employers were asked to indicate the extent to which the Covid-19 pandemic has accelerated their technology adoption; as well as the challenges and successes brought by the adoption of digital technologies.

4.8.1. How Covid-19 accelerated the adoption of digital technologies

The discussion on Covid-19 impact on technology adoption showed a clear divide between employers who were already implementing digital technologies versus those who were not. For those employers who were already implementing digital technologies as well as those whose services do not necessarily require physical interaction, Covid-19 had little to no impact on technology adoption. The main impact for this group of employers were stakeholders such as customers and shareholders who had grown accustomed to in-person business, and had to become accustomed to virtual interactions. This shows how technological adoption is not only based on internal considerations, but also based on the implications on customer relationships and retention as well as interactions with other key stakeholders.

On the other hand, some employers noted that the bulk of their services were always in-person before the Covid-19 pandemic. For this group, most have expressed their surprise and satisfaction with how the adoption of work-from-home solutions have actually worked. Before the adoption of work-from-home solutions, concerns such as productivity and the ability to monitor individual employees had been raised;

but it was realised during the implementation period that several digital solutions for employee monitoring and appraisal exist. Employers in this group hence noted that they were glad it was proven that 'work from home is possible', meaning that even in a post-Covid-19 scenario, a hybrid system of in-person interaction and virtual interaction will be adopted.

4.8.2. Skills development implications in light of the Covid-19 pandemic

The study found that the pandemic has transformed the way in which training is administered; with the new focus now on remote learning and examinations. As a result of lengthy lockdowns and the general unpredictable nature of Covid-19 waves, training providers found themselves in need of swift reactionary measures to ensure training continues amidst the pandemic. Universities and TVET colleges noted that they have been greatly challenged by the pandemic due to resource limitations, lack of access to data and computer resources by multiple students and lack of proficiency by lecturers and students to maintain a working digital learning platform.

On the other hand, professional bodies (since they ordinarily deal with smaller numbers of people, who will be professionals) noted that they have been able to adjust quickly and integrate both learning and assessment online. Using video conferencing tools, professional bodies managed to certify several practitioners, issue out professional designations and conducted several other skills development activities digitally.

4.8.3. Challenges faced in implementing work-from-home solutions

When asked to detail the challenges encountered in implementing work-from-home solutions, the following main challenges were noted: problems with work coordination, connectivity issues (electricity, data, network and others), problems with employee wellness, information security, lack of etiquette in virtual interactions, financial strains as well as employee homelife-worklife balance problems.

A number of employers noted that as employees worked from home, employee coordination challenges materialised. While in an office setup it is easier to call on each other, ask simple questions and make ad-hoc discussions, it was found that employees found it more challenging to call each other everytime and discuss work. Furthermore, with some employees periodically going offline due to a variety of reasons, supervisors and managers found it challenging to keep everyone monitored and in the loop. This challenge also relates to the issues with employee homelife-worklife balance, for instance employees who are also parents had to balance taking care of children and working (since schools had been closed).

Connectivity challenges were the most widely mentioned challenge resulting from the implementation of work-from-home solutions. Poor connectivity came as a result of some employees' limited knowledge of how to connect, unavailability of electricity due to load shedding, slow/ fluctuating internet speeds and other related challenges. One employer further noted that to deal with lack of wired internet availability, employees had to be provided with mobile data cards to ensure they connect.

Other employers emphasised that the problem with employee wellness should not be understated. In several instances, it was reported that employees found it harder to cope with the lack of human interaction while the workload remained unchanged. Managers found it challenging to keep staff motivated during

such a time, and preparing their subordinates for a foreseeable future of digital interactions. Other stakeholders expressed how some of their employees were 'feeling left out and almost disengaged' from everyday activity as a result of a work-from-home routine.

The challenge of financial strain was a point of contention since some employers reported that they in fact experienced cost savings instead of losses as a result of working from home rather than financial strain. Employers who argued financial strain pointed to the lost business during periods of load shedding as well as the payment of huge amounts to purchase mobile data for employees. In contrast, other employers noted that the lack of travel and need to hire venues for conferencing activities resulted in significant cost savings. Hence, the issue of cost was viewed as both a challenge and success based on different stakeholder experiences.

4.8.4. Successes from implementing work-from-home solutions

In contrast to the challenges, employers also noted a number of positive impacts brought by the implementation of work-from-home solutions. Some of the most commonly mentioned successes include: the improvement of employees' digital skills, cost savings and productivity improvements. For the most part however, employers who found work-from-home solutions as positive were already implenting some version of digital and remote working before the pandemic. Such employers already had their employees equipped with reliable computers for remote working, data packages and the full Microsoft Office 365 suite.

Several employers reported that their imployees' digital skills improved significantly since the adoption of work-from-home solutions. One employer described work-from-home solutions as having improved their employees', 'resilience' and 'adaptability' to changes around them. Hence, whether voluntarily or as a matter of necessity, employees had to become more conversant in digital skills.

In addition, some employers noted that working from home has in fact improved their productivity levels as they worked in a quieter environment with less distractions. However, productivity improvements through working from home were dependent on the home environment and individual discipline of employees. In an enabling home environment with reliable electricity and connectivity, employees have reported better results. The same was reported for employees comfortable with working from home; and disciplined enough to turn of home distractions and focus on work.

4.9. Emerging technologies' implications for skills development

This section brings the discussion on the skills development implications for emerging technologies full circle. In the previous sections, findings on the qualifications and jobs affected by emerging technologies were discussed. Table 6 summarises each type of emerging technology in terms of occupations that it affects (occupations in need of reskill and emerging occupations) and the skills development implications of that emerging technology.

In the FGD, the major theme emerging from the discussion on technology's implications on jobs was that technology is not necessarily placing jobs 'under threat', but rather in need of upskilling. As a result of this thinking, the focus of the discussion was to explore the ways in which existing occupations can be upskilled to ensure their continued relevance in the industry. In pursuant to this, various soft-skills were noted to be

most crucial for maintaining job competitiveness. These include: change agility and flexibility, advanced networking skills, emotional intelligence, problem solving skills, critical thinking skills as well as communication skills (basic and advanced). If implemented successfully through CPD, stakeholders noted that the inclusion of soft skills is likely to create a flexible and multi-skilled workforce that can coexist with different types of technologies.

Moreover, another emerging theme from the discussion was the likelihood that nearly each type of emerging technology is likely to impact on accountants, internal and external auditors in some form. As a result, it was agreed that specialist additional skills such as digital internal and external auditing will need further investment in.

Furthermore, another major emerging theme was the difference between emerging technologies' impact on higher level occupations such as accountants and lower level ones such as bookkeepers. It was found that while chances are that repetitive jobs such as bookkeepers (whose work results feed into accountants') and taxation technicians (whose work results feed into tax practitioners) will lose their jobs to automation, higher level jobs such as accountants and tax practitioners are likely to retain their jobs as long as they stay updated through CPD.

Table 6: Emerging technologies' implications for skills development and jobs in the FAS sector

Type of emerging technology	Occupations affected by the technology		Implications for skills development in the FAS sector
	Jobs needing upskill	Emerging jobs	
Artificial intelligence and Machine Learning - Automated bookkeeping services - Better financial protection and control - AI enhanced hedge funds and other investment tools	- Taxation technicians - Bookkeepers - Internal Auditors - External Auditors - Accountants - Administrator - Recruitment Managers - Debtors Clerks	- IT Specialists - Accountants with specialised skills - Auditors with specialised skills - Senior Information Security Officers - Coders - Product Designers - Digital Internal Auditors - AI & Robotics Managers	**Investing in the following skills for higher level occupations:** - Change agility and flexibility - Advanced network skills - Emotional intelligence - Problem solving skills - Critical thinking skills - Digital Transformation - Verification, quality control and analytical skills - Skills needed to capacitate students from school level **Investing in the following skills for repetitive occupations:** - Basic communication and networking skills - Basic computer literacy skills - Advanced communication and networking skills - Provision of tools (devices) for students to become involved **SETA should fund skills development towards emerging occupations such as coders, AI Managers, etc.**
Robotics - Chatbots - Mechanical robots	- External Auditors - Tele-sales - Call Centre Attendants - Payroll Administrator	- AI Supervisors	**Investing in the following skills:** - Basic communication and networking skills - Advanced communication and networking skills - Technical skills for students while still at university - Digital Auditing skills **(for auditors)** **SETA should fund skills development towards the enhancement of communication skills among recent university graduates**
Big data analytics - Multi-level customer interaction and customer profiling - Financial automation services - Application of big-data in automated auditing services - Real-time stock market insights	- Data Capturers - Verification Officers - External Auditors - Internal Auditors	- Data Scientists/ Data Managers - Cybersecurity Specialists	**SETA to fund the provision of the following skills to students in school:** - Data mining, extraction and analytics - Object orientated programming skills - Basic communication and networking skills - Advanced communication and networking skills

Type of emerging technology	Occupations affected by the technology		Implications for skills development in the FAS sector
	Jobs needing upskill	Emerging jobs	
- Risk management and fraud detection - Data privacy			**SETA to fund the upskilling of individuals such as data capturers into data mining, extraction and analytics**
Augmented reality - VR goggles - Immersive experiences - Hologram technology	- Training Managers - External Auditors - Internal Auditors	- Product Developers - Software Developers & Managers	- Need for skills in the application of Virtual Reality and Simulations - SETA to fund and encourage the integration of augmented reality tools such as simulations in skills development and training - SETA to fund the provision of blended learning programmes combining in-person tutoring and virtual lectures - Basic communication and networking skills - Advanced communication and networking skills
Cloud computing - Increase in accessible data storage facilities - Data consolidation	- Data Capturers - External Auditors - Internal Auditors	- Cloud Computing Specialists - Digital Transformation/ Automation Specialists	**Emphasis on the following skills for the upskilling of existing workforce and meeting emerging jobs:** - Relational Database skills - Document database skills - Data mining, extraction and analytics - Cloud based and software skills
Internet of things, advances in mobile technology and smart sensors - Home automation systems - Infrared sensors - Proximity sensors (applicable in payments, promotions etc.)	- External Auditors - Internal Auditors	- Internet of Things Specialists	**SETA to fund skills development in IoT relevant areas such as:** - Internet of Things applications - Digital Literacy - Disruptive Technologies - Basic communication and networking skills - Advanced communication and networking skills

However, it should not be entirely assumed that lower level occupations such as bookkeepers will lose their jobs to automation since with specific CPD interventions, such occupations can still be retained. According to the stakeholder discussions, skills development for lower level occupations need to focus more on specific technical skills (such as coding and data mining) as well as targeted soft skills (such as basic communication skills). Investment in such skills will likely help upskill employees to a more competitive level; or provide an opportunity to diversify in case their job is completely erased. Skills diversification will then be required in areas that ensure skills gaps for emerging occupations such as cloud computing specialists, AI supervisors, product developers and data scientists.

4.10. Stakeholder suggestions on key skills development interventions

Table 7 summarises key recommendations suggested by stakeholders as necessary to improve skills and prepare the sector for the 4IR.

Table 7: Stakeholder input on the necessary skills development interventions

Stakeholder suggestion	Suggested by:		
	Empl.	Prof. bodies	Training Prov.
Need to capacitate academic staff (courses, workshops etc.) to be able to capacitate learners with practical aspects needed by the industry	✓	✓	✓
Investment in short professional courses for students before they graduate	✓	✓	×
Emphasis on more virtual training and workshops instead of in-person learning	✓	✓	✓
Integrating basic IT skills from the first year of study, such as MS Word, MS Excel and MS PowerPoint in the curriculum. Skills development should commence from the grassroots level, i.e. with strong Math skills	✓	✓	×
Schools need to move from theory and become more practical. Possibly, at least 30% of the qualification should come from practical knowledge	×	✓	×
FASSET should join hands with other SETAs to introduce infrastructure that prepares people for work in the future	✓	✓	×
FASSET should partner with DHET to ensure the introduction of more practical subjects into current curricula	✓	✓	×
FASSET should keep stakeholders in the loop regarding new courses and other opportunities for employers	✓	×	×
There is need to ensure that instead of retrenchment as a result of redundancy, the SETA can offer a training skill that upskills such a person to become employable	×	✓	✓
Focus on AI incorporation rather than looking at AI as something that will take over Strategy planning for FAS sector employers - with specific focus on digitization, automation and emerging technologies	×	✓	×

As shown on Table 7, all stakeholder groups appear to agree on the need for educator capacitation through 'train the trainer' practical interventions meant to ensure their understanding of sector dynamics; and the need for training to become more virtual as opposed to in-person. In addition, employers and professional bodies agree to the need for professional exposure for students before graduation, integration of ICT courses at grassroots level and the need for partnerships that address ICT infrastructure requirements and

practical learning. Training providers and professional bodies also agreed that interventions can be made to incentivise employers against retrenching redundant workers; such as through offering upskilling services to redundant employees to make them more competitive.

4.11. Summary

This chapter focused on the presentation of findings based on primary data collected among FAS sector stakeholders. Findings covered several aspects such as the level of understanding of the 4IR, emerging technologies' implications for skills development within training providers and occupations within employer organisations, challenges faced in implementing digital solutions as well as the impact of Covid-19 on technology adoption. The assessment of levels of understanding of the 4IR showed that the majority of employers understand what 4IR means; and are able to discuss its implications with reference to their day to day business activity. Meanwhile, a discussion into the adequacy of skill levels of current graduates in the FAS sector to handle existing technologies found that most training providers and employers are confident of their graduates and employees' abilities respectively. However, there was a general consensus that to stay abreast of emerging technologies, employees require constant training and CPD. On the impact of emerging technologies on skills development, a mismatch was found between skills demand by employers and skills supply by training providers and (to an extent) professional bodies. While employers had a long list of necessary skills they require their employees to possess in the wake of changing technology, training providers were found to have no skills programmes in the pipeline targeting any such demands; while most professional bodies were found to be working on closing these skills gaps. Discussions into the impact of emerging technologies on jobs produced a list of at-risk occupations (such as accountants, bookkeepers, tax practitioners and data capturers) and a list of emerging occupations (such as information security officers and cybersecurity specialists). With sufficient CPD in key occupations, it was found that employees will likely be able to remain competitive and coexist with emerging technologies. Concerning the challenges impacting skills development, it was found that red tape issues, budget limitations and resistance to change were among the key hindrandes to skills development in the FAS sector. Meanwhile, it was found that the Covid-19 pandemic has accelerated innovation for several FAS sector employers, resulting in the experience of successes (such as cost savings, improvement in digital skills and productivity increase) and challenges (such as employee wellness, and poor connectivity). As a result of skills development dynamics discussed, stakeholders suggested a number of key interventions such as the improvement of training at grassroots level, CPD for existing employees and partnerships for the development of ICT infrastructure in areas with low connectivity.

5. CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

This chapter summarises findings, provides a conclusion and discusses recommendations on the way forward for enhancing skills development in the midst of emerging technologies. The next section summarises the study's findings from literature review and from the primary data collected among FAS sector employers, training providers and professional bodies.

5.2. Summary of findings

5.2.1. Findings from literature

The review of literature for this study focused on uncovering areas around the key 4IR enablers for South Africa, the impact of emerging technologies on skills needs in the FAS sector and the overall impact emerging technologies have on jobs. An overview of the understanding of 4IR by role players found that an organisation's understanding of the 4IR has a bearing on their level and rate of adoption of 4IR technologies. With the appreciation of the 4IR still fairly low among employers in South Africa, the adoption rate for emerging technologies is still low, with several companies still in the midst of implementing 3IR technologies (COEFS, 2017).

A review of the 4IR enabling factors found that besides employers' understanding of the 4IR, there are several 'enablers' that interplay to 'enable' the adoption of emerging technologies (Xu *et al.,* 2018). These enablers include the levels of internet penetration in a country, governance, key enabling infrastructure, sector and competition regulation, data governance and data justice, open data, public sector digitalisation and human development. According to the National Planning Commission (2020), this interplay of factors has to create an enabling environment in which firms can adopt emerging technologies with limited resistance. Factors such as the existence of ICT infrastructure were seen as key in explaining technology adoption rates (Myeong & Jung, 2019). To unlock faster technology adoption, the National Planning Commission (2020) argues that inefficiencies such as load shedding have to be severely reduced, since the power grid has direct implications for internet infrastructure. Meanwhile, governance in areas such as competition regulation and data justice have to be strengthened to protect innovators while promoting healthy competition among players.

A number of emerging technologies were found to have a bearing on skills and jobs in the FAS sector, such technologies include Artificial Intelligence, blockchain and cryptocurrency, robotics and big data analytics. The adoption of AI and robotics in areas such as investment fund management has seen disruptive changes in the rates of return per risk; with AI managed Hedge Funds completely outperforming traditional hedge funds (Chan, 2017; Goertzel, 2015; Lin, 2017). In addition, Ovaska-Few (2017) notes that while the potential job losses in accounting areas may be overstated, it is true that many accounting jobs are being made obsolete as a result of the adoption of AI in the accounting field. Meanwhile, blockchain technology has reportedly been causing disruptions in the financial sector through its effect on how payments are made, as well as the security of financial transactions (Knezevic, 2018; Polyviou *et al.,* 2019). On the other hand, while research is still limited in the field, Hasan, *et al.* (2020) estimated that big data analytics' impact on

jobs would be fairly minimal. Instead of changing overall employment, the application of big data is reportedly changing what workers are being asked to do, thus changing their workplace dynamics (Fleming *et al.,* 2019). This reinforces the thought that with CPD, professionals will likely be able to keep their jobs as long as they remain acquainted with emerging technologies in their areas of operation (Pattabiraman, 2019).

5.2.2. Findings from primary research

Study findings covered areas such as the level of understanding of the 4IR, emerging technologies' implications for skills development within training providers and occupations within employer organisations, challenges faced in implementing digital solutions as well as the impact of Covid-19 on technology adoption and skills development. The study also explored how factors such as the Covid-19 pandemic and the advent of emerging technologies impact skills development for the FAS sector. The following were the key findings of the study:

5.2.2.1. The assessment of levels of understanding of the 4IR showed that the majority of employers understood what 4IR means; and were able to discuss its implications with reference to their organisational training needs. During the focus group discussion, stakeholders were in agreement that the advent of the 4IR has necessitated the need for skills development and training interventions focusing on enhancing employees' coexistence with emerging technologies.

5.2.2.2. A discussion into the adequacy of skill levels of current graduates in the FAS sector to handle existing technologies found that most training providers and employers were confident of their graduates and employees' abilities respectively. However, there was a general consensus that to stay abreast of emerging technologies, employees require constant training and continuing professional development (CPD).

5.2.2.3. The FAS sector's capacity to prepare for, and to manage emerging technologies was found to be constrained by a mismatch between employer skills demand and skills supply by training providers and (to an extent) professional bodies. While employers had a long list of necessary skills (inclusive of soft skills such as: emotional intelligence, change agility & flexibility, problem solving, critical thinking and communication as well as technical skills such as data mining, data analytics, cloud computing, database management and cybersecurity) that they require their employees to possess in the wake of changing technology, training providers were found to have no skills programmes in the pipeline targeting any such demands. Most professional bodies however, were found to be making effort to close these skills gaps. Examples of professional body interventions include; providing qualifications in digital auditing, ICT courses in programming and application building, business risk & cybersecurity, and remote working as well as soft skills in critical thinking and business acumen.

5.2.2.4. The study found occupations likely to be impacted by ETs (at-risk occupations) include accountants, bookkeepers, tax practitioners and data capturers.

5.2.2.5. It was also found that there are a number of emerging occupations in the FAS sector as a result of ETs, namely information security officers and cybersecurity specialists.

5.2.2.6. The FGD revealed that there were several soft skills whose demand has now increased as a result of emerging technology. It was noted that while several occupations appear to be under threat at

face value, investment in soft skills such as problem solving, communication and critical thinking will likely help enhance the competitiveness of employees. With sufficient CPD in key occupations and soft skills, it was found that employees will likely be able to remain competitive and coexist with emerging technologies. Meanwhile, for lower level qualifications such as bookkeepers, CPD interventions were found to be necessary in technical skills (such as coding and data mining) that unlock options for work diversification. However, the ability to diversify skills will be subject to limitations such as the persons' capability to implement drastic change into their professional life.

5.2.2.7. The major challenges impacting skills development in the FAS sector which came to light were; the lengthy time it takes for curriculum development by training providers, budget limitations and resistance to change in terms of adjusting to emerging technologies.

5.2.2.8. It was found that the Covid-19 pandemic had accelerated technology adoption for several FAS sector employers, resulting in the experience of successes (such as cost savings, improvement in digital skills and productivity increase) and challenges (such as employee wellness, poor connectivity/ slow internet speeds and challenges resulting from load shedding). On skills development, it was found that the pandemic has transformed the way in which training is administered; with the new focus now on electronic learning (e-learning) and assessments; a tool that has been found to be highly instrumental and easy to implement in the current Covid-19 environment. As a result, stakeholders suggested the need for investment in tools that improve employee access to remote training and assessments.

5.2.2.9. The study aimed to investigate a number of assumption made about emerging technologies, skills development and jobs in the FAS sector. Findings on these assumptions were as follows:

- The first assumption that, "emerging technologies in the FAS sector are/ will be displacing jobs, resulting in retrechments", was only partially affirmed. While it was noted that some employees doing repetitive jobs may lose their work to automation, it was found that with sufficient CPD, most workers are likely to retain their jobs. In fact, it was found that due to emerging occupations, several jobs will likely be created as a result of the adoption of emerging technologies.
- The second assumption that, "emerging technologies in the FAS sector are resulting in emerging (future) skills needs that are necessary for employee productivity and job retention" was affirmed. It was found that AI and machine learning, robotics, big data, cloud computing and IoT, have all resulted in future skills needs that include data analytics and cloud computing, among others.
- The third assumption that, "emerging technologies in the FAS sector will create opportunities for new occupations or jobs" was also affirmed. Emerging occupations identified through stakeholder consultation include data scientists, product designers, AI & Robotics managers, cybersecurity specialists among others.
- The fourth assumption that, "emerging technologies will necessitate a changed approach into skills development and training in the FAS sector" was also affirmed. The study established that in addition to remote training and examinations already being employed in the sector, training providers were exploring further options for immersive virtual training methods such as simulations and augmented reality.

5.2.2.10. As a result of skills development dynamics discussed, stakeholders suggested a number of key interventions such as the improvement of training at grassroot level, CPD for existing employees and partnerships with other entities and institutions for the development of ICT infrastructure in areas with low connectivity.

5.3. Conclusion

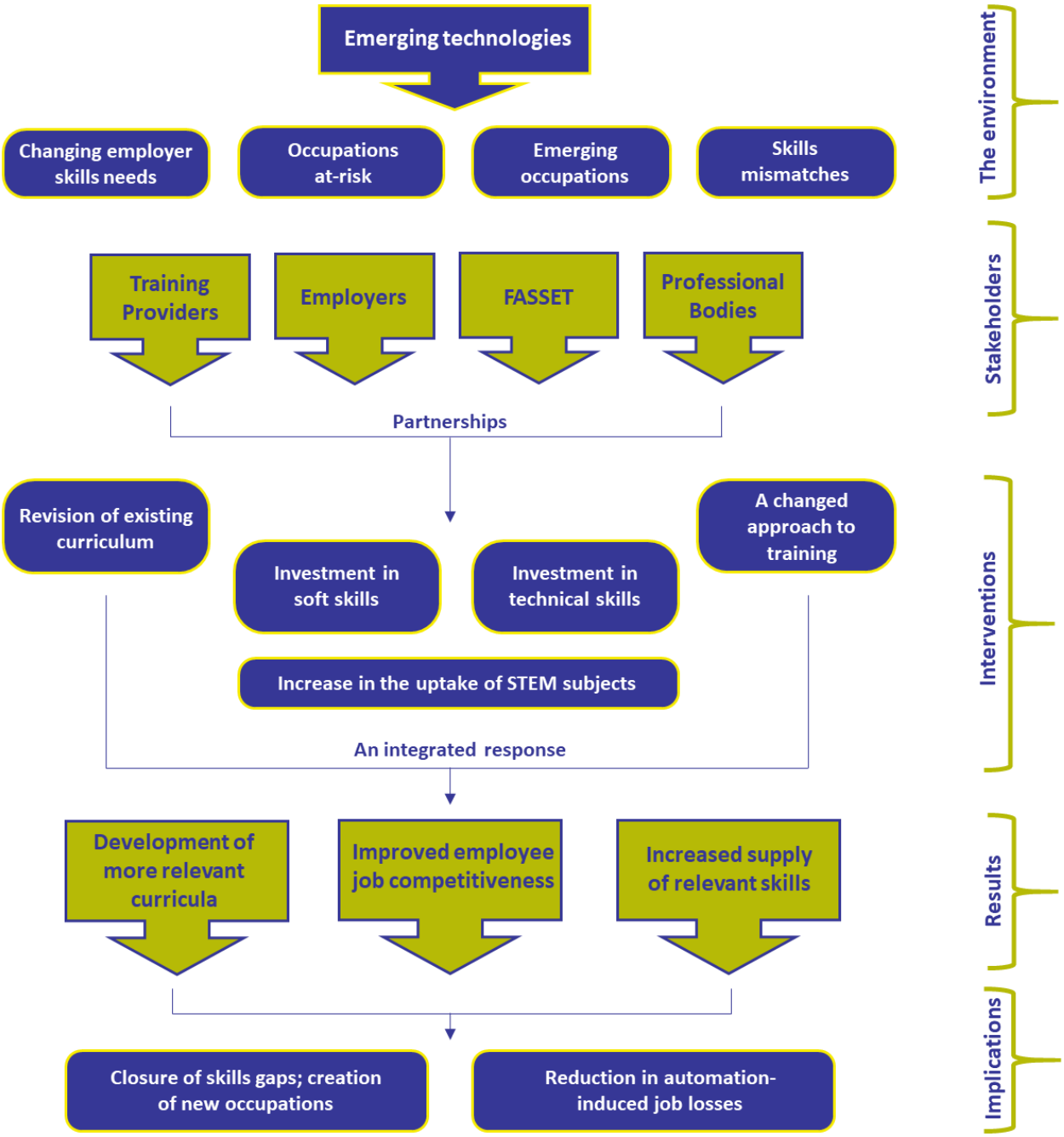
Findings of the study show that while FAS sector stakeholders possess an appreciation of the 4IR implications on skills development for their organisations, consensus on the exact skills that are needed as well as the extent of the impact on jobs, is yet to be reached. Evidence from data also shows that a skills mismatch occurs because training providers are finding it challenging to keep up with the fast nature of technological progress. At least through the flexibility and interventions by professional bodies in the sector, professionals are being provided with opportunities for CPD as well as skills diversifications and specialisations.

On their part, training providers noted that due to the nature of programme provisions in school, it is not always necessary to offer programmes responding to specific technologies, but rather to produce graduates that are holistically qualified and can handle various technologies. One major theme transcending from literature through primary research was the impact continued training has on the professionals' ability to safeguard their jobs and remain competitive. This theme integrates well with FASSET's mandate for skills development; and how professional courses can be utilised to ensure that FAS sector employees remain competitive. Throughout this discussion however, it would be imprudent to assure ourselves that no job losses will be suffered as a result of emerging technologies. Employers demonstrated clear appetite for technology adoption, which would appear to create several ICT jobs in the sector. However, for more repetitive tasks that can be easily replaced by 24 hour working bots and AI code, the sector should brace for near future job losses. On a positive note, if employer interest remains, it is likely that whole new departments will be created such as AI Managers, Cybersecurity Departments and Digital Auditors; all of which will require staffing.

Figure 9 represents the conceptualisation of the research problem statement (environment), stakeholders involved, interventions required in response to emerging technologies as well as the results and implications of the interventions. As noted from literature and stakeholder input, emerging technologies are creating both opportunities and threats for the FAS sector, and these are captured in the first section of the infographic on Figure 9 "the environment". Stakeholders identified to be key players in the FAS sector include employers (labour demand), training providers (labour suppliers), professional bodies (CPD) and FASSET (skills development authority). It should however be noted that for a concept such as emerging technology, the actual interested stakeholders are many more since they could include the Department of Basic Education (DBE), DHET, South African Qualifications Authority (SAQA) and others. Through partnerships and integrated approaches, interventions such as the revision of existing curricula, investment in soft skills, investment in technical skills, increase in the uptake of STEM subjects and a changed approach to the provision of skills development and training can be implemented. The expected results of skills development interventions are shown in the 4th section of the infographic; and include the development of curricula that are more relevant to an industry with changing technology, an improvement in the job

competitiveness for sector employees and the increase in supply of relevant skills into the sector. Given that such results emerge from the implementation of skills development interventions, the overall sector implications will be the closure of skills gaps caused by emerging technologies in the FAS sector, the creation of new occupations as technologies are implemented and the reduction in automation-induced job losses. Figure 9 hence captures not only the research problem, but shows the findings of the study, meaning of the findings, recommendations and the expected implications of findings for skills development and training.

Figure 9: Conceptualisation of the emerging technologies' implications for the FAS sector



Source: UCS conceptualisation based on primary study findings

5.4. Recommendations

Based on the findings of the study and stakeholder suggestions, the following recommendations were made:

5.4.1. Recommendations for FASSET

5.4.1.1. FASSET should establish more effective partnerships with higher education institutions (HEIs) focusing on areas such curriculum development (for example new curriculums that intergrate ICT in day to day study), to ensure graduates are well prepared for emerging technological demands. FASSET should consider funding initiatives that seek to emphasise the application of practical learning (for example, auditors need to actively apply digital auditing skills while still in school) as well as soft skills within HEIs. Partnerships can also include institutions such as the Media, Information & Communication Technologies Sector Education and Training Authority (Mict SETA) that are more focused on skills development in the ICT space. FASSET's funding support will result in the development of a curriculum that better addresses the needs of the sector based on employer needs, hence leading to the closure of multiple skills gaps.

5.4.1.2. To further develop the emerging technologies skills base, FASSET should ensure (through partnerships with professional bodies and employers) that more resources are invested into an integrated skills programme (SP) system for sector employees. The SP system should ensure that employees receive periodic short courses focusing either on emerging technologies or on skills diversification yearly. Key soft skills that can be periodically offered include problem solving, change agility, flexibility, communication, people management and emotional intelligence. This intervention will result in the maintainance of job competitiveness for FAS sector employees, hence reducing the number of job losses due to ETs.

5.4.1.3. To effectively deal with skill requirements to support emerging technologies, a national collaborative effort is required. FASSET should therefore identify and collaborate with other partners that are considered vital in providing a broad supply of key skills. Such partners may include other SETAs (such as BANKSETA and INSETA), local and international research institutions and other state entities. A model that negates partnerships will not be sustainable as skills developed by one sector will easily migrate to other sectors, thus eroding whatever gains could have been made through a single sector effort. An integrated intervention will unlock a skills supply pipeline between sectors that can result in the exchange of relevant skills programmes and courses as well as human resources from one sector that can close skills gaps in another sector.

5.4.1.4. FASSET should implement emerging technology awareness campaigns targeting all stakeholders, to promote culture change across the sector. Multiple studies have established that the adoption

of 4IR technologies is likely to provide several new jobs, opportunities for large firms to outsource to smaller firms as well as increased productivity. Instead of viewing AI as a threat to manual jobs, sector players should look into the possible opportunities that AI will bring both in productivity and jobs creation. This intervention will unlock sector awareness at all levels on the implications of emerging technologies on jobs, hence promoting a harmonious and progressive relationship among employers, employees and FAS sector emerging technologies.

5.4.2. Recommendations for all sector stakeholders

5.4.2.1. FAS Sector should be involved in support programmes designed to encourage, take up and improve pass rates in science, technology, engineering, and mathematics (STEM) subjects in the schooling system. This may include initiatives such as adopting specific schools, support for STEM teacher development, development of relevant infrastructure such as laboratories and information and communication technology (ICT) hubs. The introduction of such support programmes will result in an increase in the pipeline supply of students that take up qualifications in emerging occupations, hence increasing the supply of relevant skilled personnel into the FAS sector.

5.4.2.2. For FAS sector occupations identified as 'in need of upskill' (such as those of accountants, bookkeepers, internal auditors, external auditors, taxation technicians, data capturers and debtors clerks) skills development and training should be focused ensuring job competitiveness in light of emerging technologies. For higher level occupations (such as accountants, internal auditors and external auditors) skills development can focus on soft skills that improve employees' analytical performance. Specialised training can also be given in areas such as **business rescue** (a specialisation for accountants). In addition to soft skills, skills development for lower-level occupations such as bookkeepers, data capturers and taxation technicians, can focus on technical issues in their fields and skills diversification into areas such as data analytics and cloud computing. The upskilling initiatives for such occupations will result in a better skilled workforce that is able to maintain job competitiveness, thereby reducing the overall number of employees losing their jobs to automation.

5.4.2.3. There is a need for a change management initiative on emerging technologies, which should be implemented across the sector in order to deal with issues around resistance to change by some stakeholders. Reducing or eliminating change resistance will result in a sector that is more receptive to emerging technologies. With training providers offering relevant courses, employers implementing technologies and employees getting upskilled will relate better with emerging technologies.

5.4.2.4. FAS sector should promote and facilitate the establishment of Communities of Practice (CoP) across the sector, to encourage sharing of experiences on emerging technology skills development training and initiatives. This sharing of information and experience will result in a more informed sector thereby making it easier to come up with relevant interventions targeting occupations at risk and emerging occupations.

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