



2022 JCSE-IITPSA ICT Skills Survey *Twelfth Edition*

Joburg Centre for Software Engineering (JCSE) and
IITPSA (Institute of Information Technology
Professionals South Africa)

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EXECUTIVE SUMMARY

The JCSE (Joburg Centre for Software Engineering) is a University of Witwatersrand partnership with government and industry, founded in 2005. IITPSA (the Institute of Information Technology Professionals South Africa) is the 65-years old professional body for the sector, recognised by SAQA and accredited by the International Professional Practice Partnership (IP3). This report is the output of a collaborative partnership between the JCSE and IITPSA. It presents the results of the partnership's twelfth edition of its survey of skills trends in the South African information & communications technology (ICT) sector.

The release of the 2022 JCSE-IITPSA ICT Skills Survey coincides with an important landmark in the history of Wits University. In October 2022 Wits celebrates its hundredth anniversary. As an internationally recognised research university Wits has played a leading role in developing and defining the ICT sector in South Africa, Africa and the world.

In the 1960s Wits became the first university on the African continent to acquire a digital computer for teaching and research, when the then-head of Electrical Engineering, Professor GR Bozzoli, persuaded the university's management to lease an IBM mainframe. Wits became the first South African university to offer courses in computer science and Derek Henderson became the first professor of computer science.

Over the years tens of thousands of Wits graduates have entered the ICT sector in South Africa and throughout the world and have gone on to make their mark on the growth and development of the digital economy. There is hardly a major ICT company anywhere in the world where South African professionals don't play a major role – and many of these are Wits alumni. In South Africa, Wits graduates established some of the country's most innovative ICT companies including Internet Solutions, Entelect and Poynting to name but a very few. A little-known fact is that Elon Musk was introduced to computers by attending weekend coding camps for school children at Wits University.

There is a French expression which translates as “the more things change, the more they stay the same”. You could be forgiven, in reading this report, for thinking that you have “seen it all before”. The South African economy is still in dire straits – more so, in fact. The consequences of State Capture are coming home to roost in droves, albeit without much locking up of the perpetrators at the time of writing. In spite of some ludicrous measures, our approach to the COVID-19 pandemic has been reasonably effective in staving off the worst effects of mass infection.

The depressed national, regional and global economic environment has severely restricted any opportunities to grow the ICT sector, after the initial spurt triggered by the “work from home” (WFH) transition in 2020/2021. This is reflected in the MICT SETA statistics, which show a significant contraction in the size of the sector workforce, and in the slow-down in hiring volumes, according to some recruitment agencies.

South Africa seems to have weathered the COVID-19 pandemic, although we will have to remain vigilant to assess the long-term effects of the related illnesses on the surviving patients. As our results, and those of other surveys show, employers and practitioners have mixed feelings about the transition to working-from-home (WFH) and the return to the office or a hybrid option. The potential benefits of remote working are under closer scrutiny as a result of this transition.

Three years ago, we noted that while many stakeholder groups are making concerted efforts to improve the competency and employability of young people through some excellent skills development initiatives, the results tend to be counted in terms of hundreds of candidates, when what is needed is opportunities for hundreds of thousands of people. We continue to search hard for the initiatives that have scalability – such as the Future Skills Project started by the Global Business Services sector, through BPeSA, which has forged a link between learning and employment. The continued fragmentation of stakeholder groups in the ICT sector inhibits the ability to take an holistic approach to analysing the data available from the myriad of role-players.

We make no apologies for continuing to beat the drum about the state of South Africa's education system. The pockets of excellence and the growing number of plans for new curricula and teaching methods can never excuse nor balance the condemning of the majority of the 12 million young people attending schools to sub-standard premises, inadequate infrastructure and uninspired teaching. We must find ways of keeping a million young adults each year from starting their careers in an unemployment queue.

We cannot ignore the more localised issues of immigration and emigration. Towards the end of 2021, the Department of Home Affairs (DHA) announced the termination of the Zimbabwe Exemption Permits (ZEP) scheme, withdrawing their validity beyond December 2022 (subsequently extended to June 2023). Of the 178 000 affected ZEP holders, a significant number are employed in the ICT sector and will now have to justify being granted a Critical Skills Visa (CSV) if they are to remain in their jobs.

After 8 years of applying the 2014 list of Critical Skills, DHA revised the list in February 2022, with a further amendment in August 2022. While there were many changes in the occupations included in the list, the most significant change was the imposition of a minimum level of tertiary qualification for applicants – mostly at NQF level 7 but many at level 8 (Bachelor degree or higher, respectively). This meant that many holders of CSVs under the 2014 criteria would not be able to renew or extend their visas.

In parallel with these changes to the immigration requirements, DHA centralised all its visa processing to Pretoria, instead of the previous system of evaluation in the various embassies and consulates in the source territories. This created a massive backlog in unprocessed applications, delaying outcomes by many months or even a year. The decision has been rescinded (September 2022) but clearing the backlog will still take months of wasted time, both for the employers and the immigrants.

The other side of the immigration coin is emigration. Although firm statistics are not readily available, we do know that many highly qualified and experienced ICT practitioners are taking their skills overseas, to more stable social environments, to more lucrative economies and to better futures for their families. This opinion is reinforced by a survey conducted by the Social Research Foundation (quoted by Bloomberg in the Daily Maverick, September 2022), which found that 53% of university graduates and 43% of those earning more than R20 000 a month may leave the country. This represents a massive drain on our education and training resources, as the return on investment in these practitioners is gained by the foreign territory.

Our survey throws some light on the connection between the skills shortages and the influence of immigration and emigration on the skills supply.

THE ICT SECTOR

What is the ICT Sector? It depends on who you ask. ICASA (the regulator) says it comprises telecommunications, broadcasting and postal services. The MICT SETA says it includes media, information technology, telecommunications and electronics. Statistics SA says it is a subset of Transport and Communications. Gartner refers only to information technology (hardware, software and services). It is tempting to think in digital terms of the creation, storage, manipulation, transmission and visualisation of data, but we have not yet abandoned all analogue forms, nor can we predict all future forms. Suffice it to say that the current and future contribution of “ICTs” to most facets of 21st Century life is a given, as is the demand for the skills to enable that contribution.

ICASA’s State of the ICT Sector report in 2022 includes the following statistics. The total sector revenue (telecommunications, broadcasting, and postal services) slightly increased by 0.3% from R243 billion in 2020 to R243.6 billion in 2021. The broadcasting services revenue increased by 2.8% from R35 billion in 2020 to R36 billion in 2021, and postal services revenue increased by 11.1% in 2021, however telecommunication revenue has slightly decreased by 0.5% from R201 billion in 2020 to R200 billion in 2021.

The total numbers for the three sectors employment decreased by 22.4% in 2021. Employment changes in the three sectors were as follows: telecommunications sector employment decreased by 35.8%, broadcasting sector employment also decreased by 18.7%, and postal sector employment increased by 2.1%.

The MICT (Media and ICT) SETA provided the following information in its 2020-2025 Sector Skills Plan. South Africa’s nominal GDP at market prices in 2018 was R4,9 trillion, a R220 billion increase from 2017 (StatsSA, 2019). The MICT sector is, however, estimated to have a combined GDP exceeding R300 billion. Based on the ICASA numbers, this would suggest the IT sub-sector is worth approximately R60 billion. This seems low but, in the absence of consolidated, standardised reporting, validation is a challenge.

ICTs – BRIDGING THE GAP OR WIDENING THE DIVIDE?

In seven decades, ICTs have progressed from enabling the accounting functions of large enterprises to enabling nearly every facet of the life of someone who can hold a mobile device and pick up a wireless signal, from storing data in fixed formats on punched cards to collecting zettabytes of data in any form in massive data centres accessible from anywhere. Enterprises and individuals who can master the use of 21st Century digital tools can be exponentially more productive than their 20th Century predecessors. However, those who cannot “move with the times” may find themselves so disadvantaged that it is impossible for them to compete.

In South Africa (as in the greater African continent and elsewhere across the globe), the arrival of personal computers and wireless telecommunications launched the philosophy of the need to bridge the “digital divide”. Policies were announced, programmes launched and re-launched, that would put these new tools into the hands of the broader population, enabling them to reap the “digital dividend” and fuel greater economic growth. This culture has morphed into how the Fourth Industrial Revolution (4IR) technologies will accelerate the delivery of these benefits into our communities.

Are we seeing the benefits across our broader population groups? Without a shadow of a doubt, the mobile phone has had an enormous impact on our society. In spite of the arguments about the high price of connectivity, millions of South Africans own or have access to a mobile phone and the means to keep it charged. Granted, signal quality may vary and device facilities may range from 2G to 5G, but millions of our people are able to connect, communicate and derive value from this technology.

However, that represents only a small slice of the potential value of newer generations of technology. The ability to collect, store, analyse, transmit and manipulate “big data” takes us from the limitations of one-to-one communication to the almost unlimited possibilities of one-to-many and many-to-many sharing of ideas and information, of trading value between parties for mutual benefit.

There are significant risks arising from these vastly increased capabilities. Some are economic or socio-economic. Despite policies to close the gap between the “haves” and the “have nots” in terms of access and affordability, the gap remains. Some arise from criminal use of the enabling technologies, ranging from the misuse of personal data to larceny on a grand scale. Some arise from propagating false information to manipulate democratic processes. Some arise from dependency on the communications networks – signal failures can range from inconvenient to disastrous.

To sustain a trajectory of growth fuelled by ICTs, it is the responsibility of the employers of the practitioners and the practitioners themselves to mitigate the risks and protect the vulnerable from deprivation. At the heart of practising the skills that design, develop, implement and maintain the platforms and applications, there has to be a firm conviction that those skills must be utilised ethically, be measured against quality control and safety standards and be mindful of the protection of users and the broader community against potential harm.

An essential ingredient of the skills development pipeline must be the inculcation of a culture of ethical practice and adoption of competency standards that will result in consistently high quality outputs. Everyone – schools, colleges, universities, training providers, employers and professional bodies – has a role to play in adding this essential ingredient. Skills developed within this framework will contribute to closing both the skills gap and the digital divide.

GENDER AND TECHNOLOGICAL DISPLACEMENT IN SOUTH AFRICA

Leslie Dwolatzky and Barry Dwolatzky

It is generally accepted that new technologies have the potential to replace people with machines. The term given to this phenomenon is either “technological unemployment” or “technological displacement”. We choose in this article to use the latter term, since it is more likely that individual workers will be displaced by technology rather than left unemployed. Throughout the history of the digital age both individuals and categories of workers have anxiously responded to the announcement of new innovations with the question, “Will this make my skills redundant?”

Over the past decade there has been increasing focus on the potential of artificial intelligence (AI) and machine learning (ML) to displace workers who have skills previously thought to be reserved for highly-skilled human beings. Like much of the debate associated with the so-called Fourth Industrial Revolution (4IR), there has been a great deal of hype, but very little actual research to support either side of the argument. A research project was therefore undertaken at Wits University with the aim of understanding some of the impacts of ML on skills and associated jobs in South Africa. The work, carried out as research for a Master of Arts in e-Science¹, focused specifically on whether women would be more or less impacted than men by technological displacement associated with ML.

The research drew on work by Brynjolfsson, Mitchell and Rock² carried out in the USA in 2018. With advancements in ML and its increased applicability to processes in many economic sectors, a worker’s skill-level is no longer an effective measure of the types of worker which are most vulnerable to the threat of technological displacement. Instead of focusing on skill-level, it has become important in identifying vulnerable workers by examining the occupational tasks that they perform. Brynjolfsson, et al., developed a “suitability for machine

¹ Leslie Dwolatzky, 2022, “Gender and Technological Change: Measuring Vulnerability to Technological Unemployment in the South African Labour Market”, MA in E-Science Dissertation, University of the Witwatersrand, Johannesburg.

² Brynjolfsson, E., Mitchell, T. and Rock, D., 2018. What can machines learn, and what does it mean for occupations and the economy? AEA Papers and Proceedings, 18: 43-47.

learning” (SML) framework which offers an effective approach to quantify the extent to which occupational tasks and occupations can be performed by ML systems instead of by humans.

The Wits University research used the SML framework as a basis to investigate various dynamics of the South African labour market in order to identify the demographic characteristics of workers who perform occupations that are most vulnerable to technological displacement. The research applied the Brynjolfsson, et al., SML measure to the South African labour market by matching it to workers and their occupations found in the official South African Quarterly Labour Force Survey (QLFS). Using statistical methods, the South African data was analysed to determine the demographic and educational characteristics of workers most likely to be affected by ML systems. A comparison was also done between 2009 data and 2019 data for these demographic populations.

What did the research show? Firstly it found evidence that South African women are significantly more vulnerable to the threat of technological displacement due to ML systems, compared to their male counterparts. Within the broader group of all women, young, black women are the most vulnerable demographic segment of the South African labour force. The research also found that, while the vulnerability of the female population as a whole has decreased between 2009 and 2019, the vulnerability of young, black women has increased in this ten year period.

This finding is explained by considering the types of occupations being performed by young, black women in the South African labour force. Over the past ten years this group of women has benefitted from various policy initiatives that have allowed them to become better educated and more active participants and sought-after employees in the labour market. Ten years, or more, ago this group of women would typically be found in relatively unskilled occupations such as domestic work, cleaning and care. They are now moving into higher-skilled clerical and service-oriented occupations. It is precisely these occupations that are characterised by routine and repetitive occupational tasks, making them highly vulnerable to displacement by ML software systems, such as robotic process automation (RPA).

This research is of significant importance because structural unemployment and income inequality are two of the most pressing challenges facing the South African economy. While the research only considers one of many factors that account for these challenges, it does highlight an important relationship between emerging digital technologies and the vulnerability of a significant subgroup within our workforce. The research should also be seen as an attempt to lay the foundation for further investigations into technological displacement and labour force vulnerability in South Africa and other developing economies.

Another important consideration is that there is a lag in the penetration of new technologies into developing economies such as South Africa as compared to more developed economies. This is partly due to the lower relative price of labour. However, as technology develops at an increasingly rapid rate and as these technologies become more cost effective, firms become more incentivised to replace labour with capital. Research of the type presented in this article place us in a far better position to anticipate more accurately what the impact of new technologies will be, allowing us to develop mitigation strategies.

SURVEY PROCESS

The Skills Survey continues to follow the process established in 2008. Its objective is to identify the most pressing skills needs from the corporate perspective, balanced with the view of current skills capacity of the practitioners and their intentions for future skills development. The questionnaire, devised by the JCSE, is in a consistent format to track trends and is published as an on-line survey. In 2022, as for the previous seven surveys, we were assisted in this regard by Eduflex (a Cape Town-based company), who gave us the use of their Virtual Assessor™ survey engine and hosted the on-line access. Our thanks go to their team for great support.

We acknowledge the ongoing partnership between the JCSE (Joburg Centre for Software Engineering at Wits University) and the IITPSA (Institute of Information Technology Professionals South Africa), and the assistance of the ITA (Information Technology Association) in bringing the survey to the attention of their members and ITWeb as our media partner.

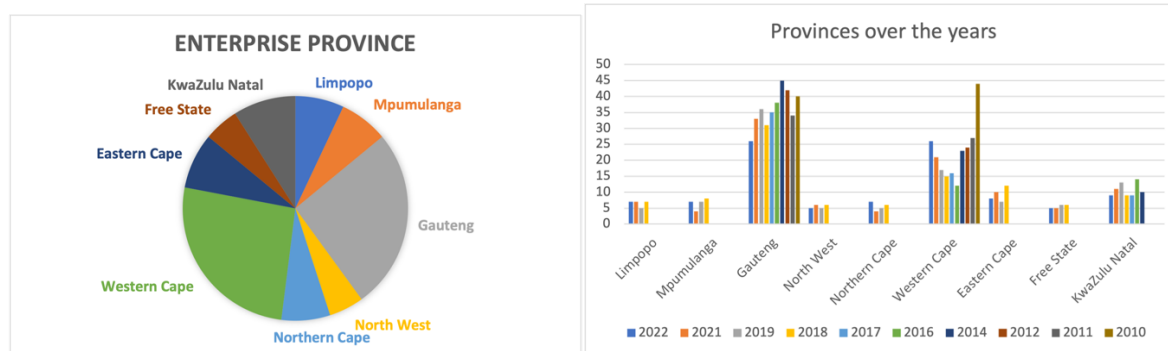
The data gathered from the questionnaires is put into context by an environment scan and literature review, supported by informed opinion from some of the sector's leading stakeholders.

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CORPORATE RESPONSES

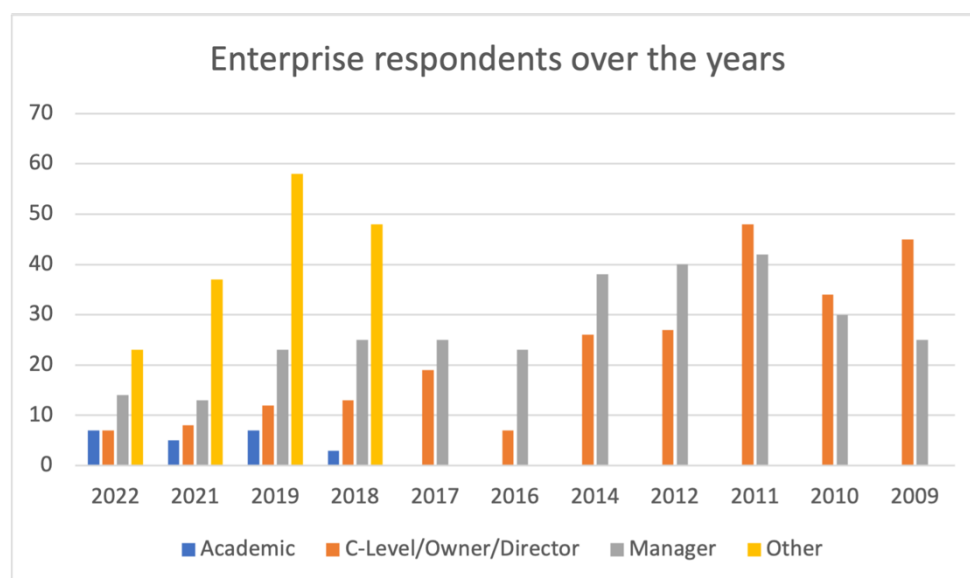
In this section of the report, we analyse and comment on the responses received from employers, usually from the executives and managers responsible for ICT creation, implementation and support functions. Corporate response levels from senior executives in 2022 are slightly lower than those experienced in the previous surveys.

PROVINCES



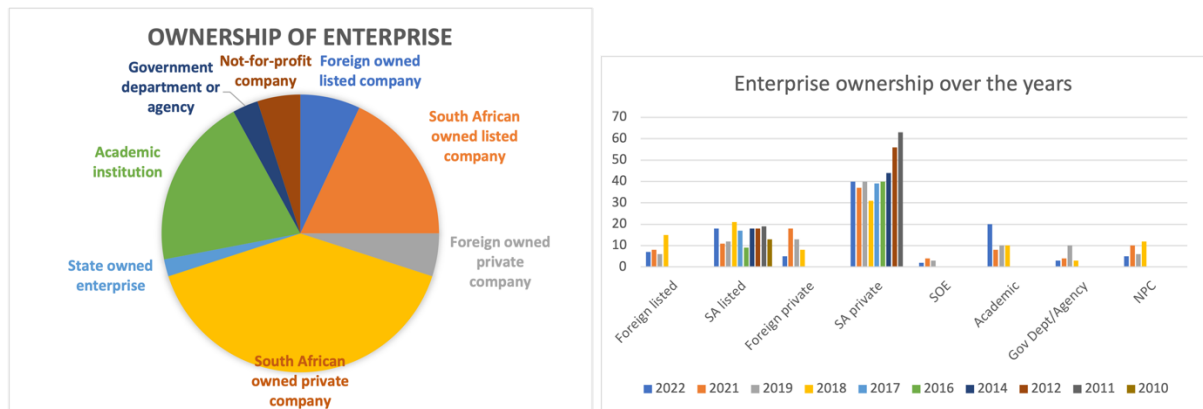
This pattern is a reasonable reflection of the geographical distribution of ICT enterprises in South Africa. Gauteng and Western Cape continue to dominate the sector. It is notable that there is a distinct trend of enterprises moving from Gauteng to the Western Cape over the last 6 years.

RESPONDENT LEVEL



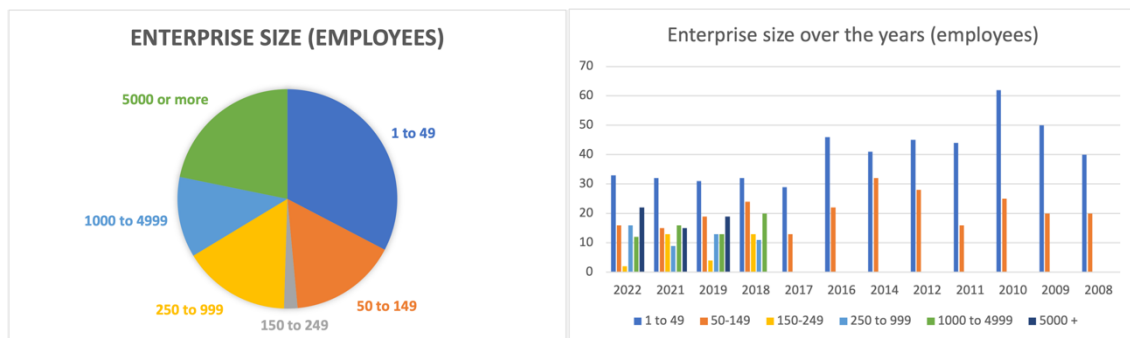
While managerial and executive level respondents have remained reasonably constant for four years (having declined from the high levels of 2009-2011), we see a decline in the number of professional level practitioners telling us about their enterprises (a statistic we began to track in 2018). There has been a small reduction in the volume of corporate responses in 2022. This is not unexpected, as many regular respondents are focused on the issues arising from the pandemic and the general state of the economy and did not wish to be distracted by the time taken to complete the survey.

TYPE OF ENTERPRISE



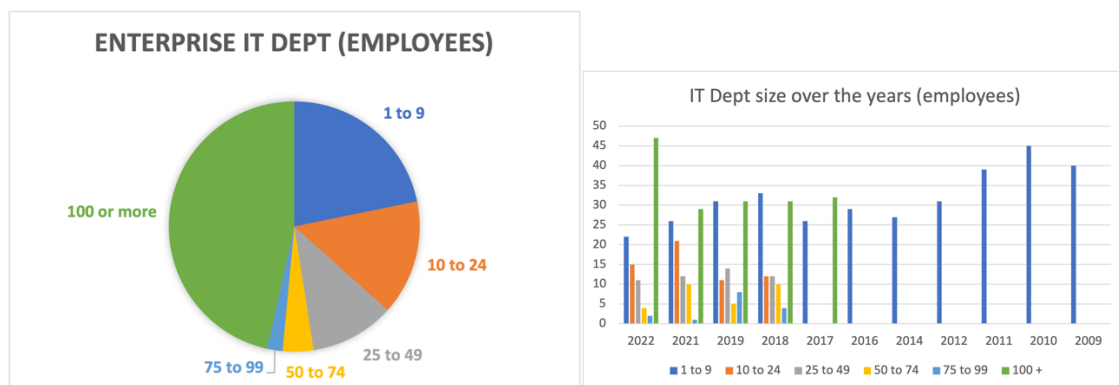
Almost 60% of enterprises responding to the survey are South African private enterprises and in 2022 the proportion of foreign-owned private enterprises responding fell from a quarter to 12%, replaced by a higher number of academic institutions. We regard this as a fluctuation in respondents and not a reflection of reduction in foreign-owned enterprises operating in South Africa.

SIZE OF ENTERPRISE



Overall, we can split our corporate enterprise respondents into three slices, for both the overall size of the enterprise and the size of the IT department, when measured by number of employees. One third are small, one third are large and one third falls into the middle.

This is not reflected in the MICT SETA statistics but that is explained by the lack of engagement by the majority of small enterprises in our survey. It is hardly surprising that most small business owners and managers have little time for completing surveys!



In line with the pattern established over the last 5 surveys, our respondent enterprise IT departments are mostly in the small or large categories, with less than 25% falling into what might be termed “medium”.

In 2022, we have attracted responses from a much greater proportion of large IT departments than usual but we see no apparent cause for this.

ANALYSIS OF CURRENT MICT SETA ANALYSIS OF THE SECTOR

The following information is extracted from the Sector Skills Plan 2023/24 First draft (MICTSETA 2022). {Authors’ note: This is an update for their 2020-2025 SSP and not a complete revision.}

As of 2022, the MICT Sector is made up of 32 985 employers, which are spread across five Sub-sectors, this represents a 7% decrease from 35 569 in the previous financial year.

From the current employer base, only 8 896 employers are paying levies, showing a slight decline from 9 093 reported the previous financial year. The MICT sector experienced an increase in the number of employees recording 228 990 in 2022. The largest proportion (54%) of employees are working in the Information and Technology sub-sector, followed by 28% working in Telecommunications, and 9% in the Electronics subsector. The sub-sector with the lowest number of employees is Advertising, accounting for 4%, with Film and Electronic Media accounting for 5%.

{Authors’ note: The Director-General of the Department of Public Service and Administration (DPSA) stated in September 2022 that 4 523 (0,3%) of public service full time employees are in ICT roles and that not all of them are qualified for their positions. We are not clear on whether the numbers include SITA and other SOEs, nor whether municipalities are included. Even so, this is a shockingly small proportion of the government workforce engaged in analysis, policy-making and implementation of service delivery to our nation. It calls into question the government’s capacity to even contemplate bringing the benefits of 4IR technologies into their operations.}

Key Skills Change Drivers

The key drivers of change influencing skills demand and supply across the MICT sector include artificial intelligence, cloud computing, big data analytics, 5G and internet of things.

Change drivers affect how businesses operate and survive into the future. Thus, new ways of doing things, including skills training, are required to exploit new opportunities in the market that emerge as a result of 4IR. Furthermore, the Covid-19 pandemic has spurred on the uptake of 4IR technologies and the relevant skills that are required to enable it. The above-mentioned change drivers call for the continued development of technologies and skills in the sector.

However, this must be balanced with also catering for lower-end skills. Ensuring inclusive digital revolution means paying attention to those still becoming digitally literate.

Occupational Shortages and Skills Gaps

The following is a list of the top 10 sectoral priority occupations for the MICT sector: Software Developer; Computer Network and Systems Engineer; ICT Systems Analyst; Management Consultant (Business Analyst); ICT Security Specialist; Multimedia Specialist; Programmer Analyst; Developer Programmer; ICT Project Manager; and ICT Sales Representative. The predominant skills gaps in the sector include: Design and Critical Thinking skills, Communication skills, Leadership skills, Technical skills, Project Management skills, and certified skills (CompTIA A+, Network+, MCSA, MCSE, Azure, CISCO, etc.). The MICT sector priority occupations list makes up

14% of the national priority skills published by DHET in February 2022, being 14 occupations out of the 101 occupations in that version of the national list. {Authors: The list was extended in August 2022 (mostly with occupations in the medical field), so the MICT proportion dropped, accordingly.}

The Career Junction Employment Insights Report (July 2022) showed that overall hiring activity was 23% higher than a year previously and indicated the demand for IT professionals ranked third, behind Finance and Sales professionals. Career Junction also carried out research to identify “future jobs” and included the following in the top 10 roles: Cloud Engineering; Data Science; DevOps Engineering; E-commerce Manager; Data Engineering; Digital Marketing; Salesforce Developers (i.e. the Salesforce CRM platform).

SUB-SECTOR ANALYSIS

Information Technology

The pandemic has given an enormous boost to digital transformation and the IT industry.

Supply chain issues, chip shortages, an upsurge in cybercrime, and the July 2021 riots, all had a major impact on South African companies and the way they work. Ratings of South Africa's IT industry compared to top global performers on network readiness to optimise the use of ICTs, the relationship between ICT infrastructure investment and economic growth and digital competitiveness show that South Africa's rankings are low compared to global economies, albeit the highest on the African continent. It is predicted that the companies in the ICT sector contribute about 8% to South Africa's GDP. South Africa's IT sector is generally robust, has access to the latest technologies and methodologies and underpins the operations of most other sectors of the economy. However, there is a significant shortage of specialised skills in the sector (Business wire, 2022).

During the Covid-19 pandemic, technology and internet connectivity have helped to maintain business continuity, keep students in education and ensure online access to essential goods and services. However, the pandemic has also exposed significant areas of digital inequality and exclusion in areas without internet access (Business wire, 2022).

Electronics

South Africa has a diverse electronics sector that ranges from electrical machinery, household appliances, and telecommunications equipment to consumer electronics. According to Statistics South Africa, the country manufactures more than R90bn worth of electro technical equipment per year. South Africa has both world-class capabilities in the industrial electronics industry as well as in consumer electronics. Overall, electronics manufacturing contributes 4% to South Africa's total manufacturing output. In dollars, the South African Electronics revenue is projected to reach US\$2.61bn in 2022, showing an annual growth rate (CAGR 2022-2025) of 22.33%, resulting in a projected market volume of US\$4.77bn by 2025 (MarketLine, 2022).

Telecommunications

The South Africa's ICT sector continues to demonstrate signs of growth, recording R243.6 billion in revenue in 2021, up from R243 billion in 2020. This represents an overall increase of 0.3% in total sector revenue, according to the 2022 State of the ICT Sector in SA report. The broadcasting services revenue increased by 2.8%, from R35 billion in 2020 to R36 billion in 2021. Postal services revenue increased by 11.1%, from R5.9 billion in 2020 to R6.6 billion in 2021. In contrast, the telecoms services, which has often dominated, experienced a slight decline, with a revenue decrease of 0.5%, from R201 billion in 2020 to R200 billion in 2021.

However, the telecoms sector still generated more revenue than the broadcasting and postal services sectors combined. The revenue for the three sectors increased by 4.3% over a period of seven years.

Key experts in the sector are of the view that data costs will be brought down, and competition will be increased due to a new bid for high frequency spectrum, which has now been concluded. Voice's contribution to overall revenue is falling, with the decline being offset by growth in mobile data income. However, data prices are also slowly falling, and the intensive-user market of wealthy and contract consumers is increasingly stable. The majority of subscriber growth is in the lower-revenue prepaid segment.

How COVID-19 has ushered in the Fourth Industrial Revolution in South Africa

The COVID-19 pandemic resulted in changes in South Africa's private sector as well, as 4IR technologies are being implemented to varying degrees depending on the firms' capabilities.

Many of those that could not deploy these technologies have either shut down or had to close temporarily. Although digitization and automation already began developing during the Third Industrial Revolution, the sector is now witnessing an increasing integration of such technologies in how people should work and live.

The pandemic brought about a number of new ways of doing things, such as working remotely, which brought about an exponential rise in video calls/phone calls as an increasing number of people are organizing meetings via apps or collaboration platforms; a rise in e-learning; online education; and e-governance, amongst others. As such, cybersecurity, and data security saw a surge as most workforces are operating remotely. Cloud services grew, boosted by higher usage of content, video conferencing, and the impact of remote access to corporate networks (Business Wire, 2021).

Employer profile

From the current employer base, the reduction in levy-payers is most likely to be the result of the constraints arising from the pandemic and the decline in economic activity. Many small businesses would no longer be sustainable under the circumstances.

Labour Market Profile

It is important to understand the dynamics around employment within the MICT sector; this section sheds light on the new developments in the labour market between 2020, 2021 and 2022. The MICT sector experienced an increase in the number of employees recording 228 990 in 2022.

Sub-sector distribution of employees

The largest proportion (54%) of employees are working in the Information and Technology sub-sector, followed by 28% working in Tele-communications, and 9% in the electronics subsector. The sub-sector with the lowest number of employees is Advertising, accounting for 4%, with Film and Electronic Media accounting for 5%.

Table 4: Sub-sector distribution of employees

Sub-Sector	Number of employees	Number of employees in %
Advertising	8 964	4%
Film and Electronic Media	10 968	5%
Electronics	19 522	9%
Information Technology	115 003	54%
Telecommunications	60 091	28%

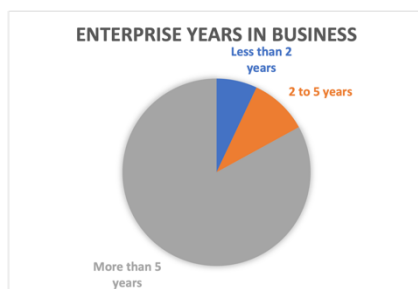
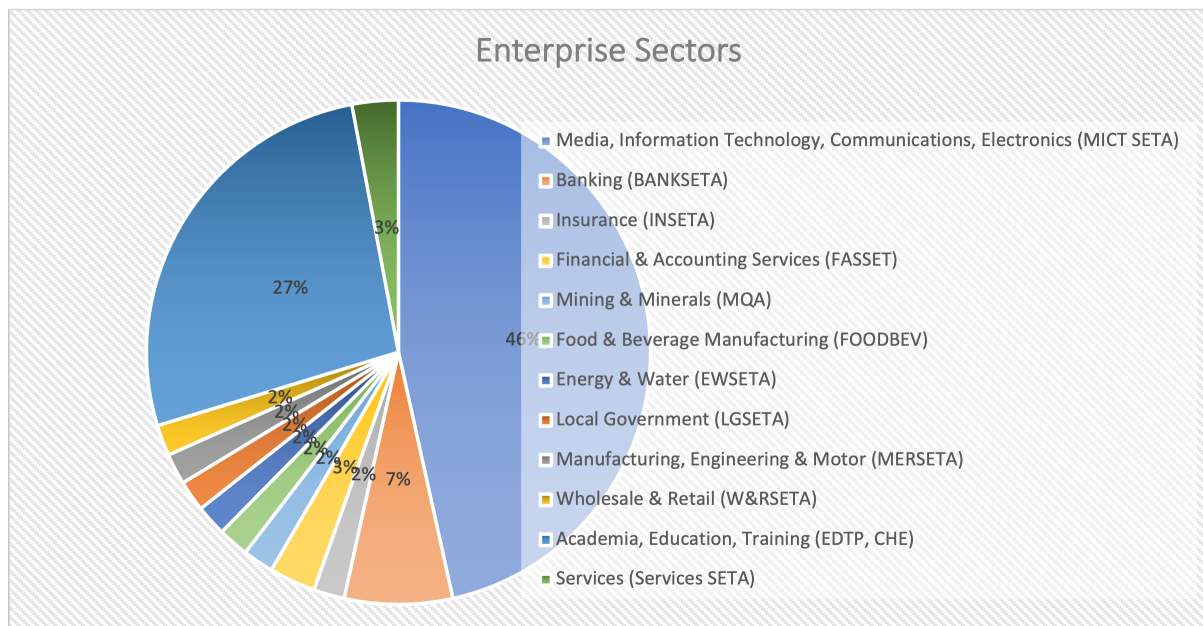
Source: MICT SETA Levy (Huge File, 2022)

Employee Geographic Distribution

The province with the largest number of employees is Gauteng (48%), followed by the Western Cape (22%) and KwaZulu-Natal (16%). These three provinces account for nearly 100 % of all employees in the sector. They are

trailed by Mpumalanga with (6%) and the Free State accounting only (1%). Provinces with least number of employees are Northern Cape, North West and Limpopo each without representation in the SETA results.

REPRESENTED SECTORS AMONG OUR ENTERPRISE RESPONDENTS



Our corporate respondents represent most of the sectors where ICTs play a significant role in their operations. Our 2022 respondents represent fewer of the sectors that have lesser involvement of ICT in the operations of their enterprises and we have seen greater interest from academic institutions this year. More than 80% of these enterprises have been in business for longer than 5 years.

SECTOR SKILLS PLAN CORRELATION 2022

Our introduction to this section of the Report remains unchanged. We believe it is important to bring together the ICT-relevant information available in all the SETA Sector Skills Plans (SSPs), based on the fact that approximately half of the country's ICT practitioners are operating in non-ICT sectors. We also believe that this is the only report that brings together the various sectors' views on the importance of ICT skills. In the following sections of this report, we extract the information available from the latest published SSPs (acknowledging that some SETAs do not make them available timeously). The focus on the Top Ten Hard-to-Fill-Vacancies (HTFVs) means that there is often no mention of ICT skills in those sectors where they do not make it to the head of the list.

MICT SETA

The following is extracted from the draft MICT SETA SSP compiled in June 2022 for the 2023-2024 period.

Skills Demand, Supply and Scarcity

The following is a list of top occupations with hard to fill vacancies in the MICT sector (and the quantity needed):

- Software Developer (1435)
- Computer Network and Systems Engineer (1070)
- ICT Systems Analyst (1036)
- ICT Security Specialist (270)
- Developer Programmer (252)
- Telecommunications Technician (220)
- Telecommunications Engineer (168)
- Electronics Engineer (156)
- Electronic Engineering Technician (100)
- ICT Sales Representative (115)

[Authors note: This is interesting from two perspectives when compared with the 2021 numbers (below). First, the significant reduction in gross numbers, which is indicative of a severe slowing of growth in the sector. Second, a shift in the occupations included, such as the disappearance of some categories: ICT Communications Assistant, Web Technician, Systems Administrator, as examples.

- Software developer (2 434)
- Computer Network Technician (1 948)
- Developer Programmer (823)
- ICT Communications Assistant (755)
- Computer Network & Systems Engineer (731)
- ICT Security Specialist (713)
- ICT Systems Analyst (676)
- Web Technician (514)
- Systems Administrator (405)
- Programmer Analyst (397)
- Management Consultant (Business Analyst) (359)
- Advertising Specialist (224)
- Telecommunications Network Engineer (164)
- Database Designer & Administrator (114)]

MICT SETA found the top programming languages in 2022 to be Python, C and C++, compared to the 2021 list of .NET, C#, C++, Java and VB. Demand for people to maintain legacy systems, such as COBOL developers, continues to decline.

The MICT SSP has listed thirteen 4IR technologies, ranked by their stakeholders as change drivers:

- Artificial Intelligence (AI)
- Cloud Computing
- Big Data
- 5G
- Internet of Things (IoT)
- Automation and Robotics
- Cybersecurity
- Blockchain
- Virtual Reality (VR)
- Drones
- Autonomous Vehicles
- 3D Printing
- Augmented Reality (AR)

Skills Implications of Change Drivers

MICT SETA goes on to comment on the “top five” of this list. They say that nearly half (46%) of South African companies are actively piloting AI within their organisations. Businesses are experimenting with a range of different technologies, including Chatbots, Robotic Process Automation and Advanced Analytics. AI technologies most useful to 67% of South Africa organisations include machine learning, smart robotics and biometrics (BusinessTech, 2019). The level of skill required by AI is advanced and needs to be financially and technically supported by the industry and government.

They comment that Cloud Computing is a key driver of digital transformation in our environment. South African organisations are consuming significant amounts of cloud services, including software as a service, platform as a service and infrastructure as a service (Gartner, 2019). The rise of cloud computing puts pressure on skills development, more so now during the Covid-19 pandemic, as more companies are becoming dependent on cloud computing services. Individuals with the skills to design and deploy such technology are in high demand and often poached not only in South Africa, but by global companies.

The demand for highly qualified big data analysts and artificial intelligence professionals is outperforming supply to the point where it can take many months to fill vacancies (IOL, 2017). This is due to big data analytics being a relatively new field, and the existing workforce is having to retrain in work with large, sophisticated datasets. Larger companies swiftly recruit new graduates, thus, making it difficult for smaller MICT companies to keep up with the changing labour market.

The fifth-generation wireless technology (“5G”) has been identified as a key driver of network transformation in South Africa. It has been associated with the need for a greater and wider adoption of emerging technologies. Companies currently struggle to attract and retain staff with scarce skills in hard-to-fill occupations (i.e. computer network and systems engineers, cybersecurity specialists, and those with cloud computing skills), and 5G will make this task even more difficult.

IoT will continue to grow as cloud computing and cloud app offerings expand in the coming years. IoT thus links to virtually all of 4IR change drivers, further expanding the impact of 4IR. There is limited recognition of emerging 4IR occupations in the OFO, thus limiting funding and formalised training opportunities in “new-age” fields such as IoT. In consultations, stakeholders expressed a need for more “IoT specialists”. However, currently no such occupation exists in the strictest sense, instead IoT specialists may emerge as specialisations of existing fields such as software development and design.

OTHER SETAs

We have reviewed each SETA's SSP to establish any references to skills relevant to the ICT job roles. Not all SETAs publish updates to their SSPs with any regularity and several fail to make the latest edition available through their web sites. This exacerbates the paucity of comprehensive and current data needed by skills development policy makers and talent managers across the board.

AGRISETA

The AgriSETA SSP, published in June 2019 for the period 2020-2025, has only one mention relevant to ICTs. The Grains and Cereal, Sugar & Tobacco chamber list the 4IR: Technology and Mechanisation as a driver.

Specifically, they highlight:

- Ability to develop and research new innovation, technologies and analysis of large data sets
- Ability to integrate and implement new technologies and innovation in workplaces and
- Increased need for computer skills for employees at all levels

It is recommended that AgriSETA focus on collecting data relating to the Fourth Industrial Revolution skills needs and allocate resources to develop the interventions required for employers to remain competitive on the international market

BANKSETA

BankSETA Sector Skills Plan 2022/2023 update largely repeats the information in the 5-year plan. We will not repeat the details here (they may be found in our 2021 Report) but will highlight some relevant skills issues.

The BankSETA SSP update includes the following table of jobs where the demand for the skills is increasing and where it is declining, sourced from the World Economic Forum:

Increasing demand for these Jobs	Declining demand for these Jobs
1. Data Analysts and Scientists	1. Data Entry Clerks
2. AI and Machine Learning Specialists	2. Administrative and Executive Secretaries
3. Big Data Specialists	3. Accounting, Bookkeeping and Payroll Clerks
4. Digital Marketing and Strategy Specialists	4. Accountants and Auditors
5. Process Automation Specialists	5. Assembly and Factory Workers
6. Business Development Professionals	6. Business Services and Administration Managers
7. Digital Transformation Specialists	7. Client Information and Customer Service Workers
8. Information Security Analysts	8. General and Operations Managers
9. Software and Applications Developers	9. Mechanics and Machinery Repairers
10. Internet of Things Specialists	10. Material-Recording and Stock-Keeping
11. Project Managers	11. Financial Analysts
12. Business Services and Administration Managers	12. Postal Service Clerks
13. Database and Network Professionals	13. Sales Rep., Wholesale and Manuf., Tech. and Sci.Products
14. Robotics Engineers	14. Relationship Managers
15. Strategic Advisors	15. Bank Tellers and Related Clerks
16. Management and Organization Analysts	16. Door-To-Door Sales, News and Street Vendors
17. FinTech Engineers	17. Electronics and Telecoms Installers and Repairers
18. Mechanics and Machinery Repairers	18. Human Resources Specialists
19. Organizational Development Specialists	19. Training and Development Specialists
20. Risk Management Specialists Clerks	20. Construction Laborers

Source: World Economic Forum, the future of jobs report (2020)

This is clearly not only relevant to the Banking sector but across the broad range of business enterprises.

The SSP uses the following table to highlight the implications for skills planning arising from the key skills change drivers:

Key Skills Change Driver	Implications for Skills Development	Demanded Occupations/Skills
COVID-19	As remote work continues into the future, there will be an increase in demand for secure applications for virtual teams, information security and digital literacy	<ul style="list-style-type: none"> • Cyber-security, • Applications developers • Time Management • Adaptability • Digital literacy
Digitisation and technology	<p>Skills</p> <p>There'll be both job/skills losses, and opportunities for upskilling and/or new jobs.</p> <p>Skills that will be in demand will be for high skills in computing technology.</p> <p>Policy:</p> <p>Policy to support the development of appropriate and accredited digital short-courses; and support for a new suitable digitalisation tertiary degree.</p> <p>To better inform policy through evidence-based research, it is recommended that the quantitative impact of digitalisation on occupations is determined, alongside qualitative multiple-criteria – such as investment in upskilling, retention of jobs etc.</p> <p>To ensure the digitalisation of the banking sector is a just transition, policy needs to recognise the inclusion of women. See Annexure 1</p>	<ul style="list-style-type: none"> • Analysts • IT systems architects • Software developers • Network specialists • Data scientists and data engineers • Robotics engineers and technicians
Changing customer expectations	Focus on the appropriate ways to deal with customer queries and challenges	<ul style="list-style-type: none"> • Relationship consultants • Sales and marketing manager
Regulatory changes, risk and cyber-crime	A greater focus on the new regulatory framework for prudential and conduct authorities, cybersecurity as a risk that all banks must address by ensuring they have the appropriate skills to manage these risks.	<ul style="list-style-type: none"> • Chief cybersecurity officers • A range of occupations in cybersecurity • Compliance officer • Skills programmes for Basel IV

In respect of IT skills, the BankSETA identifies ICT Systems Analyst and Developer Programmer as roles with the most significant skills shortages, quoting lack of relevant qualifications and relevant experience as the characteristics of potential recruits.

The SETA reinforces its previously expressed concern about the poor performance of the South African education system. The South African education system has marginally succeeded in creating a workforce with a high knowledge base, as is evident in the graduate data available as provided by the Labour Market Intelligence Project (2018). The data provide an astounding indication that for every hundred learners who enter the schooling system, only thirty-seven pass matric, and only four finally complete with a full university degree. A further examination indicates that when these individuals enter the skills supply pool, of a hundred job seekers, only four will hold a complete degree, thirty-three will hold a matric certificate and sixty-three will hold some form of schooling. Within the banking environment where technology is driving employment patterns, these statistics are of serious concern as the sector seeks to employ highly skilled individuals.

Among their planned interventions, the BankSETA will add resources to a digital literacy programme and demand-driven technology, digitalisation, cybersecurity and analytics skills development initiatives.

CATHSSETA

CATHSseta Sector Skills Plan 2020/21-2024/25 - 2022/23 Financial Year Update (CATHSseta 2022) puts 4IR at the top of its list of priorities. “To support the industry’s success and facilitate this projected growth, industry partners must work together to ensure access to suitably skilled labour. In response to this, this SSP will contribute to the following skills development priorities in the sector:

1. Fourth Industrial Revolution (4IR);
2. Training provision (skills supply, quality assurance: accreditation, assessment, certification and training providers);
3. Analysis of skills needs (research projects and qualifications review);
4. Increased partnerships to include worker-initiated interventions;
5. Sector advancement (Mentoring and coaching/TVET & CET capacity-building);
6. SMME interventions and Green Economy (Resource Efficiency);
7. Monitoring and Evaluation;
8. Addressing occupational shortages and skills gaps (Skills Demand: Learning Programmes delivery);
9. Technological advancement to combat the impact of the COVID-19 Pandemic ; and
10. Sector Transformation (partnership projects for transformation imperatives).”

The identified change drivers are as follows: the COVID-19 Pandemic, Technology and the Digital Divide, the Gig Economy and the Green Economy. The SSP expands on two of these as follows:

Technology and the Digital Divide

Technological advancements and the Fourth Industrial Revolution (4IR) have played an important role in all the CATHSSETA sub-sectors in the last decade. Technology has helped reduce costs, enhance operational efficiency, and improve services and customer experience. As an extension of these technological developments, 4IR also represents a fundamental change in the way in which people live and work. These advances in human development are merging the physical, digital, and biological worlds in ways that create huge potential for the sector. The exact impact of the 4IR is difficult to predict, given that we are still in the early stages of this revolution. However, industries across South Africa are considering the ways in which new technological developments can improve business practice, which calls for a reform in regulatory frameworks to ensure the use of technology is fair, responsible and considers the country’s broader socioeconomic objectives. In the context of skills development, South Africa has an opportunity to reshape the composition of the sector by leveraging opportunities presented by technological advancements and 4IR to develop what has previously been deemed low-end skills to match the demands of 4IR. The 4IR has forced us to re-examine and re-develop the skills development system to ensure that it is fit-for-purpose to prepare the workforce for the new world of work and the advances and adjustments that 4IR brings with it.

The internet has an impact on all CATHSSETA’s sub-sectors. A customer’s first experience with a business is via a visit to the website or social media page of the business in question. It is vital for a business to effectively utilise online advertising, social media, and online purchasing to help convenience their customers across all CATHSSETA sub-sectors. Recognition technology is already being used in some hotels to allow access to rooms via fingerprint recognition, or to allow for semi-contactless check-outs. In the Tourism and Travel and Hospitality sub-sectors, technological advances have resulted in the use of Electronic Tourist passes, Global IT booking systems, accommodation booking sites and applications, such as: Trivago, Airbnb, TripAdvisor, etc. The Tourism and Travel industry has seen the use of remote access technology for Tourist Guides to easily access information on key points of interest as well as the use of remote listening devices that Tourist Guides use to guide visitors. Artificial Intelligence (AI) systems in particular, are forecasted to have a significant impact on the Gaming and

Lotteries sub-sector. This includes the use of AI-based nudging techniques to influence punters' decision making, and profile individuals to provide personalised advertising for gambling services and products, allowing AI and swarm intelligence to track, predict and control human behaviour (Fong, 2018). This will minimise human interaction and interference, allowing experts to analyse customer behaviour and marketing insights.

The Sport, Recreation and Fitness sub-sector has also become more technologically driven, with advances in gym equipment, fitness and health mobile applications, electronic media, and even in the way sports events are covered. Wearable technology is becoming ingrained in professional sports, allowing adverse metrics to be considered and utilised within training, thus permitting real-time decisions. The use of virtual fitness instructors within the field of recreation will likely see a decrease in the use of fitness instructors and fitness facilities. In the Conservation sub-sector, curators and conservation biologists require innovative solutions for information management. As a result, there is a growing demand for cross-cutting transdisciplinary skills. This calls for tailored professional development programmes and ICT strategies as well as plans to support traditional higher education curricula. In the Arts, Culture and Heritage industry there is movement towards the increased use of digital communication in editing and post-production tasks, which will likely impact the human resources required. The impact of music and film streaming, YouTube channels and the emergence of apps, has threatened the sustainability of the music industry.

The Department of Communications and Digital Technologies published the National Digital and Future Skills Strategy in August 2020. The Strategy seeks to address the need for mechanisms to foster digital skills development across South Africa, at early childhood development, schooling and post-school education and training levels, recognising that digital skills are necessary for economic growth and social development. It sets out different levels at which digital skills should be given attention, and many mechanisms for advancing digital skills. The Strategy calls on the education sectors, inclusive of SETAs, to build a strong focus and invest in digital skills, as well as invest in the development of digital innovation skills in the sector.

There has also been an increased demand for alternative approaches to education provision in the form of e-learning. CATHSSETA needs to take the time to frame an approach on e-learning for the sector and conceptualise an e-learning policy and framework for accreditation and implementation in the sector. The SETA will need to move with speed and agility as demand increases. This is necessary both for economic sustainability and to unlock future entrepreneurs who will assist in economic stimulation (Biz Community, 2020).

With that said, South Africa's post-education system is complex, with historical inequalities. Most of the country's learners come from disadvantaged backgrounds and there is a huge digital divide to be considered.

From an economic perspective the "divide" is related to lack of affordability due to low disposable income, while geographical factors are related to lack of infrastructure support. The 2019 General Household Survey conducted by Stats SA revealed that just over 60% of households in South Africa have access to or use the internet (Stat SA, 2019). Most of those households were reported in the more developed provinces such as Gauteng and the Western Cape, where over 70% of households had access to the internet, while the more rural provinces such as Limpopo and the Eastern Cape reported numbers below 60% (Stats SA, 2019).

Gig Economy

The sector has seen a growing trend in the 'gig economy'. The gig economy is defined as a labour market characterised by freelance, flexible, on-demand work rather than the more traditional nine-to-five working model. The gig economy is made up of three main components - the independent workers paid by the gig (i.e., a task or a project) as opposed to those workers who receive a salary or hourly wage; the consumers who need a specific service, for example, a ride to their next destination, or a particular item delivered; and the companies that connect the worker to the consumer in a direct manner, including app-based technology platforms. Companies such as Uber, Airbnb, Takealot, Bookings.com or Mr Delivery act as the medium through which the worker is connected to – and ultimately paid by – the consumer. These companies make it easier for workers to

find a quick, temporary job (i.e., a gig), which can include any kind of work, from a musical performance to plumbing.

The growth of the gig workforce in the past decade is driven by the development of new technologies that enable transactions directly between providers and consumers, and the difficulty of finding traditional, stable jobs. On the one hand, app-based technology platforms are replacing people as middlemen to connect consumers and producers quickly and easily, allowing individuals to perform a variety of tasks for complete strangers based on real-time demand.

One of the characteristics of the CATHSSETA sector is that it is highly seasonal. Gig workers are especially helpful in the Hospitality and Tourism and Travel sub-sector when it comes to the staffing approach in the high and low seasons. The gig economy has already changed the sector in more ways than one. People are spending more money on travel and restaurants – cue ride-sharing services such as Uber, food-delivery services such as Mr Delivery and Uber Eats. (Texas Hotel and Lodging Association, 2017).

CATHSSETA needs to position itself to respond to the needs of the changing nature of the workforce in the sector. Skills interventions need to respond to the virtual and fluid requirements emanating from careers in the gig economy. The sector therefore needs to move beyond traditional methods of up-skilling and training employees and adopt more flexible and easily accessible modes of learning provision. Through stakeholder engagements/workshops, the SETA in collaboration with the sector, needs to set out a plan on how to increase equitable access to skills development opportunities for the modern labour market in the gig economy.

CATHSSETA includes the following table of emerging occupations, and it is notable that a high proportion require advanced ICT skills:

Sub-sector	Emerging Occupations
Arts, Culture and Heritage	Audio-Visual 3D Technicians; Application Development Practitioners; Social Media Specialists; Heritage Multimedia Specialists; Repatriation Artists; Marketing Practitioners; Digital Lighting Practitioners; On-Site Nurses; Digital Media Strategists; Information Technology Technicians; Information Technology Support; Information Technology Recruiter, Human Resources Partner, Talent Acquisition Specialist, Human Resources Business Partner
Conservation	Chief Information Officers; Brownfield Redevelopers; Ecological Rehabilitation Professionals; Social Media Specialists; Business Development Specialists; Technologists; Environmental Scientists; Bio Technicians; Wildlife Ranchers; Animal Attendants; Biodiversity Planners; Conservation Scientists; Climate Awareness Educators; Environmental Disaster Responders; Green Marketers; Fish and Game Warden, Recycling Coordinator, Compliance Manager, Green Marketer, Environmental Science and Protection Technicians
Gaming and Lotteries	Application Development Managers; Customer Relations; Data Analysts and Marketing Data Analysts; Social Media Specialists; Website Designers; Customer Relations Specialists; Industrial Psychologists; CCTV Technicians; Data Feeds Managers; Digital Artists; ICT Developers; Emergency Service and Rescue Officials; Gaming Supervisors, Fraud and Risk Analyst, Senior Data Engineer, Test Engineer, Retention Manager, Network Architect
Hospitality	Social Media Specialists; Operations Managers; Trends/Market Analysts; Health and Safety Auditors; Food Safety Assurance; Information Technology Specialists; Administrative Maintenance; Bar Managers; Food and Beverage Scientists; Online Bookings Specialists; Dieticians; Computer Network and Systems Engineers; Internet of Things Specialist
Sports, Recreation and Fitness	Risk Managers; Payroll Managers; Sports Psychologists; Sports Agents; Event and Project Management; Sports Lawyers; Media Coordinators; Fitness Management; Exercise Physiology, Disease Control Specialists; Sports Copywriter and Social Media Manager
Tourism and Travel	Business Development Managers, Guest Relations Officers; Communication Strategists; Legal Tourism Consultants; Marketing Practitioners; Travel Accommodation Inspectors; Travel Agency Managers; Business Analysts; Software Developers; Applications Developers; Online Travel Agent, Influencer Marketer, Smart Technology Developer, Sustainability Consultant

Source: CATHSSETA Stakeholders consultations, 2019 - 2020

CETA

The CETA SSP, published in August 2020 for 2021/22-2025/26 includes the following paragraphs under the heading of technology and innovation, bearing in mind it was compiled in the early months of the coronavirus lockdown period.

For the better part of five months, communication, globally, has relied almost exclusively on technology (Zoom, Facebook, Skype, et cetera). Whilst not all CETA work lends itself to remote performance, there are large swathes of the mandate that can be performed more effectively with less travelling and social contact. There are several computer-based project management applications that allow for regular reporting, monitoring, quality management and oversight. A large chunk of the CETA's work is essentially project delivery. As a strategic response to the current crisis and in an endeavour to enhance efficiency and save costs, the CETA might want to explore the viability of increased deployment of technology in its workings and operations. Outside of the CETA, the sector is increasingly going digital and these innovations need to be invested in and supported and skills would inevitably be required to bring these innovations into practise.

Examples of such change and innovation consist of the emerging technologies such as the fourth industrial revolution, 3D printing of prefabricated walls, artificial intelligence, machine learning and advanced data analytics. These technological drivers are expected to shape the future skills demand in the construction sector, but not in the immediate term, where South African building techniques are expected to remain traditional, with the dominance of bricks and mortar and steel frame methodologies. However, foresight and early investment in the future is critical. After all, the process of producing skills is not instantaneous, instead it calls for advanced planning.

CHIETA

The latest available CHIETA SSP is the update published in 2021 for 2022-2023.

The section on technological development and innovation reads as follows:

The scope for digital disruption within the Chemicals Industry is broad. Also, the rate of digital innovation will likely accelerate due to Industry 4.0. The Chemicals Industry is committed to driving process improvements indicating a plan to invest 5% of their annual revenue (or approximately half their average operating profits) in digital advancements within their operations over the period 2016 and 2021 (Barnes & White, 2020).

As businesses navigate this uncharted territory, it's the digital transformation that proved to be the critical lifeline. Digitalization will continue to be fast-tracked across every aspect of the Chemicals Industry as one of five key trends that will shape 2021 (KPMG, 2021). One of the focal points of this efficiency-seeking digitalisation is the reduction of waste, specifically heat, which is a significant input cost to most chemical plants. Modelling of the many data points in real-time can develop and maintain the most optimal energy plan and identify other potential applications for the surplus heat being generated in the conversion process.

Few examples exist of chemical companies changing the entire paradigm of operation through digitalisation. However, companies such as Siemens are supporting the Chemicals Industry on this front by fast-tracking the digitalisation of the industry. New skill sets are needed by the Chemicals Industry to respond to the challenges and capture the opportunities embedded within the transition to Industry 4.0. A move away from lower-skilled workers is clear given the increasing complexity of the digitized Chemicals Industry. To gain the full benefit of these and other technological developments, companies will need to invest in people and their capabilities or people with the relevant skills. Thus far, the Chemicals Industry has struggled to upskill the existing workforce partly due to financial limitations (PWC, 2020), but upskilling is essential to drive future growth.

Data suggests (GPCA, 2020) that the digitalisation of the Chemicals Industry has proven to be challenging and it is not clear whether the industry is ready to embrace this revolution. It is against this backdrop that CHIETA commissioned a study to assess the state of readiness among chemical manufacturing companies to operate in

industry 4.0. The study draws attention to the diversity of subsectors, their knowledge of industry 4.0, their level of preparedness, and their skills requirements (Quest Research Services, 2020).

In December 2020, CHIETA conducted a research study on existing knowledge of the market conditions regarding nanotechnology across all relevant chemical industries in South Africa. The research findings revealed that nanotechnology in South Africa is still mainly in the research phase as it has not advanced far into the manufacturing and commercialisation aspect. However, there is room for growth for the Chemicals Industry in nanotechnology as it has the potential to help in vast areas and industries. The study also provided insightful recommendations that nanotechnology can improve South Africa's economic performance. However, to create the best outcomes of the patents and research outputs produced in this field in South Africa, the country needs to find sustainable commercialisation strategies.

EDTP SETA

The latest available EDTP SETA SSP is the update published in 2021 for 2022-2023.

The SSP reinforces the impact of the 4IR on their processes. "The COVID-19 pandemic and consequent lockdown of society has forced the EDTP SETA to become a driving force in the Fourth Industrial Revolution (4IR). This new reality requires a re-examination of how we do things and a re-engineering of our programmes to prepare the workforce for the new world of work, especially in the Post-school Education and Training (PSET) system."

The inclusion of the table that analyses the number of school learners over the 5-years from 2016-2020 provides a sobering context to our unemployment statistics. On average, there are 12,5 million learners in public schools and over 600 000 in private schools. More than 1,2 million young people are leaving the school system each year, the majority of whom will not be qualified to take up reasonable employment, as they lack the skills demanded of the 21st century workforce.

"To respond to the demands of the Fourth Industrial Revolution, the DBE plans to increase the supply of educators in science and technology. Over the medium-term period, the DBE plans to continue facilitating an increase in newly qualified teachers in mathematics, science and technology in various phases. This is expected to be achieved by providing 37 500 Funza Lushaka bursaries to prospective teachers over the medium term. The number of bursary awards is expected to be maintained at 12 500 per year over the MTEF period (DBE, 2020)."

"The double impact of COVID-19 and the 4IR shows that programme offering in the PSET system is struggling to keep up with these changes. There is a need to make qualifications development and employment relations more flexible and responsive to socio-economic needs and transformation (Rasool, 2020). Skills will be more attractive than credentials (degrees) and, as such, will instil a new culture of engaging in lifelong learning and acquiring skills faster to retain jobs. This challenges the NQF to be agile and flexible; and the quality assurance models and accreditation models will have to change.

The SETA continues to monitor the implications of the 4IR and COVID-19 in the ETD by continuing to research these areas. These research projects will significantly assist the SETA in determining which of the existing occupations will be affected by both phenomenon and how they will be affected. Furthermore, the investigation intends to show the nature of change in the ETD occupational outlook regarding demand and supply levels of occupations in high demand. It also means that the SETA needs to review and change its approach for workplace monitoring for programmes such as work-integrated learning (WIL) and workplace approval.

Therefore, the DBE is piloting a coding and robotics curriculum in 1 200 schools across the country before introducing it to all public schools. Approximately 200 schools will be piloting the draft curriculum from grades R to 3, and approximately 1 000 schools will be piloting the Grade 7 curriculum during 2021. The programme will begin incrementally with grades R, 3 and 7 being introduced in 2021, grades 4, 6 and 8 in 2022 and Grade 9 in 2023. The department has already completed the pilot programme in KwaZulu-Natal and will now move to other provinces (DBE, 2021).

EWSETA

Energy and Water Sector Education and Training Authority Sector Skills Plan 2022/23 (EWSETA 2021) recognises technological advancement as a key change driver. It now includes Software Developer in its top ten hard-to-fill-vacancies. It also includes Advanced IT and software in its skills gaps, again referencing software developers and also ICT security specialists.

FASSET


These are the extracts from the FASSET Sector Skills Plan 2022/23 Update (FASSET 2021):

In the 2022/23 Update, the persistent challenges experienced in the sector are underscored by the impact of the COVID-19 pandemic and the advent of the Fourth Industrial Revolution (4IR). The sector is plagued by persistently low numbers of learners obtaining the NSC with Mathematics and Accounting at the school level, which is a major impediment to supply in the sector. Output from the TVET colleges is still relatively small and pass rates remain low. Following the pandemic, matters such as remote learning and online training highlight the lack of infrastructural resources, such as access to the internet and technological devices, for many in the country. Training providers at present are not adequately skilled and equipped to manage and implement learning. The delayed readiness of SA PSET institutions in this new era will significantly impact the supply of skills and occupations in the sector and economy.

The onset of the pandemic created an immediate shift to remote and online work for most of the South African labour force in March 2020. This shift meant that companies and workers, including those in the Financial and Accounting sector, would be-come reliant on technological tools and platforms for business continuity, such as Zoom, Microsoft Teams, Skype and ClickUp, for example.

Cloud-based, task-driven work platforms used across industries during the pandemic to assign tasks to employees and manage projects remotely are expected to remain in the work environment long after the effects of the pandemic have passed and will require newer or up-dated skill sets in the sector. For the FAS sector, strategic 4IR technologies such as cloud computing, automation, digitalisation, blockchain and cryptocurrency will become relevant in the next three to five years. New entrants will be inducted with the necessary competencies to work alongside these technologies, while existing workers may require upskilling and re-skilling in line with changing trends.

FASSET notes the following key skills issues and implications for skills planning:

KEY SKILLS ISSUES AND IMPLICATIONS FOR SKILLS PLANNING	
Strategic (4IR) technologies 	<ul style="list-style-type: none">• FAS workforce must be prepared with the skills, tools and competencies to work alongside technological advances• Accounting, finance and auditing occupations should adapt to technologies to enable changing roles in organisations• Professionals with coding and programming skills will have value• Adoption of data mining and business engineering solutions by companies will impact the type of skills and occupations demanded in the next 5–10 years• Workers will have to re-skill and upskill to coexist with these technologies that could either enhance or interfere with their current work processes• New technologies will directly impact decision making and problem-solving in the workplace, at all occupational levels• New entrants to be equipped with the requisite skills and tools at induction• Many young people are “internet-savvy” but poor access to the internet and other technology remains a challenge and impacts work and learning for these individuals

{Authors: The FASSET list of ICT professionals occupational shortages in the FAS sector (2020) is remarkable for the significant reduction in total numbers from 6 487 in the previous report to only 485.}

Rank	FASSET Occupation Group	OFO Code	Occupation	Needed	Reasons
3	ICT Professionals	251201	Software Developer	105	Shortage of Black African software developers; candidates require specific financial service industry knowledge; lack of coding and automation experience
		251202	Programmer Analyst	64	Global SAP skills shortage; highly specialised skill that is not widely available in SA
		252101	Database Designer and Administrator	55	Technological advances in the FAS sector require data analytics as a skill among candidates; lack of EE candidates; lack of informatics skills as a foundation; lack of consulting experience
		252801	ICT Security Specialist	47	Shortage of project management skills with investment experience; highly complex and specialised skill; very few EE candidates—scarcity of skill in SA; complex and specialised training and experience required
		251101	ICT Systems Analyst	45	Lack of Black African candidates; very new technology with fewer than 300 certified consultants in SA; high salary expectations; candidates lack financial services experience
		133103	Data Management Manager	36	Digitisation skills required; a limited number of people with this certification and skill, specifically in a management role; lack of data privacy specialists in the market
		251401	Applications Programmer	27	Shortages of developers across various technologies in the market; inability to compete with international companies for talent/candidates
		243403	ICT Sales Representative	24	Requires specialised skillset and extensive working experience; shortage of EE candidates
		133104	Application Development Manager	22	Limited number of qualified and experienced emerging technology specialists (globally, locally); a new field of work (4IR); lack of candidates who hold a degree—most candidates hold certificates; STEM background needed
		262202	Information Services Manager	14	Small and niche professional industry in South Africa
		251203	Developer Programmer	13	Remuneration expectations; lack of advanced skills and competency in advanced mathematics; lack of EE candidates
		251102	Data Scientist	12	Lack of appropriate qualifications and work experience; lack of new entrants; sought-after skill in the market currently
		133101	Chief Information Officer	7	Position requires a unique skill set; candidates require both qualification and certification
		252301	Computer Network and Systems Engineer	7	Lack of experience; the Azure, AWS and SAP certifications are in demand and there are a limited number of certified people in SA; there is a transformation skills gap
Total Needed				483	

{The three occupations that were previously indicating more than 2 000 needed personnel each and are now no longer included are Computer Consultant, Programmer Analyst and Database Designer & Administrator. We have no indication of the reason for the appearance and disappearance of these categories over the course of the two SSPs.}

FOODBEV

The 2021/2022 Sector Skills Plan Food & Beverage Manufacturing (FoodBev SETA 2020) looks at technological advancements as a key change driver.

Technological advancement is having a profound effect on the Food and Beverages Manufacturing sector and has been reinforced by stakeholders during interviews. The COVID29 pandemic is emerging as a powerful driver for digital transformation in the FoodBev industry (FoodBev SETA COVID-19 Survey Report, 2020; SSP FGIs, 2020; SSP Survey 2020).

New technology may create job losses in the short term but enables creation of a greater number of jobs in the long term. Increased productivity via technology enablement has resulted in reduction of weekly working hours resulting in increased time for leisure activities. New technologies promote innovation in the food industry (Siegrist, 2008). While the food and beverages industry has been slow in capitalising on the benefits that can be realised from utilisation of technology (World Economic Forum, 2018), COVID-19 has accelerated digital transformation which may have a long-lasting impact post the pandemic (WEF, 2020). This is affirmed with the COVID-19 survey, which identified the pandemic as a powerful driver for digital transformation in the food and beverages industry (FoodBev SETA COVID-19 Survey Report, 2020). The COVID-19 survey and interviews demonstrated that the restrictions imposed by the COVID-19 pandemic forced many companies that were previously dependent on face-to-face contact with learners to rapidly shift to mixed methods approach to skills training (FoodBev SETA COVID-19 Report, 2020).

Various technologies affect and influence the food and beverages industry resulting in optimised sales and marketing, logistics, maintenance, and quality. RFID used with mobile phones, could enable easy access to information about the authenticity, freshness, ripeness, shelf life and nutritional content of food (World Economic Forum, 2018). Advanced analytics and Nutrigenetics can be used to enable consumers to get nutrition-related recommendations personalised to individual digestive ability, diet, health needs and taste preferences (World Economic Forum, 2018).

As the industry adjusts to the new and uncertain environment caused by the COVID-19 pandemic the key to overcoming current and future challenges while leveraging the opportunities lies in rapid adoption of food technologies and digitisation (WEF, 2020). COVID-19 is transforming skill delivery mechanisms, with digital and online training at the forefront. A workforce that has advanced technical knowledge, an understanding of digital supply chains, relationship management and digital skills will be crucial. Technological advancement also calls for increased investment in post-graduate research and learning to ensure that the industry remains at the forefront of technology.

According to the World Economic Forum (2018), the following combinations of 4IR technologies can enable address of some of the challenges and create more effective production systems in the food and beverages industry: Digital building blocks, i.e. new computing technologies, big data and advanced analytics, the Internet of Things (IoT), artificial intelligence, machine learning, Blockchain, and virtual and augmented reality. Advances in science, i.e. next generation biotechnologies and genomics; energy creation, capture, storage and transmission. Reforming the physical, i.e. autonomous and near autonomous vehicles, advanced smart robotics, additive manufacturing and multidimensional printing, advanced materials and nanotechnologies. Big data and data analytics can play an informative role for policy decisions and the facilitation of cost-accounting that can create a significant impact on consumer consumption (World Economic Forum, 2018). Connectivity technologies, i.e. social networks, peer-to-peer networks and online e-commerce could enable tracking of consumption patterns and increase access to nutritional food alternatives (World Economic Forum, 2018).

This section shines light on the skills that are likely to be in greater demand (future skills). Based on the interviews, surveys and qualitative analysis of global literature, a range of the various skill sets required for the food processing industry are identified. The world of work is undergoing dramatic changes (World Bank, 2019) due to factors such as scientific and technological advances, automation, globalisation, new ICTs and the drive for continuous improvement (Akyazi et al, 2020). While the abovementioned factors are bringing radical shifts to how people live and work, the global COVID-19 pandemic has accelerated the adoption of fully digitized approaches to re-create the best of in-person learning through live video and social sharing (Agrawal et al, 2020; WEF, 2020). As the world transitions to these new ways of working, questions arise about the skills companies will require to improve their performance and competitiveness. The skills and competencies needed within the food industry will rise across virtually all occupations (Akyazi et al, 2020). Smart technologies such as robotics, Artificial Intelligence (AI), Internet of Things (IoT) and machine learning are going to re-engineer business models (Akyazi et al, 2020). A majority of respondents who were interviewed indicated that many employees will continue to work remotely, and employees will have to learn new technologies and develop skills to use emerging technological tools in their work effectively (SSP FGIs, 2020). The skills identified by stakeholders were effective communication, leadership, technological, cognitive, technical, numeracy and literacy (SSP FGIs, 2020). The demand for social and emotional skills, especially advanced communication and negotiation, leadership and strategic management, team management and adaptability will also increase rapidly at senior level. Higher cognitive skills such as creativity, critical thinking, teamwork, problem, decision making, and life-long learning will be crucial as workers will become responsible for more complex tasks (Agrawal et al, 2020; Akyazi et al, 2020; Bughin et al, 2018). Finally, food safety and hygiene are some of the key skills expected to be recognized for many years post-pandemic, particularly at the lower occupation level. Having identified the various and potential future skills set, the FoodBev SETA needs to ask what steps need to be taken now to achieve a smooth transition into the future that benefits all of society. The new world of work will require innovative ways of mapping, developing and bridging skills across the workforce. Reskilling and upskilling efforts will be important in addressing future skills needs in the Food and Beverages Manufacturing sector post the global COVID-19 pandemic.

FP&M SETA

As with many other sectors, the Fibre Processing and Manufacturing SETA acknowledges the impact of technologies as drivers of change in its 2018-2022 SSP (FP&M SETA, 2018). The following is extracted from that document (and is unchanged from our 2019 report):

Drivers of change

Rapidly advancing technology and innovation has had profound impact on certain FP&M sub-sectors. There are new technologies being developed in textiles, clothing and new natural fibres are being explored. Existing technology used throughout the sector in manufacturing companies in packaging, printing and print media, paper and pulp, textiles, clothing are now designed to operate faster and more efficiently. Training on new machinery and maintenance is often sourced internationally. Increased mechanisation may reduce the demand for labour.

At the same time, technological changes are the biggest drivers of demand for skills, as workers have to continuously upgrade their skills to keep up. Electronic media usage has expanded and is expected to change the face of the printing and publishing sub-sectors. Social media provides an additional source of valuable consumer data. Both national (IPAP and NDP) and sector-based industrial strategies are driving technological advancement and innovation through customised sector programmes and other initiatives.

Factors Impacting on Skills Demand and Supply: Technological Advancement and Innovation

Innovation results in change and change almost invariably has a structural component. Regardless of their size, companies in the manufacturing industry face many of the same challenges – increased competition within their sector, evolving managerial and technical skills and workplace cultures, and a greater need to become more responsive to fast changing markets. To overcome these challenges, manufacturing companies must find effective solutions that allow them to proactively manage changes in their competitive landscape while keeping Research and Development (R&D) costs at a minimum. Productivity technology and public-sector policy on R&D investments have been, and will continue to be, major determinants of comparative advantage and competitive position.

Technological developments do not have a uniform effect on the demand for labour. On the one hand, the mechanisation and computerisation of processes may reduce the demand for labour. While, at the same time, technological changes are the biggest drivers of demand for skills in the sub-sector and all levels of workers have to continuously upgrade their skills if they are to keep up with technological changes. The use of electronic media is increasing at a rapid rate and is expected to change the face of the printing and publishing sub-sectors locally and internationally. Paper products used for communication purposes, such as newspapers, are under threat from digital technologies and have dropped substantially over the past few years. Existing technology in large manufacturing companies in packaging, printing and print media, paper and pulp, textiles, clothing, for example, are designed to operate faster and more efficiently. Through the development of automation, robotics, and advanced manufacturing, the global manufacturing sector has bounced back along with the overall economy.”

In spite of the foregoing commentary, only one ICT occupation is included in the hard to fill vacancies in the FP&M sector:

2015-216603 Multimedia Designer (90 required).

Skills Gaps in the Sector

Skills gaps refer to areas within an occupation where a worker is not fully competent to perform a particular task. These can include cognitive skills, such as problem solving, language and literacy skills. These “top-up” skills can be specific to a particular occupation resulting in skills gaps, which might arise because of phenomena such as improved technologies or new forms of work organisation.

All FP&M SETA sub-sectors report investments in new technology and training new staff to use such technology is therefore a key critical skills driver for the sector. Similarly, managers are required to lead the sub-sector in new business directions, to achieve the required industrial restructuring. Managers are therefore also an important focus for critical skills development.

Many sub-sectors are competing in a global arena currently, and improved labour productivity is becoming an increasing priority. This, too, is a major critical skills driver. Included in the prevalent skills gaps that exist across all the major groups in the FP&M sector are:

- Clerical Support Workers Information Technology expertise
- Service and Sales Workers Information Technology expertise

One of the biggest challenges with regards to skills gaps is the increased utilisation of latest technologies in the sector. Often new machinery requires technicians to be retrained in countries like Germany or Sweden where such machines are produced. That means technology related expertise is a major skills gap. Moreover, where local expertise exists for servicing or repair of machinery, often this is limited to major cities and towns, leaving the small towns where industry is located not having qualified technicians capable of working on the new machines.

There are people in the sector who are losing jobs due to the introduction of new technologies. That also creates a requirement for retraining staff to use the new technology and retooling others to be redeployed elsewhere.

HWSETA

HWSETA Sector Skills Plan 2022-2023 (HWSETA, 2022) included the following comments on technological change:

New technologies have a profound effect on the sector. In some instances, it allows for the automation of processes, which leads to a reduction in employment. Simultaneously, technological developments also have a constant effect on treatment methodologies and interventions. Studies have shown that the 4IR requires changes in the skills requirements for certain occupations in the health sector. This creates opportunities for inclusion of technology modules in certain undergraduate curricula and the up-skilling of the current workforce through tailored skills development training courses.

This inclusion, according to the ERRP Skills strategy, will be a way of addressing the ‘curriculum shortcomings’ by the SETAs such as targeting digital literacy. The COVID-19 pandemic has specifically drawn the attention to technological advancement in the laboratory services industry relating to big data and telepathology (NHLS 2020).

The HWSETA specifically refers to skills gaps in the Social Development and Health sector as including computer skills in order to utilise and maintain computerised information systems. However, there is no specific reference to the roles required to fill this gap.

INSETA

In similar fashion to its “sister” sectors in banking and finance, the insurance SETA’s 2020-2025 SSP discusses the influence of technology in some depth, as follows:

Technology is disrupting the insurance sector. This disruption is referred to as the 4th Industrial revolution and involves the increasing use of artificial intelligence, robotics, big data, digitisation, digital marketing, blockchain, predictive analytics and machine learning. There are desirable career opportunities for graduates who can work in these technology areas in the insurance sector.

The Top 10 occupations on the Sectoral Priority Occupations List are insurance agent; insurance broker; actuary; **data analyst**; insurance loss adjustor; financial investment advisor; fraud examiner; **developer programmer**; **ICT security specialist**; and organisational risk manager.

There was a 31% growth of technicians in the insurance sector. Technicians are broadly representative of IT professionals in the sector. As the sector adopts digital platforms, social media marketing channels, AI and informatics, there is a demand for IT professionals such as software developers, systems analysts, cloud specialists, IT technicians, database administrators and network professionals.

The INSETA recognition of ICT change drivers is encapsulated in these tables:

2.2 KEY CHANGE DRIVERS

The following have been identified as key change drivers in the sector:

CHANGE DRIVERS	IMPLICATIONS FOR SKILLS DEVELOPMENT
TECHNOLOGY	
<ul style="list-style-type: none"> Technology is disrupting insurance companies. This disruption is referred to as the 4th industrial revolution (4.0) and involves the application of artificial intelligence, robotics, big data, digitisation, digital marketing, blockchain, predictive analytics and machine learning. Clients want seamless, quick and transparent interactions, and this requires a new kind of marketer (salesperson) that it is tech-savvy. 4.0 presents opportunities for first-time entrants into the insurance sector to acquire in-demand skills and pursue non-traditional career paths. Companies need to offer faster and cheaper products; create online tools to "sweat" their distribution channels; develop digital portals, customer self-service and automation of back-end processes. Online social networking has emerged as an active component of social interaction. Financial institutions are looking to gain a competitive advantage while also trying to mitigate the threats posed by social media. Many companies are now using social media to revolutionise the traditional business models. Financial technology companies (FINTECHs) are start-ups trying to disintermediate incumbent economic systems and challenge traditional corporations. The FinTech market is booming and captured over US\$12 billion investments since 2015. New start-ups are popping up at an increasing pace, and large banks and insurance companies are being pushed toward increasing digital operations to survive. 	<ul style="list-style-type: none"> There are attractive career opportunities for graduates who can work in technology areas such as cyber-security, blockchain, AI, predictive analysis, social media, digital marketing, open-source and machine learning. The critical success factors for insurance companies are developing workforce skills that can: <ul style="list-style-type: none"> use "big data" to manage client relationships, design new insurance products, and reach new markets. find the right "young" talent. give clients a superior relationship experience. create innovative products. digitise business operations. attend to cyber-security risks.

CHANGE DRIVERS	IMPLICATIONS FOR SKILLS DEVELOPMENT
FUTURE WORK	
<ul style="list-style-type: none"> Insurers find it challenging to hire specialist IT experts, data scientists and actuarial talent. Robotic process automation and artificial intelligence that can automate manual tasks are rapidly infiltrating the sector, remaking or eliminating jobs that are labour intensive. The time and attention of actuaries, underwriters, claims adjusters and other key players will likely be freed up for higher-level tasks. Employees should ultimately be spending more time on ideation and decision making—and far less on computation and distillation. Insurers are also putting plans in place to respond to broader, fundamental employment shifts as more professionals join the open talent economy—a blend of full- and part-time workers, short-term contractors, and freelancers. 	<ul style="list-style-type: none"> Insurers will likely be challenged to retrain and repurpose workers impacted by tech upgrades to make more productive use of their time and talent. Most insurers are analysing jobs, determining which capabilities should be automated, and establishing what new skill sets may be required to maximise the value employees can bring in the wake of automation. This requires the development of new qualifications in the sector.

INSETA lists the following ICT roles as hard-to-fill: Data Analyst/Data Scientist, Developer Programmer/ICT Programmer/Applications Developer, ICT Security Specialist/ICT Security Architect/Database Security Expert. The comment that the ability to identify trends and develop innovative solutions from the analysis of big data will become a vital competitive advantage. Mastery of IT knowledge domains is a necessity for companies to stay competitive, particularly in the face of fintech companies.

LGSETA

The Local Government SETA's update to the SSP published in January 2020 for the period 2020/21-2024/25 repeats the commentary on Technological Changes and Digitisation:

Technology is a ubiquitous driver of change in almost every facet of the economy. In local government, the adoption of new technologies has varied across municipalities. The bigger metros have introduced new technologies in the delivery of municipal services in areas such as water and electricity metering. Apart from customer interfaces, the role of technology in modern municipal infrastructure is likely to gain importance as aging equipment gets upgraded and replaced. Another aspect to consider with regard to technology is the Fourth Industrial Revolution (4IR). The 4IR alters the way communities live and work through a fusion of technologies, blurring the lines between the physical, digital and biological spheres. Key areas of the 4IR include, but are not limited to, virtual reality, robotics, big data analytics and cloud computing. The 4IR will result in new roles being

assigned, which will require new, higher-level skills and knowledge. People will therefore need to be upskilled to fill any gaps created by the 4IR. Key occupations identified as critical for the 4IR with regard to the Local Government Sector include, data analysts, cyber security specialists, drone engineers, virtual meeting specialists and software programmers.

Further comments have been added, related to the effects of COVID-19. The pressures that individuals, organisations, and societies face continuing daily operations amidst COVID-19 have further accelerated the uptake of the 4IR. The pandemic has increased reliance on advanced technologies for digital learning, working remotely, keeping healthy, and transforming economies. This has enhanced the need to focus on training about digital and 4IR related skills such as computer skills, internet, and data analysis.

The COVID-19 pandemic has called for swift uptake of 4IR technologies to increase productivity and service delivery, particularly in remote working age. Occupational shortages or scarce skills were identified through the analysis of WSP data. Occupational shortages identified include Electricians, Civil Engineers, Finance Manager, Water Plant operators, and ICT Project Manager. Skills gaps or top-up skills were defined for each of the eight major Organising Framework of Occupations (OFO) groups. End-User Computing skills are the skills gaps most prevalent across occupations. Those OFO groups with the greatest number of reported skills gaps are clerical support workers, service and sales workers, managers, and professionals. As a result of the COVID-19 pandemic, health and safety-related occupations and skills and 4IR related occupations and skills such as cybersecurity technicians and data analysts may also be in higher demand. Change management and the adoption of remote working practices will also need to be fast-tracked.

MERSETA

The SETA for Manufacturing, Engineering and Related Services published its 2021/2022 SSP update in August 2020. The SSP has a more muted comment on the impact of the 4IR than previously:

In the Fourth Industrial Revolution (4IR), steel and metals manufacturers have an opportunity to transform their operational model by implementing digital technology, to improve operational efficiency, customer service, inventory levels and profit margins (World Economic Forum, 2019).

Economic pressures and emerging technologies have placed pressure on organisations and workers in terms of skills, requiring updated curricula and an increase in worker flexibility. From a skills development perspective the implications are that the propagation of the 4IR could undermine inclusive growth due to negative growth, high unemployment and scarcity of relevant high-tech skills. Lower-skilled workers will become more vulnerable, requiring re-skilling or up-skilling to stay relevant.

Therefore, in order for the government to create jobs, the integration of new technologies such as artificial intelligence should be introduced, while preparing the existing workforce for the type of work which will be required in an automated economy (Mabasa, 2019).

From a skills development perspective the sector will have to keep pace with rapid advances in technologies such as AI, robotics and big data. In addition, new technologies require significant research and development which can be costly as this will require the skilling and re-skilling of the country's labour force, as well as investigating new manufacturing potential to ensure a smooth transition. South Africa also continues to face stiff competition from low wage, high-productivity countries in vehicle production. Supportive policies and regulations, incentives and boosting investor confidence will remain key in ensuring that South Africa remains an attractive investment for the automotive sector.

The SSP went on to list emerging occupations and skills challenges, including these ICT-related roles:

- Software and applications developers and analysts (Analytical thinking and innovation)
- Data analysts and scientists (Complex problem-solving)

- Data analysts and scientists (Big data analytics, block chain development, AI, software)
- Robotic engineers
- Software engineers and coders
- Block chain, cyber security, AI specialists, forensic investigators, app developers

MQA (MINING QUALIFICATIONS AUTHORITY)

The mining and minerals sector (MMS) published its SSP in August 2019 for the period 2020-2025. They, too, bring the 4IR into their commentary on the changing technological landscape.

The fourth industrial revolution is described as a world where individuals move between digital domains and offline reality with the use of connected technology to enable and manage their lives (Miller, 2015). It integrates cyber-physical systems and the “Internet of Things”, big data and cloud computing, robotics, artificial intelligence-based systems and additive manufacturing (MCSA, 2019). This digital revolution does not only impact the mining sector, but its effects are evident across all sectors globally and nationally.

In the MMS, key informants reported that South Africa’s mining industry are slower adopters of technology compared to other countries such as Australia and Canada. South Africa lags behind in terms of the fourth industrial revolution as mines are said to be less digitised than those in many other regions as a higher proportion of its operations are underground, and thus, technology ramp-up will be more challenging to be undertaken.

According to the Deloitte 2018 Tracking the Trends Global Mining Study, the mining industry’s success will be determined by the border of analytics and artificial intelligence (AI) which will be used to leverage data generated to sharpen planning and decision-making across the mining value chain. This will also be accompanied by the digitalisation of mining supply chains and, driving sustainable shared social outcomes where mining organisations will become interdependent of other sectors and judged based on their relationships with their employees, investors, regulators as well as their impact on society at large.

Furthermore, the implementation of sophisticated technologies is transforming the sector’s operations in terms of the type, level and mix of skills required, thus starting to transform occupations such as rock drill operator, blaster, drill rig operator as well as most of the artisan trades. Upskilling and reskilling programmes are needed so that employees are trained in new mining processes that will extend the lifespans of mines and to also ensure the smooth transition to embracing the fourth industrial revolution and to meet new digital demands (Moodley, 2019). As mining becomes more automated, physical strength and stamina will become less important than fine motor skills, dexterity and problem solving – all of which are more easily acquired by new entrants to the workforce will generate opportunities to attract more females and therefore, redress gender inequalities in the sector.

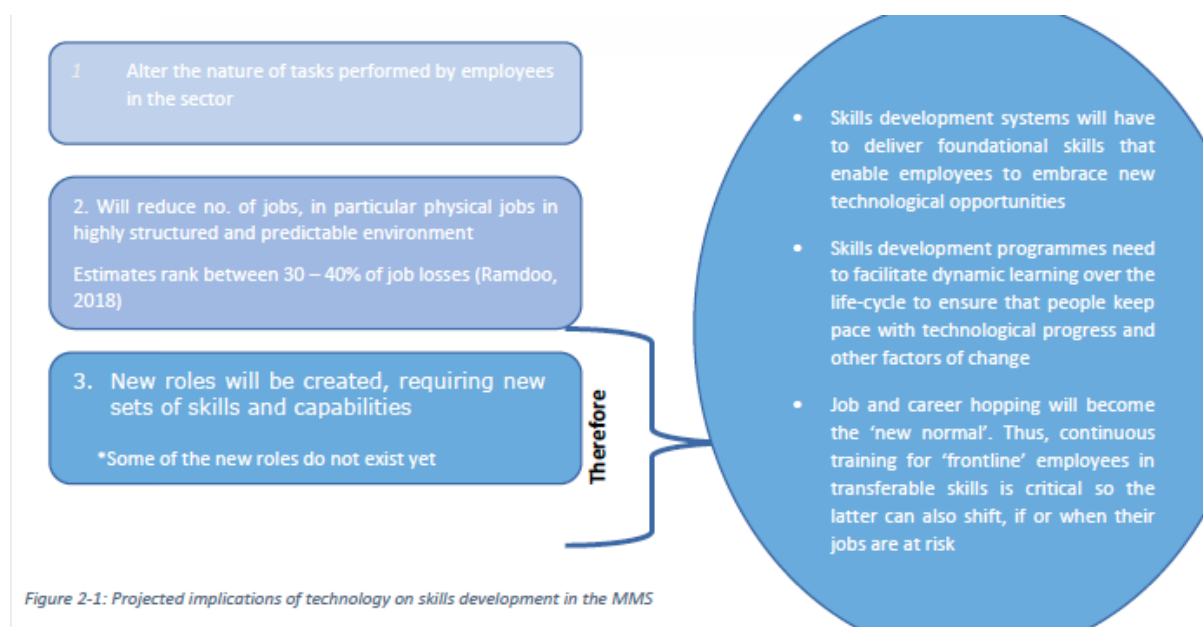
Key informants also emphasised the need to place focus on integrating technology in AET (adult education and training) programmes up to level 4. This is more particularly imperative for uneducated employees as a way of improving literacy, technological and numeracy levels to prepare them to operate new machinery and coordinate new processes that emerge with the introduction of the fourth industrial revolution. At a supply level, the integration of technology can be incorporated in the curriculum of Higher Education and Training (HET) institutions as a delivery mechanism, as a complement to instruction, and as an instructional tool for training novice employees in the sector.

The diagram on the next page indicates how automation and new technologies will impact skills demand and supply in the MMS:

The workforce coming into the industry currently (Millennials) are all digital natives. In their personal lives they require rapid measures to function menial tasks and want to spend more time focusing on experiences. This doesn't translate into the workspace in mining presently. Key informants asserted that the sector has not fully

embraced the fourth industrial revolution-especially those in deep level mining. There is a significant gap between companies that have fully embraced technology compared to those who are running conventional operations. As a result, some millennials find it challenging to be attracted to the sector. Those that do get absorbed in the sector find it challenging to adapt to conventional modes of operations. As a result, the sector loses talent to other industries that can accommodate their needs. The MMS also needs to rebrand its image to increase its attraction among the millennial talents. This could be done by embracing the fourth industrial revolution notwithstanding the cost implications for digitally revolutionising production. Mining companies must consider not only the shifting nature of work, but also how to attract a new variety of workers and tailor their workplaces accordingly. This will also lead to the retention of those that are already absorbed.

On the other hand, as the typical workplace progresses towards keeping up with sprouting technological trends, there are expectations for older employees to adjust to these developments. Skills development programmes will need to educate existing workforce about the new world of work, through innovative training; re-training/ re-skilling important for smooth transition for new types of tasks. Moreover, considering that many older employees are employed in managerial positions, there will be a need for the old to mentor the young in managerial skills as they will be the next wave if management once the old employees retire. This will ensure that the sector retains skills and has enough skills for future generations.



PSETA

The Public Service Seta published its SSP update in July 2019 for 2020-2021. It brings the 4IR into the discussion.

The emergence of the Fourth Industrial Revolution (4IR) has a profound effect on the Public Service Sector and has been identified in this SSP as a key change driver which is impacting on skills demand and supply in the sector.

Information and Communications Technology (ICT) advances impact on the nature of work profoundly by shaping the types of skills required, and the modes of service delivery in the Public Service. The 4IR has enhanced digitalisation, big data, artificial intelligence, online platforms, and the Internet of Things which are some of the major drivers of skills change in the Public Service. The 4IR provides the opportunity for greater government efficiency and effectiveness in providing services to its citizens. The digitisation of the Public Service Sector through e-government forms part of the move towards improved ICT systems within the sector.

South Africa's e-government strategy provides the policy framework for incorporating ICT as a key enabler in modernising government services and improving accessibility and convenience. Examples of e-government services in the Public Service include e-filing, e-health, e-education, e-commerce, and eNatis (an online vehicle and transport management system implemented by the Department of Transport). Other examples include the recent launch by the DPSA of e-recruitment, with the aim of introducing a paperless administration across the Public Service.

It is expected that robotics, in combination with the Internet of Things, could lead to more effective, leaner and cost-efficient governments in the not-so-distant future. The NDP recognises the access to and application of ICT as key enablers in fighting poverty in the country.

While the sector has progressively moved toward implementing ICT across its systems and processes and the government's e-strategy has progressed in its implementation, evidence still points to a lack of adequate skills to develop e-government services and solutions. A PSETA study conducted by the HSRC in 2018 found that most government departments do not currently have the human and physical resources to optimise the role of ICT in the Public Service Sector.

The 4IR and Technology

- The increasing emergence of ICT in the Public Service Sector is coupled with the need for new tools, systems, platforms and the related skills required to operate them. The introduction of new technologies may require the Public Service to expand its personnel complement (especially in terms of technical support roles) and enhance training and education of current staff, with a need for ongoing re-skilling and/or up-skilling.
- ICT requires employees to be skilled in technology-related skills, big data analytics, related fields and other forms of information relevant to the 4IR. There is thus a need for constant skilling and re-skilling and the development of appropriate human resources to integrate emerging ICTs in the Public Service. ICT appears to be one critical area in which the Public Service Sector needs skilled personnel, yet the overall shortage of technicians nationally means that government departments struggle to compete with the private sector for these skills. A lack of skills in this area could hamper the government roll-out of priority projects that need ICT skills.
- In the Public Service space, technology in the form of e-learning has been identified as a crucial mechanism for delivering skills development in a cost-effective and efficient manner. This delivery mechanism allows for skills development to evolve, especially in terms of being more accessible and available to employed people within the sector.

PSETA specifically mentions ICT Systems Analysts, IS Auditors and ICT Security Specialists among its skills shortages.

SASSETA

SASSETA Sector Skills Plan 2021/2022 Updates (SASSETA 2020)

The Safety and Security SSP states that shortages of skills and lack of urgency in implementing measures to tackle cybercrime are still a challenge in South Africa. "Technological advancements and data protection laws are driving the need for specialist IT technicians and IT professionals, as well as the operational IT skills needed by all attorneys. The Criminal Justice Revamp plan will also drive particular IT skills needs as well as skills required by operational personnel who will be required to make use of new IT processes. Within the private security sector special skills will be driven by the environment where IT is playing an increasing central role in the provision of effective security services.

The fourth industrial revolution represents a new era of innovation in technology that is envisaged to enhance human machine relationships, unlock new market opportunities, and fuel growth across the global and our

national economy. This implies the current skills at the disposal of the economy should be scrutinised because employability of the candidates with the current skill set could be compromised in the foreseeable future due to the advent of the 4IR. The largest continent in the world today is no longer a physical geographical location but a virtual one stop cyberspace that has redefined how our people, business and the global economy operate. However, emergence of the digital economy has also resulted in the proliferation of cyber-crime. South Africans have become a target of cyber-crime because these criminals not only are aware that our law enforcement agencies are not equipped to detect and fight cyber-crime, but they also know that citizens are very lax when it comes to securing their devices and have an “it will never happen to me” attitude. The following statistics about cyber-crime in South Africa and global are worth noting: 70% of South Africans had fallen victim to cyber-crime and other risky behaviour, compared to 50% globally; 47% of users of smart phones in South Africa were victims of mobile cyber-crime in the past 12 months, compared to 38% globally. If cyber-crime was a nation, it would have been 27th biggest in terms of GDP. Cyber-crime costs the global economy 445 billion U.S. dollars annually. In South Africa cyber-crime has an economic impact equal to 0.14% of the national GDP which translates into about 5.8 billion Rand annually.

To keep up with evolving cyber threats, the safety and security sector needs to develop the technological and professional capacity to address cyber-crime. Law enforcement agencies, prosecutors and public sector cyber professionals must receive training on current and anticipated cyber-crime trends and techniques. A massive input of soft and technical intelligence training skills [a form of upskilling and reskilling] is required to efficiently and effectively fight and detect this complex and sophisticated crime

The restructuring and revamping of the criminal justice system requires a focus on enhancing and complementing the framework to establish a single integrated seamless and modern cross criminal justice system while addressing the critical issues of public trust and confidence.

The skills gap in specialist areas such as ballistics, cyber-crime detection skills, forensic skills, and crime scene investigations must be addressed on an ongoing basis. A good skills base in these areas is pivotal for the successful investigation and prosecution of serious crimes. Equally of fundamental importance is the need to establish an integrated system containing all information relating to the justice system and to upgrade key components of the ICT infrastructure at national and regional offices as well as service points and courts. The lack of interface of electronic information systems between the Department of Justice, correctional services, police, health, and social development is impacting negatively on court-based justice services.

The prolonged duration of ICT systems integration problems affect the role players in the justice, criminal prevention and security cluster, who also required capacity to manage technical project teams and large scale technology infrastructure. Rapid changes in technology impact on the sector in terms of effective service delivery and its demand that skills need to be upgraded to ensure the effective and efficient usage of technology in the sector.

Rapid changes and advances in technology are driving a shift from manual to automated forms of security which include off site monitoring and remote access control. In the face of high crime levels, large corporations demand access to the latest security technology and are willing to make substantial investments to prolong the longevity of the systems they install. Improved access control systems such as biometric access or card identification need to be supported by advanced camera surveillance that can clearly identify people and objects under all conditions. These also need to be linked to company human resource databases and other systems. Shortages of skills and lack of urgency in implementing measures to tackle cyber-crime are still a challenge in South Africa. A large percentage of the incidents are not being reported to law enforcement agencies and a very small percentage reaches the courts where successful prosecutions take place and information is made available to the public domain. Technological advancements and data protection laws are driving the need for specialist legal practitioners, IT technicians and professionals, as well as the operational skills needed by all attorneys to ensure they continue to meet their professional obligations to clients.

Among the hard-to-fill vacancies listed by SASSETA are the following ICT roles:

- Computer operator
- Quality systems manager
- Computer network technician
- ICT Systems Analyst
- Technical ICT support services manager
- Web designer
- Developer programmer
- ICT security specialist
- Computer network and systems engineer

SERVICES SETA

The Services SETA SSP Update for 2020-2021, issued in August 2019, also emphasises technological change as a significant driver. They introduce the topic in this way:

Rapid changes in technology due to high paced and disruptive innovation remains the biggest driver of change for the services sector economy. Industries mostly affected by technological change include marketing, real estate, postal services, contact centres and funeral services. Implications are that the labour force needs to be constantly acquiring the requisite skills, while the education and training institutions ensure the relevance of qualifications on offer. Efforts are underway at the Services SETA to develop qualifications that address skills demand driven by technological change, especially management of big data.

The SSP goes into more depth, with ICT as a change driver in the various sub-sectors:

Information and Communications Technology

Research on the impact of technology in terms of how current products and services are developed as well as how people interface with an industry is well-documented and the services sector is no exception. OECD (2016, p. 35) suggests that by 2030 “firms will be predominately digitalised, enabling product design, manufacturing and delivery processes to be highly integrated and efficient”; adding that digital technology will “make the services sector a more dynamic part of the economy.” Research (Cedefop, 2016; OECD, 2016; Pew Research Centre, 2014) suggests that while technology is replacing routine tasks within most jobs through higher levels of automation, it is making jobs more challenging. This, in turn, requires employees to acquire and/or develop skills to cope in more technology-centred work environments.

In response to this, the Services SETA commissioned a research study on future jobs and skills which was completed on 31 March 2019. The findings thereof identified technology as one of the major change drivers to influence the future job market, with many reports now focusing on its impact and the Fourth Industrial Revolution.

It is important to state that the influence of the drivers of change varies across Services SETA sub-sectors. For the real estate industry, technology has had an impact on the design, form and nature of interaction between sellers and buyers of property on the one hand, and/or between rental agent and lessor, on the other, as more people turn to various websites and applications (Apps, as they are commonly known) to access, compare and utilise information. This has necessitated real estate and property management agents to use technology to provide high quality and useful information to increase traffic to their websites and Apps, in order to facilitate sales. The implications of this trend is that real estate agents and property managers not only require information about the product that they are selling, but now need to have knowledge about brand management, digital sales, marketing and social media.

A major consequence of technology for business services is that companies, now more than ever before, have access to more data about their customers. This 'big data' requires that managers and professionals acquire higher levels of analytical skills to use data strategically. The introduction of disruptive technologies and solutions has had a significant impact on the traditional business models, resulting in businesses having to adapt to remain economically viable.

For the labour and collective services, the internet presents new means for recruiters to communicate to personnel through videos that advertise jobs. On the other hand, jobseekers are also relying less on traditional resumes to advertise their skills as social networks provide platforms for online profiles and portfolios for recruiters to consider. This has resulted in the emergence of new ways of organising work.

Marketing services enterprises in South Africa need to operate within the ambit of the Consumer Protection Act of 2011, which places stringent requirements to protect consumer information during marketing activities. Firms focused on improving their services will increasingly need to adopt social media and multi-channel solutions for customer service, and for getting closer to consumers (Buchner, 2013). Research participants highlighted that a major trend was the shift to digital marketing due to increased use of social media, and their integration into traditional marketing activities.

The participants further highlighted that this is also evident for public relations where print media is under threat and there is a growing trend of accessing news online as opposed to traditional ways of buying newspapers and magazines. As such, some printing companies are closing down as demand for their services declines. Firms in the marketing services sector recognise that smart phones are a game changer. These devices bring the firm closer to consumers and open new marketing opportunities. This means firms need to adapt to new ways of working to remain relevant.

General consulting services benefit from advancements in technology in two ways, namely, increased flexibility for work to continue outside of the traditional working hours and work outputs which are increasingly computer-generated. Skills in the use of information technology (IT), including social media for desktop and online research, will be increasingly needed to ensure that firms become competitive.

Changing consumer preferences have brought about a demand for e-services in postal services around the world. The addition of information, communication and technology (ICT) infrastructure into post offices in rural areas is a major step forward in bridging the divide between urban and rural areas. It is anticipated that postal services will benefit from being able to connect users to broadband services and thereby encourage adoption of digitised mail for the revival of postal services. Auxiliary services such as parcel delivery and logistics may also be launched off a wider broadband infrastructure which will enable technology to connect people to goods as well as reinvigorate postal services by shifting revenue generation to logistics and parcel delivery. Skills needs in this sector include IT and logistics.

Despite technological advancements that allow automation software to simplify the process of accessing a large database at predictable intervals, there is growing discontent with contact centres among millennial audiences who have a greater interest in multi-channel communications with businesses as opposed to voice-to-voice communication (Rouse, 2014). This has implications for direct marketing. While voice-to-voice communications will remain a feature of sound practice, the status of voice will be supplanted by the unique advantage of digital communication and its growing weight on the buying choices of consumers in a fast-changing globe (Holmes, et al., 2013).

In the contact centre environment, as far as technological trends are concerned, the emergence of speech analytics and call-categorisation is creating greater efficiency and control over quality of work. Research participants also highlighted that the contact centre industry was seeing higher levels of automation of certain tasks, and with customers becoming more technologically savvy, there was a growing trend in the reduction of the number of contact centre call agents.

The cleaning sector is likely to be impacted by technology as well. The findings revealed that cleaning machines are required to perform a variety of tasks such as cleaning and are able to operate faster and cheaper than humans. It can be argued how far machines will replace human beings. It is therefore expected that some tasks will be fully automated and certain tasks or activities will be partly automated. As a result, new occupations will be introduced and the anticipated skills for the subsector will/could include robot maintenance and repair. Table 11 summarises the impact of technology on various service sub-sectors.

Table 11. Impact of Technology on Services Sub-sectors

<i>Subsector Affected</i>	<i>Nature of Impact</i>	<i>Occupations Affected</i>
Business Services	Ability to access and use big data	Quality Managers, Consultants/ Business Advisors
Cleaning Services	Robotics are likely to take over cleaning chores	Cleaners
Contact Centre	Automation of certain tasks	Contact centre call agents
Labour Recruitment	New means for recruiters to communicate to personnel	Recruitment Managers
Marketing Services	Use of digital channels	Sales Marketing Managers, Publishers, Editors
Postal Services	Increased access to broadband services resulting in digitised mail	Delivery drivers, postmen, Mail-sorters
Real Estate	Changing nature of interaction between sellers and buyers	Estate Agents, Property Managers, Valuers

The Services SETA has devised a number of initiatives to respond appropriately to challenges posed by before the end of 2019. Key role players will be invited to share inputs on the best way to respond to this need. In addition, the Cleaning and Hiring, and Communication and Marketing Services Chambers have initiated research studies that look at the impact of technology on these sectors in more detail, proposing actionable recommendations. These research studies were expected to begin by the last quarter of 2019/20 and be completed by the second quarter of 2020/21.

HTFVs in the sub-sectors include:

- Data Analyst
- Information Security Officer
- Software Developer, Engineer
- IT Developer
- IT Specialist

TETA

The Transport Education Training Authority Sector Skill Plan 2022/23 (TETA 2021) has the following commentary on the Fourth industrial revolution and technologies:

Artificial intelligence (AI), blockchain, 3D printing, virtual reality, computational technologies, biotechnology, innovative materials, energy capture and the internet of things (IoT) would significantly shape the future outlook of the transport industry in South Africa (TETA, 2021). The nature of disruptive technologies is such that they can disturb the system in favour of emerging technology. The disruptive technology replaces existing technology with a newer, better, efficient, workable and high-performance system (Ebrahim, 2019). It signals the readiness of a society to move into a different future based on advanced principle propelled by innovation. In South Africa,

AI and the internet of things are interconnected, working together to shape the future outlook of the transport sector. The IoT refers to the connectivity of multiple devices through the internet.

Motorised vehicles are now equipped with technologies that use internet connectivity when updating algorithms based on drivers defined data. The IoT devices require a large amount of data collection and processes. The collected data is then shared between vehicles, operational centre, clients to provide information about traffic incidents, road closures, alternate routes, etc.

The future outlook of the transport industry will greatly be influenced by understanding how IoT operates. The use of these technologies will transform the transport industry and contribute to economic growth in South Africa. We noted that the various sub-sectors are already using the IoT.

Application of these technologies already has been applied in the transportation industry. TETA (2021) study on the skills responses implication for transport industry chambers in the context of 4IR found that while some industries have applied 4IR technology relatively quickly, other industries such as the transportation and logistics sector have adopted technology and innovation at a much slower rate. Specifically, sub-sectors like aerospace, road passenger, clearing and forward have adapted technology and innovation as a mechanism for driving competitiveness, even during the COVID-19. In contrast, other industry operators (i.e. logistics and taxi) are slower in making the necessary shift. At the same time, the use of autonomous vehicles is becoming a global trend and is likely to reach South Africa with an improved level of internet connectivity.

Investment in technology and innovation will be key to the future output of the sector. Adopting technologies would ensure the optimisation of transport operations as high-quality data and analytics become readily available for transport planning and operations. A notable challenge is that the technology disruption is happening against South Africa developmental context, evident by the rising cost of production, relatively low productivity levels, lack of high skills labour and uncertainty about government policy (Campbell 2017). This view was supported by the transport industry stakeholders who participated in the virtual SSP workshops conducted by TETA in May 2021.

4th Industrial Revolution and technological innovations

Technology and innovation shape the nature and direction of skills development needed for today's Transport sector. Most of the changes within the sector in the last decade were driven by technological innovations. While most role players in the sector have responded in a way favourable to business growth and development, technological advancements have also brought about competition that has led to a shrinkage of other businesses due to an inability to adopt new technology. Technology and innovation for the sector have meant that operators are now able to gain real-time information about goods and/or people in transit, and customers can enjoy the flexibility, convenience, security, time efficiency, and reduction in the price of services. At the same time, technological innovation has created a critical shortage of skilled workers within the sector. It has transformed the nature and direction of jobs with available jobs now requiring both basic and advanced technological skills, automation and artificial intelligence. The supply of tech-savvy staff is not matching the required demand for this level of skill needed in modern transport operations. As such, this challenge has given rise to the concern about the fairness of the transition to new technology. In many reported cases, there is a recognition of conflict between new technological opportunities and the loss of jobs for low skilled workers. An analysis of the effect of the transition on skills development and planning is necessary.

W & R SETA

The Wholesale & Retail SETA published its 2020-2025 SSP in August 2020. Its comments include the following:

Technology advancements and increased access to information: Technological advancements are significantly changing the Wholesale and Retail Sector. These advancements include mobile applications, online shopping, big data, social media, cyber-crime, mobile phones and internet usage.

The following are new and emerging top-up skills:

- Digital marketing skills
- Digital customer communication skills
- Problem solving skills
- Financial literacy skills
- Data analytics skills
- Ethics & discipline, and
- Information Communication Technology (ICT) skills such as Software Developers, Business Analysts and Computer network and Systems Engineers.

Technology Advancements and Access to Information

The wholesale and retail industries are rapidly changing due to technological advancements. These advancements offer wholesalers and retailers opportunity to increase their efficiency and revise their business models.

However, these advancements have also given consumers more power in relation to retailers. This power is often through constant connectivity, communication and access to information. Furthermore, consumers are more inclined to support businesses who operate ethically with a sustainable ecological footprint. With the rise in access to information consumers can easily seek out retailers who demonstrate these characteristics.

Implications of technology for Skills Planning in the sector include the following:

- **Mobile Applications:** Smartphones, tablets and wearable devices present retailers with new opportunities for engagement with customers. Retailers can build personal relationships with customers based on their preferences, shopping styles, and mobile interaction.
- **Online Shopping:** Online shopping is growing rapidly in popularity. Companies are increasingly marketing online in order not to be outdone by rivals.
- **Big Data:** Large, complex datasets from multiple sources. Provides information on consumer behaviour and is a strong predictive sales indicator. **Social Media:** A platform for retailers to expand marketing to a wider range of consumers. Major platforms are Facebook, twitter, LinkedIn and others. Conversely, social media offers Consumers an opportunity to gather information about retailers. This includes negative publicity (e.g. retailers being accused of unethical conduct, poorly thought out marketing campaigns, etc.).
- **Cyber Crime:** Retailers are a target for cybercriminals. Retailers experience nearly three times as many cyber-attacks as those in the finance sector with 77% of organisations being affected.
- **Mobile phones and Internet Usage:** Africa's claim to be the "mobile continent" is even stronger than previously thought, with researchers predicting internet use on mobile phones will increase 20-fold in the next five years. This will double the rate of growth in the rest of the world. Retailers are taking advantage of that by increasing the online shopping and marketing.
- **Ethical issues:** Apart from saving, consumers also consider ethical issues when buying i.e. Buying from sweatshops; workshop or factory where manual workers are employed at very low wages for long hours and under poor condition is considered a vote for worker's exploitation which most consumers are against.
- **Eco Friendliness:** Consumers are now concerned with the natural environment; they prefer buying products that are with minimal detrimental impact on the natural Environment.
- **Greening sustainability:** Businesses are becoming more conscious of protecting the environment. Increased legislation and consumer pressure are driving the demand for eco-compliance. Businesses must show that they are environmentally friendly in their business processes and in the products and services they offer.

Other uncategorised implications include the following:

- The future of work is changing as technology is rapidly advancing towards latest trends such as automation and artificial intelligence, which will change the traditional roles leading to some jobs becoming obsolete.
- Employers and employees will require skills in the ICT and data analytics space.
- Re-capacitation and reskilling of workers is critical to ensure their readiness to embrace the new technological changes.
- Retailers may have an increased need for environmental managers, social corporate managers, public relations managers and HR Managers. Furthermore, it is increasingly important that companies have the skills to make the correct decision quickly (both in terms of business sustainability and ethically).
- Should the business make a decision that is unpopular (as was the recent case when a major retailer was accused of appropriating someone's product idea as their own) it is imperative that they have the required public relations skills to mitigate the negative impact this incident may pose.

The Skills Gap Needs that were identified include ICT, analytics, graphic design, photography, programming, cloud computing, web development, data mining, statistics, research, forecasting, marketing and sales, management, networking, mobile device management, cyber security and ICT law. Re-capacitation and reskilling of workers is critical to ensure their readiness to embrace the new technological changes.

The occupational needs include Software Developer/ Web Designer/ Web Administrator/ ICT Security Specialist/ Graphic Designer/ Analyst/ Researcher/ Marketing and Sales Manager Digital skills/Cognitive based work/ Programming/ machine device management/ Customer Service optimization.

SECTOR CONSOLIDATION

The lack of consistency in the approach and timing of the various Sector Skills Plans makes it very difficult to extract an holistic view of the demand for ICT skills nationwide. At the very best, the data is based on reports from levy-paying enterprises, leaving a large number of unreported needs from the mass of SMMEs found in many of these sectors.

What is apparent from the Sector Skills Plans is the general recognition that the advance of digitalisation and the concomitant amassing of data resources is placing enormous pressure across the board for the skills necessary to implement and maintain the new technologies that are driving these changes.

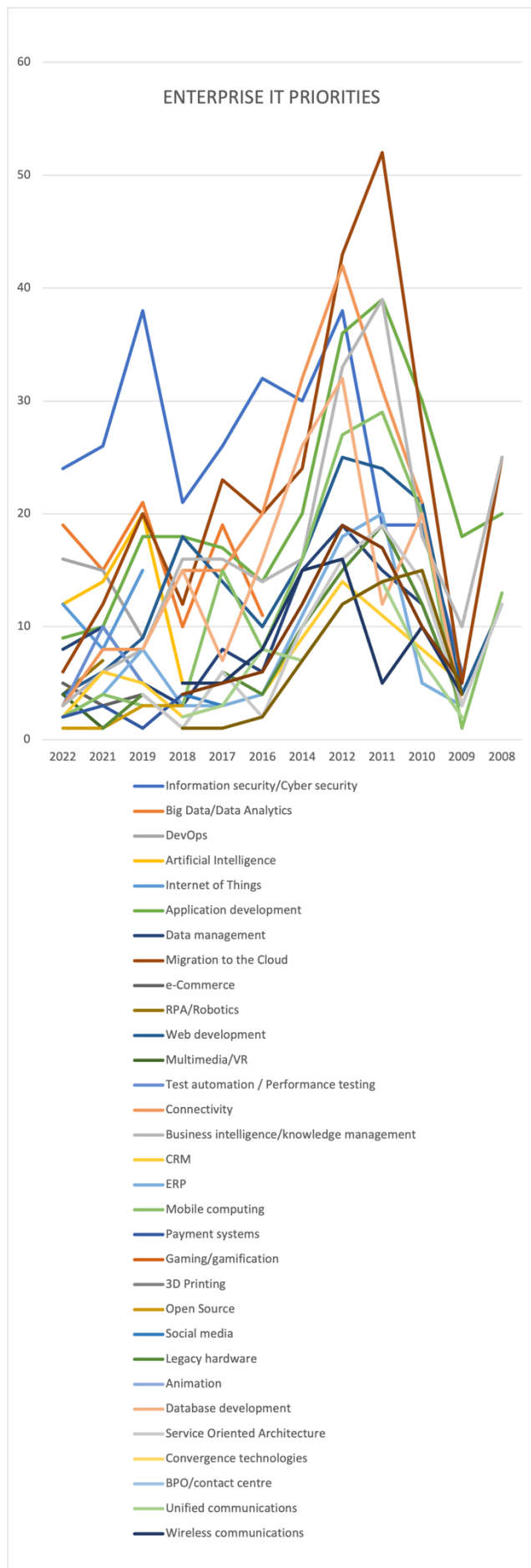
At a more foundational level, several of the SETAs have highlighted the problems in the education pipeline, where South Africa is (so far) tackling the critical need for vast improvement in curricula for STEM subjects and in learning methodologies in only fits and starts.

ICT PRIORITIES SINCE 2008

The 2008 Survey identified the top 6 priorities overall, based on the selection of their own top 3 by each respondent. That analysis showed **Business Intelligence/ Knowledge Management** to be the top-ranked priority, followed by **Application Development** and **Software as a Service**. These were supported by Service Oriented Architecture, Web Development and Mobile Computing.

In 2009, the data was revised to include all identified priorities, and the chart showed that **Application Development** was that year's top priority, with **Business Intelligence/ Knowledge Management** being pushed into third place by the entry of **Network Infrastructure** in second place. CRM, Information Security and the Operating System were the supporting cast, although there was little difference between many of these "other" priorities.

We thought that the emphasis on Network Infrastructure in 2009 reflected the realisation that effective broadband access is essential if enterprises are to benefit from the technology innovations becoming available. The **2010** survey was revised to indicate what each respondent thought was their 1st, 2nd and 3rd priority for the



coming year. **Application Development** retained its top spot for the second year, with **Web Development, Software as a Service** and **Business Intelligence/ Knowledge Management** just surfacing above several other contenders for the next most significant issues. We observed that the spread of interest among the second and third tiers of “priorities” indicated the wide range of challenges facing enterprise decision-makers who need to keep their information systems capable of delivering services that support the changing business needs. We also commented that if we compare the changes over the three year period, we could see a significant drop in the importance of **Business Intelligence/ Knowledge Management** and a significant increase in the interest in **Web Development**. We felt the lowered interest in **Software as a Service** (SaaS) in 2009 seemed to have been an anomaly and this opinion was confirmed by the 2011/12 and 2014 results.

In **2011**, we showed the Priority Progression picture over the four years of the Survey. We could see that **Software as a Service** was definitely high on the agenda, albeit as a second priority, while **Application Development** was still the firm favourite as first priority. Managers continued to face a wide range of challenges in applying technology to support business needs and it is notable that **Mobile Computing** emerged from the “also ran” ranks in 2011. The popularity of tablet computers and “smart” phones was cementing the demand for the adaptation and implementation of systems that offer safe, secure and reliable facilities for mobile workers.

The **2012 results** follow a similar pattern to that established in 2011, with **Software as a Service/Cloud Computing** now leading the field. **Network Infrastructure** and **Information Security** move into second and third place respectively, pushing **Application Development** into fourth slot. However, the differences between these rankings are not great and we can add **Business Intelligence/Knowledge Management** and **Database Development** to complete the Big Six of priority issues in the year ahead.

In **2014**, the Big Six became the Big Five. The ranking of the top five priority areas remained

unchanged from the previous survey – in descending order, they are **Software as a Service/Cloud Computing, Network Infrastructure, Information Security, Application Development** and **Business Intelligence/Knowledge Management** (which now includes Big Data/Analytics). It was almost impossible to separate the next five areas of priority attention – they were: Database Development, Mobile Computing, Web Development, Data Storage and Operating System.

In **2016**, we were able to again identify six leading priorities. **Information Security** had become the clear leader, followed by **Network Infrastructure, Software as a Service/Cloud Computing, Database Development** and **Application Development**. Because of its growing profile, we separated **Big Data/Internet of Things** from the **BI/KM** category, and it now appears in seventh place. Had we left it combined with sixth place **Business Intelligence/ Knowledge Management**, this category would have been a close second to the highest priority.

Our **2017** results showed two “top” priorities, **Information Security** (still the leader) and **Software as a Service/Cloud Computing** (up from 3rd place in 2016). Then, there was a group of 6 priority areas that all received similar ratings from our respondents. They were: **Big Data/Internet of Things** (up from 7th place in 2016), **Application Development, Business Intelligence/ Knowledge Management, Network Infrastructure** (down from second place in 2016), **Mobile Computing** and **Web Development**.

2018 reinforced **Information Security/Cyber security** as the leading priority, with familiar faces among the next group of five – **Development (Applications, Web and Database), Business Intelligence/Knowledge Management and Network Infrastructure**. **Software as a Service/Cloud Computing** had retreated from its giddy heights of 6 or 7 years ago. Up-and-coming and newcomers include **Big Data/IoT, Artificial Intelligence and Payment Systems**. **IoT** and **Big Data** were also reported by Brainstorm’s *CIO Survey* in 2018 as focus areas for CIOs.

Slipping out of the priority zone, as the technologies become less of a challenge and easier to implement are areas such as Wireless and Unified Communications, Operating Systems, Mobile Computing, Data Storage, Hardware, SOA and Bandwidth.

In **2019**, clearly still the top priority, **Information security/Cybersecurity** received even more attention than in 2018. Then there was a cluster of second level priorities made up of **Big Data/Data Analytics, Software as a Service/Cloud Computing, Artificial Intelligence** and **Application Development**. Web development, Database development and Business Intelligence/Knowledge Management fell into the third level on the priority scale, well below the first and second levels.

In **2021**, with **Information Security/Cybersecurity** continuing to be the top priority by a significant margin, it appeared that the globalisation of data and networks exposes most enterprises to the considerable risk of data breaches and data loss. The tightening of laws around the protection of data (eg POPIA and GDPR) put the defence against such incidents high on the IT executives’ agenda. **DevOps** joined the cluster of second level priorities, which include **Big Data/Data Analytics, Artificial Intelligence, and Migration to the Cloud**. The third tier of priorities includes **Application development, Data management and Test automation**.

The **2022** graphic (see previous page) shows the latest rankings on the left, with the historical data extending to the right. The top 5 are similar to the placings last year, with **Internet of Things** moving into 5th place, below **Information Security/Cybersecurity, Big Data/Data Analytics, DevOps** and **Artificial Intelligence**.

Many of the “hot issues” of a decade ago have either become routine or have dropped off the IT managers’ radar in terms of skills requirements – these include Unified Communications, Wireless Communications, Operating Systems and Bandwidth. Expected to become more prominent in the search for supporting skills are **e-Commerce, RPA/Robotics** and **Multimedia**.

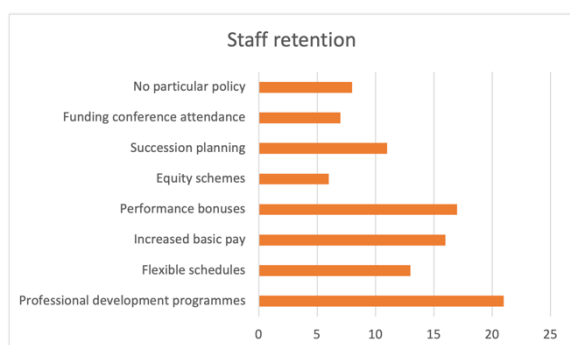
South Africa continues to compete in the international market for these “top skills”. Australia is an attractive emigration destination and they have reinforced their policy of attracting immigrants to close their skills gaps.

Their new Labour government has increased the number of permanent migration places and are addressing the issues surrounding persuading immigrant students to stay, rather than returning to their home territories. IT technical and professional and IT management and operations roles are predicted to be the fastest growing occupational groupings over the next five years, according to research commissioned by the Australian Computer Society (ACS).

The ACS' latest Digital Pulse report, which was conducted by Deloitte Access Economics, forecasts the number of technology workers in Australia to increase to just below 1.2 million by 2027, or an increase of 330,000 workers or 5.5 percent. Most of this growth will be in ICT technical and professional roles with 156,000 additional workers during the period, representing a 6.5 percent increase, and in ICT management and operations roles with 125,300 more workers, or a 6.2 percent increase. Electronic trade workers are forecast to grow by 4.1 percent, ICT trades by 3.9 percent, ICT industry admin and logistics support by 3.1 percent, while ICT sales will remain steady with a 0 percent increase.

Career Junction (op.cit.) lists the following roles as growing in South African hiring activity in July 2022: Software Development; Systems/Network Administration; Business Analysis; Data Analysis/Data Warehousing; IT Project Management/ Administration; Technical/Business Architecture; and Systems Analysis. It is interesting to note that there are no “buzz phrases” or “4IR terms” in these roles.

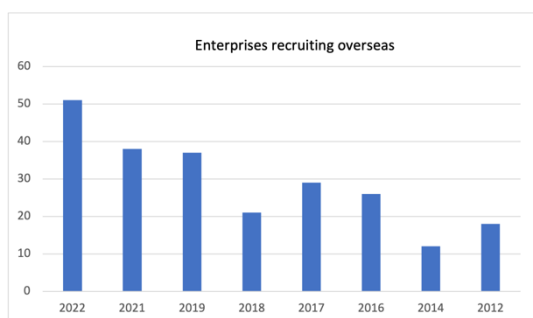
STAFF DYNAMICS



The demand for skills generally and for ICT skills in particular is subject to a wide range of influences. These include the depressed state of the economy, uncertain political stability, fallout from exposure to crime and corruption and the introduction of new and improved technologies. In this section, we look at the ways in which employers approach the skills pool conundrum.

The pattern of staff retention policies in 2022 continues the practices of previous years. Professional development programmes and performance bonuses continue to lead the preferences, followed by flexible schedules and increased basic pay. The other incentive approaches are much less utilised. Comments from respondents continue to place the emphasis on developers and programmers as the toughest to retain.

The 2022 respondents indicate a much higher proportion of responsibility for training and skills development resting on the shoulders of line managers (48%) than previously reported. This is followed by 26% allocated to HR and only 19% at C-level executives.



The percentage of respondent employers recruiting overseas in 2022 shows a sharp acceleration from last year's 38% to over 50%. With the continuing very high level of unemployment (particularly among young people), this is a disturbing trend, as South Africa is not making inroads into the opportunity to skill and employ locally. Following the exit from the lockdowns arising from the pandemic, there continues to be a steady stream of applications for “critical skills visas” via the South African embassies and consulates,

as the country remains a desirable destination for ICT practitioners from some of our African neighbours and from India. The revisions to the “critical skills list” used by the Department of Home Affairs, published in February 2022 and amended in August 2022 have caused many existing Critical Skills Visa holders to apply for renewal, in line with the changed job categories. New applications are also being made. We are not able to assess the impact

of the reported backlog of visa applications awaiting processing by Home Affairs but we are aware that months can elapse between the time of application and the time of the visa being issued.

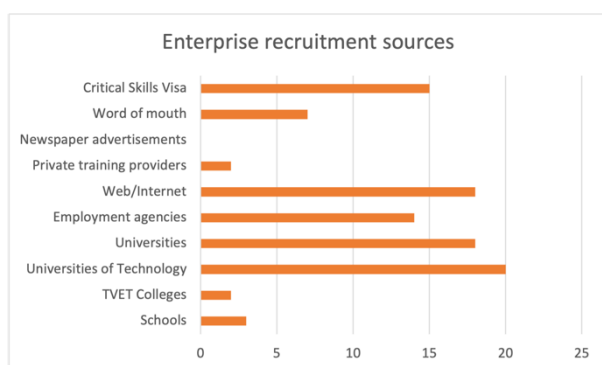
CORPORATE PREFERENCES

RECRUITMENT VALUE



Graduate degrees have given way to professional experience as the most highly ranked attribute of potential recruits in this year's survey. This is an interesting development, seen against the background of DHA's insistence on graduate degrees for critical skills visa applicants. It also suggests that, as the pressures on business margins increase, employers are less willing to wait for graduates to "get up to speed".

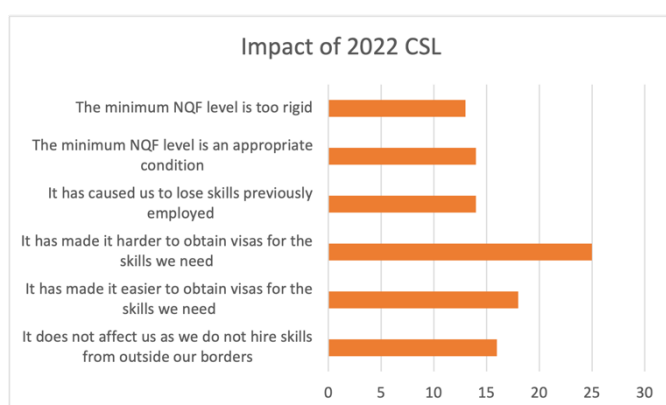
LOCAL AND OVERSEAS RECRUITMENT



The overall pattern of preferred recruitment sources in 2022 is similar to recent experience. Universities of Technology have nudged ahead in 2022, indicating that they are filling the gap arising from the paucity of IT graduates from Universities. The continuing value from "Web/Internet" indicates that services such as LinkedIn are proving worthwhile "hunting grounds" for new talent.

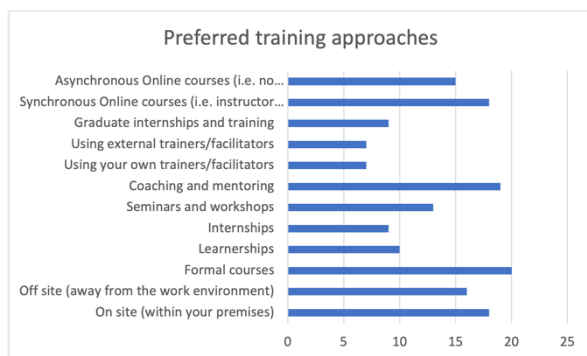


As indicated by the increase in employers recruiting overseas (left), critical skills visas are growing in importance in drawing new recruits. In responses to the changes to the Critical Skills List (CSL) in 2022, we asked what was the impact of those changes on the recruitment of overseas skills.



Opinion was divided on whether the changes were negative or positive, although the highest number of responses was to the "it has made it harder..." question. Given South Africa's extremely high rate of unemployment, it would be worth studying whether these visas are utilised for skills transfer to local resources or merely used to fill skills gaps for as long as possible.

TRAINING METHODOLOGIES

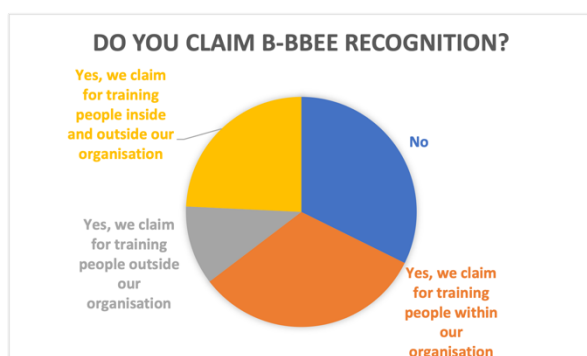


The pattern of preferences for skills transfer in 2022 from the employers' perspective is very similar to 2021, reinforcing the focus on coaching and mentoring, while continuing the balance between on-line and formal courses.

MANAGEMENT DEVELOPMENT



This year, the pendulum swings, returning mentoring and coaching to second place, behind formal management courses, as the preferred approach to management development.



It is now six years since the appointment of the B-BBEE ICT Sector Council, and five years since the implementation of the Amended ICT Sector Code. The annual monitoring reports from the Council have yet to show significant progress in the development of Black managers in the sector. However, the majority of enterprises are claiming BEE recognition for their training efforts. As with the Generic Codes, the Sector Code was meant to be amended before the end of 2019 to shift the emphasis between the elements of

BEE. At the time of writing (August 2022), the revised ICT Sector Code has yet to be published. We note that there are calls for the overall approach to B-BBEE to be reviewed and overhauled but there is no time frame for this to happen.

SKILLS NEEDS



The chart alongside shows our respondents' view on which skills are most needed now and which in a year from now. The indicators to look for are where the light blue (now) and grey (next year) lines are clearly longer than the yellow and red lines, which suggest a sufficiency of those skills.

Significant shortages are indicated in the following areas:

- Information Security / Cybersecurity
- Big data design / analytics
- Data Science
- Artificial intelligence / machine learning
- Blockchain
- RPA
- DevOps

Significantly moving into the “needed” categories are Data Science, Big Data/Analytics and RPA, while Internet of Things has moved lower in the rankings.

In six of the skills areas listed, the demand exceeds supply by a clear margin., Blockchain, AI/Machine Learning, Data Science and Big Data/Analytics stand out, together with Information security/Cyber security and (to a slightly lesser extent) Robot Process Automation (RPA). In other areas, although many respondents indicated sufficient supply of skills, there are still significant shortages anticipated, such as DevOps and UX design.

PROGRAMMING LANGUAGES

In 2022, the demand for **Java** and **Python** is equally ranked first and clearly much greater than for **C#** and **JavaScript**, which therefore take up equal third place. Much lower down the scale, only **SQL** and **HTML/CSS** rank ahead of the “also ran” languages.

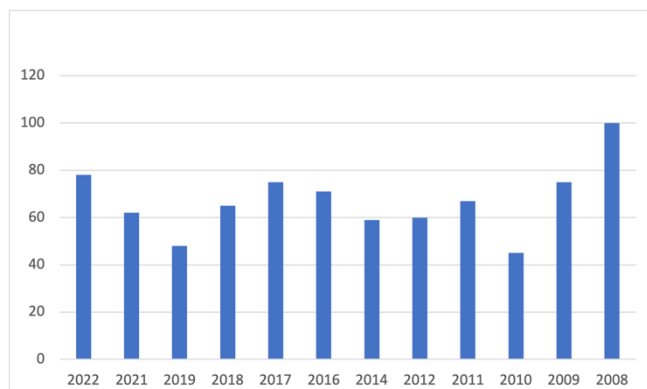
The pattern of demand for programming languages in 2021 continued the pattern from 2019 which saw **Python** move into second place behind **Java** and ahead of **C#**. JavaScript nudges C# into 4th place. .NET slips into the “also ran” group of half a dozen less noted languages.

In 2018 **Java** was in the lead, followed by **C#** and **Python**. **.NET**, **C++**, **HTML** and **SQL** followed.

In 2017 **Java** was the clear leader and **C#** was in second place, unchanged from 2016. **Python** moved into third spot, with **.NET** and **C++** tied for fourth. Of equal but lesser popularity, R, PHP, COBOL and Delphi all get mentioned.

In 2016 the leading languages were also **Java** and **C#**, followed by VB.NET and PHP. 2014 was very similar to 2012, with Java, C#, .NET, C++ and VB the most popular.

IMPACT OF SKILLS SHORTAGE AND PANDEMIC ON BUSINESS

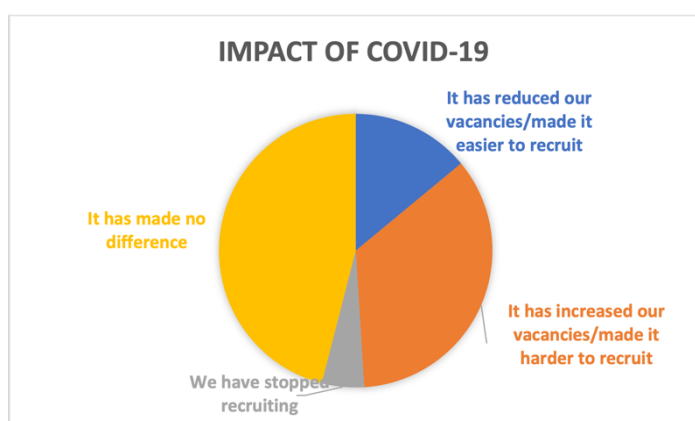


In continuing to track this opinion from our respondents, it is worth noting the improving trend of the 2018/2019 period, which reversed in 2021, has continued to show increasing levels of concern in 2022.

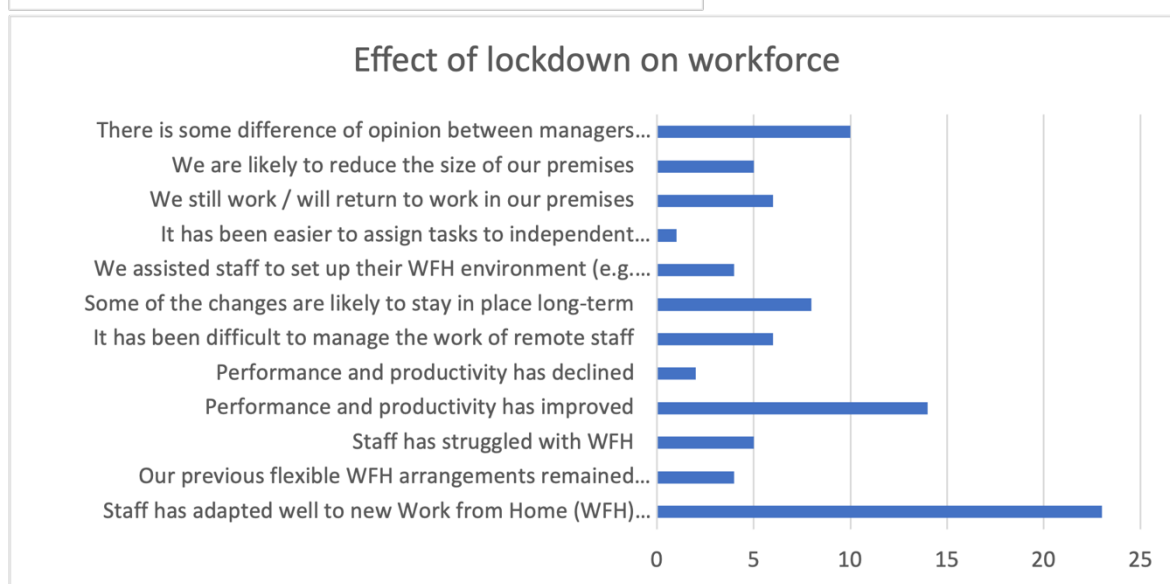
In 2008, all respondents indicated that the skills shortage was having at least a major effect on their business. Several factors can influence this trend. On the negative side, the stagnant economy and the pandemic has reduced the

business prospects of some of the employers, thus reducing the demand for skills, although that is not borne out by the number of respondents saying the opposite.

On the positive side, the various initiatives to close the skills gap are bearing some fruit, whether the new resources are coming from immigrants, private sector / NGO skills programmes or better output from the education pipeline. However, we do not see any significant scaling of these interventions to have a noticeable impact of the nation's unemployment rate.



It is significant that the pandemic effect on the skills balance has worsened in the last year. The proportion of respondents indicating more vacancies/harder to recruit has increased from 20% to 35%. 51% of our employer respondents felt that the pandemic had not affected skills availability (or they had stopped recruiting), while only 14% felt it made it easier to recruit.



In 2022, the overall pattern is very similar to 2021. There is a recognition that the restrictions imposed by the lockdowns have resulted in a positive view on the impact of the enforced changes in working arrangements. It is significant that employees have adapted to WFH and that many companies report an improvement in productivity and that the enforced changes will likely stay in place on the long term. We did ask two new questions in 2022 and it is worth noting that not all managers agree on the benefits/disadvantages of the WFH scenario, while some enterprises are already looking to reduce their investment in premises for their workforce.

RE-SKILLING FOR THE DIGITALISED AGE

Our respondents were asked a new question in 2019 – do they feel a responsibility to assist their employees to reskill to meet the challenges of the new era of digitalisation?

The answer is still an overwhelming “yes” in 2021 and 2022, with 97% affirmative responses this year.

CORPORATE SUMMARY

The ICT skills field from the employer perspective continues to show muted demand for skills but that the ongoing pressure from the introduction of new and innovative technologies continues to ensure that the skills gap is not closing. There are no major changes in platforms, programming languages or methodologies as we advance into the third decade of the 21st Century, although we can expect increased take-up of Artificial Intelligence and Robotics as more enterprises digitise their business operations.

The market continues to be overshadowed by the impact of non-technological factors – local and international politics, local and international growth rates and local societal issues of violence and crime. Thankfully, the worst restrictions of the COVID-19 pandemic are behind us in South Africa, although there is a very significant ongoing impact on the supply chain for many industries, including electronic component and device manufacture. The war in Ukraine is also having a global negative impact, way beyond the borders of the conflict on the ground.

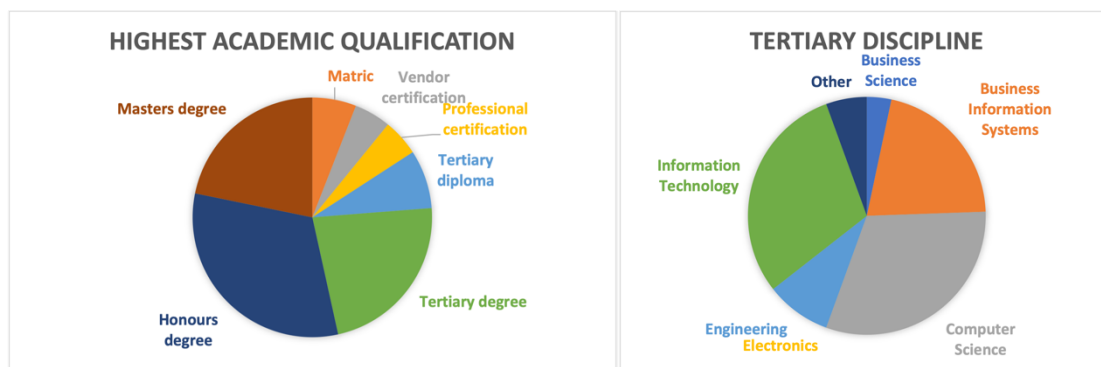
The common thread is the urgent and persistent need to raise the game in the education pipeline and it is incumbent on the private sector to drive the required changes through partnership with government and expansion of the many initiatives taking place. We are heartened by the planned changes to curriculum and teacher training but it is vital that these plans are implemented without delay and with appropriate funding.

Equally important as strengthening the skills pipeline is the creation of work opportunities for the newly-skilled. Without some serious government re-thinking on rebuilding the economy, it is not easy for the private sector to increase the number of jobs and other value-add economic opportunities. We continue to see myriad schemes driven from the private and NGO sectors and there is an over-abundance of providers offering certifications and qualifications. That these initiatives are not creating the required resources must be seen as the trigger for a re-think on a grand scale. We do note a potential exception to this in the Future Skills Project being driven by the Global Business Services (GBS) sector, through BPesa, in 2022. Their target is to train AND employ 60 000 young people over the next few years. Other sectors will do well to follow this example.

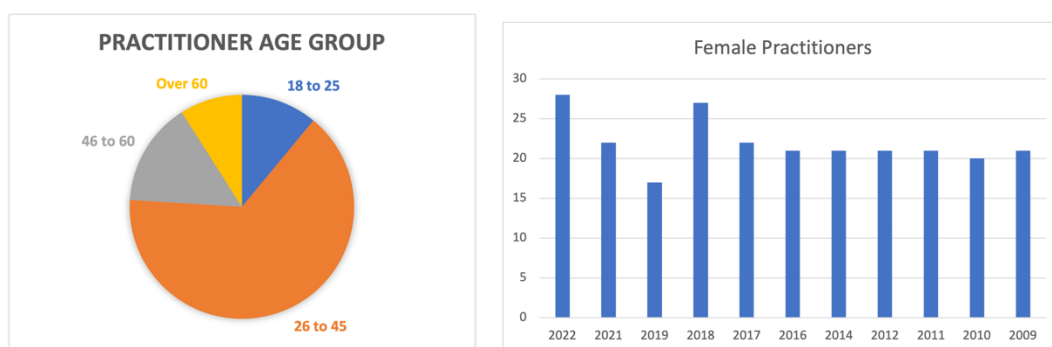
PRACTITIONER RESPONSES

Our pool of practitioner respondents remains fairly constant in numbers and we are satisfied that the sample is large enough from which to draw valid conclusions. In this section of the report, figures in (brackets) are the 2021; 2019; 2017; 2016; 2014; 2012; 2011; 2010; 2009 results, respectively.

PRACTITIONER PROFILE

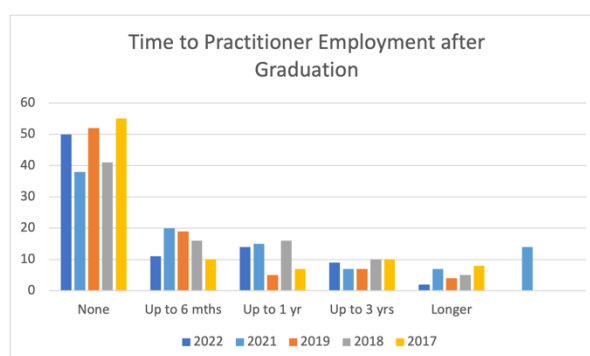


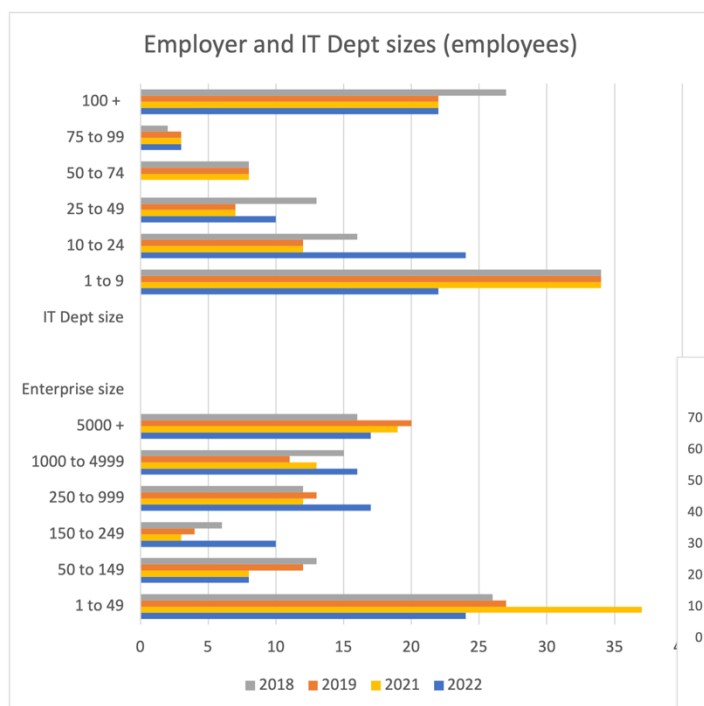
Our “average” practitioner respondent has changed a little in the last 14 years. He’s now in his mid-30s, lives in Gauteng or the Western Cape, is highly qualified, has more than 5 years’ experience but has only been with this current employer and in this current role for 3 years, working as a manager or a developer in a small to medium sized enterprise. We are encouraged by the increased percentage of female respondents in 2022.



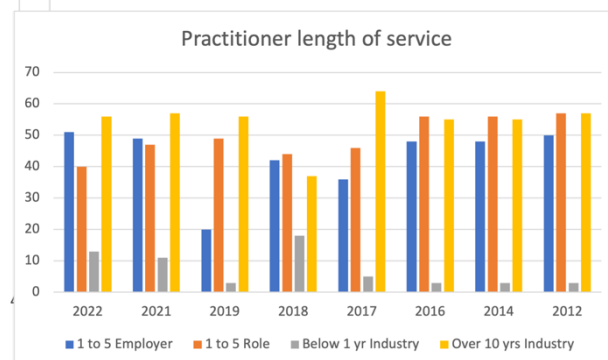
We inserted this question into the JCSE-IITPSA ICT Skills Survey in 2016, asking practitioners how long it took them to become employed, after they had completed their studies.

While it is good news that half of graduates are finding immediate employment, it continues to disappoint us that a significant proportion are still having to wait up to one year.

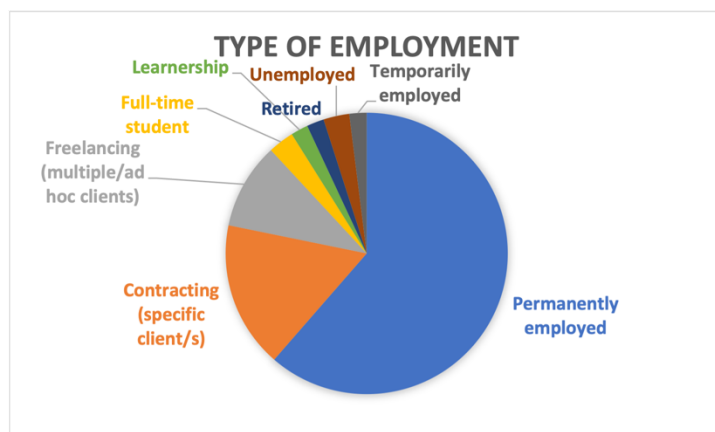




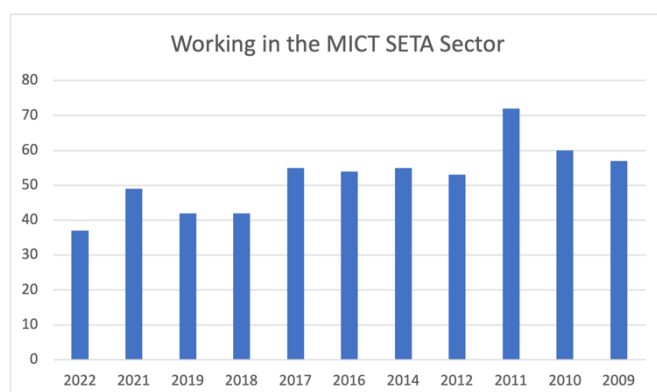
There is no change to the fact that most respondents work in a small (1-9) department or a large one (100+).



More than half have been with their current employer for less than 5 years and 40% have performed their current role for the same period. After the 2019 anomaly where only 20% (about half of the average for the preceding years) had worked for their current employer for between 1 and 5 years, the 2021 and 2022 results have reverted to the trend shown during 2010-2017. Over 55% of responding practitioners have been in the industry for more than 10 years.

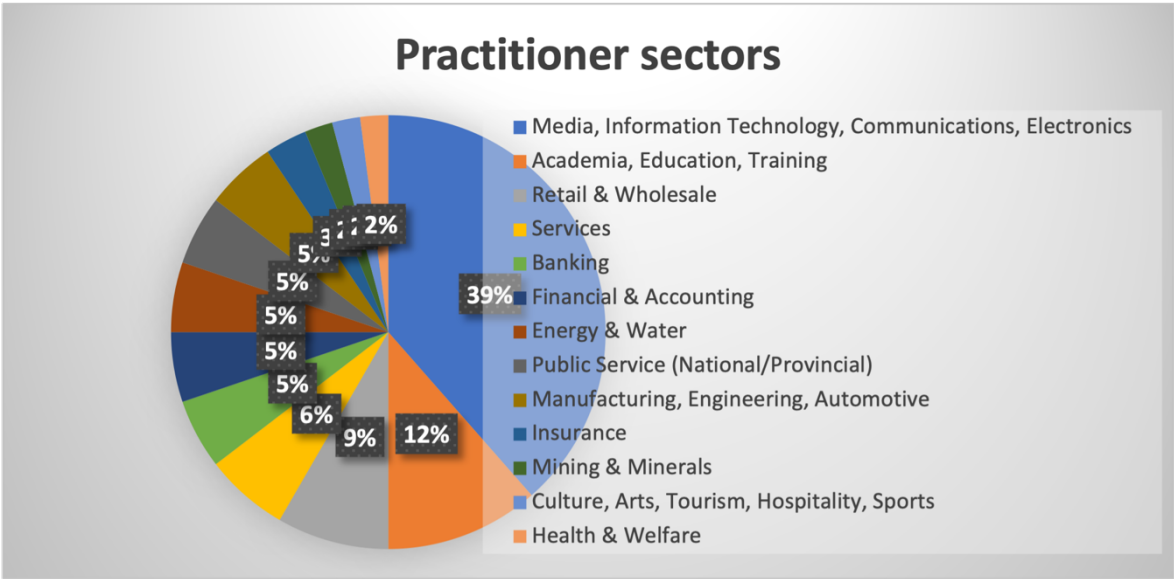


62% (67%, 58%; 51%, 69%; 77%; 78%; 79%) of practitioner respondents are in permanent employment. This proportion was almost unchanged from 2009 until 2016 but was noticeably lower in 2017 - 2019. 2021 and 2022 show somewhat higher values but not as high as the earlier years of our survey. The flexibility of skills resourcing offered by the existence of the contractor pool now at 17% (20%, 20%; 25%; 15%; 17%) is a long-standing vital component of the ICT industry's ability to apply labour where and when it is needed. It is worth noting the significant 10% of practitioners who are freelancing, adding to the flexible pool.



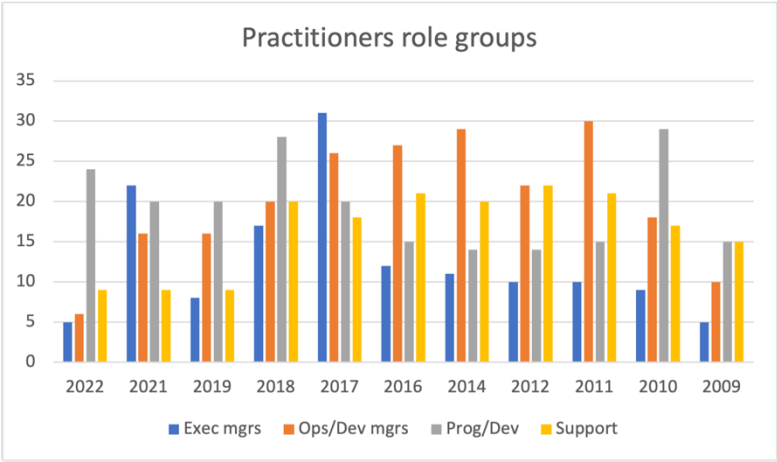
With more than half of practitioners working in other (i.e. non-MICT) sectors, this underlines the pressing need for the coordination of data from ALL stakeholders in a formal, credible methodology. We continue to suggest that the SETAs set up a trans-sector mechanism that

acknowledges the pervasive nature of ICTs and the skills required to support the various technologies.

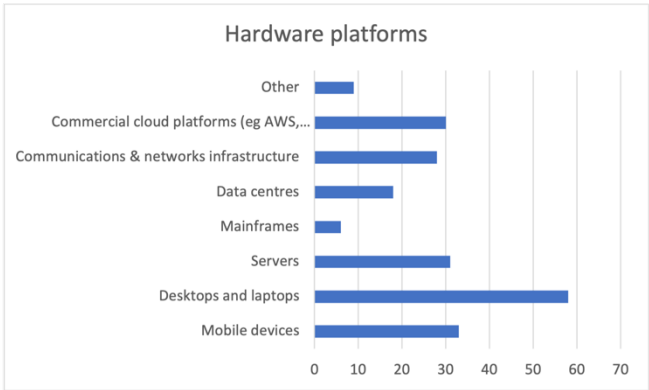


We continue to hope that there can be urgent progress with standardising the nomenclature of job roles and functions across sectors to make the planning of skills interventions more meaningful. Reliance on the inaccurate and misleading OFO codes can lead to poor policy and decision-making.

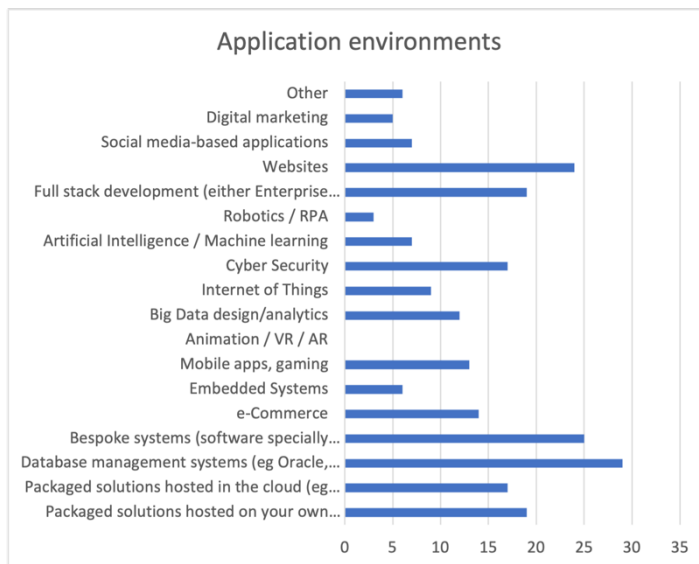
PRACTITIONER PRACTICES



There are some inconsistencies between how respondents view their level in the enterprise and the job title that they hold. This issue further emphasises the need for rationalisation of the job titles and job roles used in industry and the Organising Framework for Occupations (OFO) codes used by the SETAs and DHET.

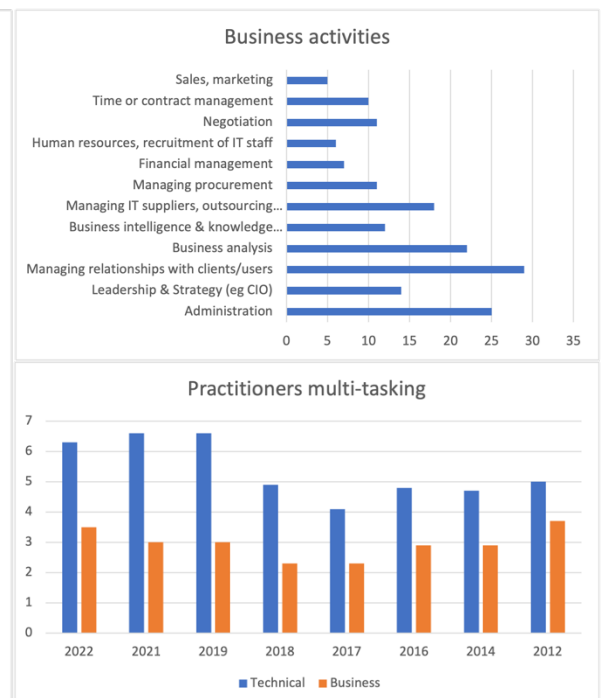
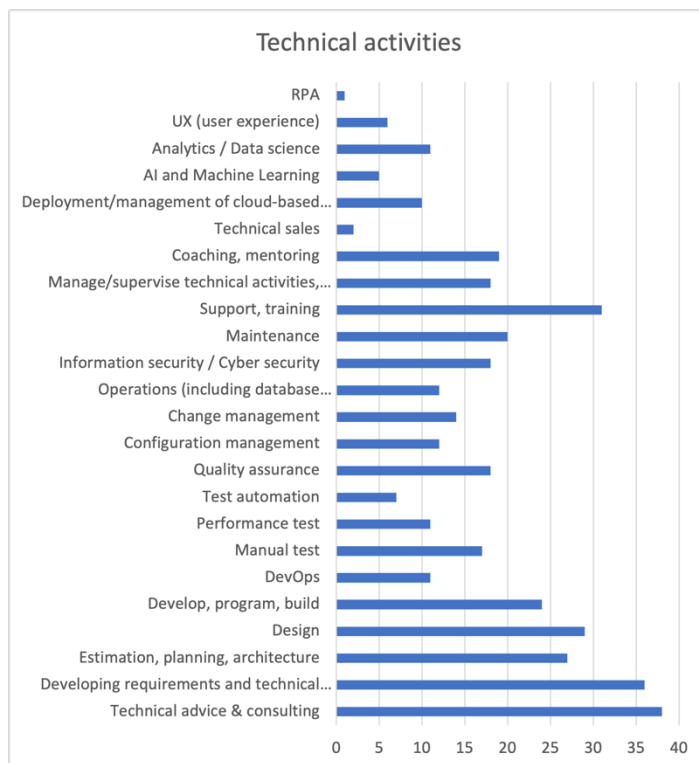


Most of our practitioner respondents are working in the PC/laptop and mobile device environments, linked to server and cloud platforms. The hardware platforms pattern is almost the same in 2022 as in the previous year. Similarly, their engagement in applications that are perceived to be in the 4IR domain, such as Big Data, IoT, AI/Machine Learning and Robotics are still emerging. The mainstream of practitioners are still engaged in what may now



be described as traditional applications – enterprise solutions, databases and bespoke systems. Websites and full stack development are important environments.

MULTI-TASKING



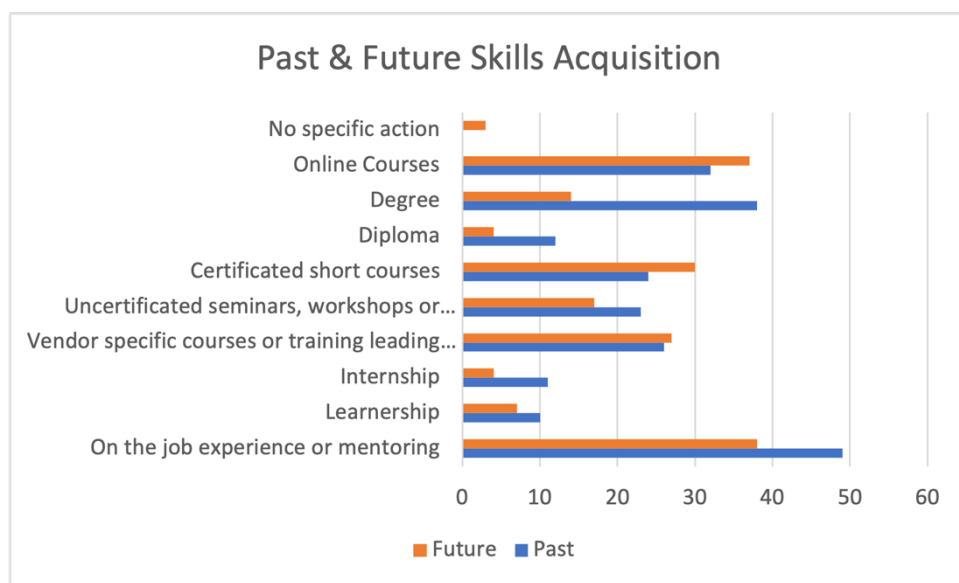
We see little change in the range and mix of business activities engaging the practitioners. The average South African ICT practitioner continues to perform multiple task sets, with only a few identifying their role as “specialist” in nature. Only a minority of respondents describe what they do as involving less than three areas of activity. As we have commented before, we understand that it is appropriate for complementary roles to be performed over time, such as design, developing requirements, programming, testing and maintenance. In small enterprises, skilled practitioners will be responsible for all phases of management, administration and systems development.

We have raised the flag of the multi-tasking issue in every report. If a practitioner perceives that they are performing several different roles, from technical consulting to administration, from programming to client

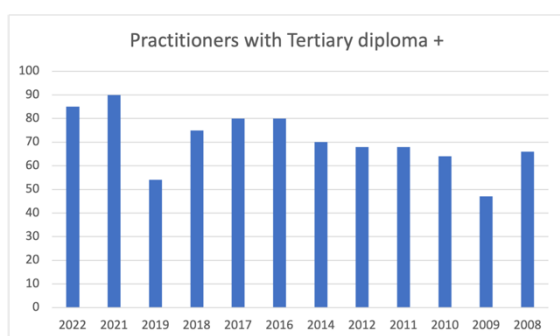
management, from business analysis to outsourcing arrangements, it is difficult to see how they can maintain focus on specific objectives while juggling these responsibilities. It is unlikely that they have the required strengths in all these activities or the time available to carry them all out, which would lead to a degree of underperformance in some areas. It also leads to over-dependence on the individual concerned, who may be perceived as “irreplaceable”.

However, while there is an economic case for greater division of labour, the multi-tasking phenomenon is entrenched as a fact of ICT practitioner life in South Africa and shows little sign of changing.

SKILLS ACQUISITION

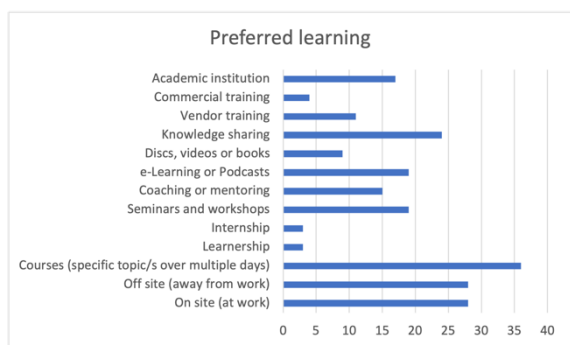


As in all the previous surveys, respondents showed how they had acquired their skills in the past, to qualify them for their current post, and how they intended to acquire skills in the future, to maintain their value in the job market.



In 2014, we changed the presentation of this response to indicate the primary contributor to past skills development of the practitioner. The predominance of “on the job experience or mentoring” has been fairly constant, reported by 20+% of respondents in previous editions. This year (similar to 2019), it is close to 70%. Outside of the work environment, the need is for “proof of learning” in the form of a certificate, diploma or degree for almost half of our respondents.

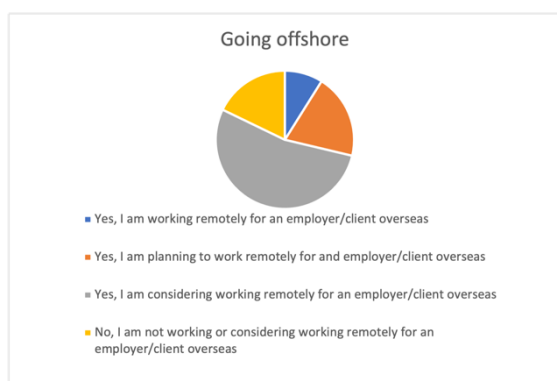
Looking ahead, there is very little change from the last four years. Skills acquisition through experience, supported by short courses that lead to certification (whether vendor-specific or not) are preferred by practitioners. Pressure of work makes less time available for continuing academic studies, even on a part-time basis. In spite of the preference for on-site learning, almost as many respondents indicate that the transfer of knowledge is best suited to an environment outside of the actual workplace. The move to WFH since March 2020 will also be a factor.



In 2017, we observed a shift away from on-site learning to offsite, when 53% of respondents preferred the latter. In 2018, the pendulum swung, and we show 57% of respondents favouring on-site again. In 2019, the pendulum swung again with 51% preferring off-site. This trend was repeated in 2021. In 2022, the pendulum came to rest, with a 50/50 response. There is still a high level of interest in courses and seminars/workshops. The shift away from commercial and vendor training remains, with ongoing support for e-Learning/Podcasts and knowledge

sharing. As previously, there is still a strong interest in academic offerings.

In 2019, as we did with the Corporate respondents, we asked the practitioners if they felt they needed to reskill themselves in view of the changing digital environment. The overwhelming answer was “yes”. This did not change in 2021. In 2022, 100% of respondents supported this approach. This represents a major opportunity for a dialogue between enterprises and practitioners, facilitated by professional bodies and training providers, to embark on a sustained reskilling programme for the foreseeable future.



HOME OR ABROAD?

A new question in 2022 – are you as a practitioner working or planning to work remotely? We felt responses to this question would give us an indication of how the COVID-19 lockdown might have precipitated new thinking among the ICT workers about the potential advantages of working from anywhere.

While almost 30% of respondents said they were already or were planning to work remotely, we were surprised that more than 50% said they were considering doing so.

These responses are addressed in the following article.

THE END OF KNOWLEDGE WORK AS OFFICE WORK?

Barry Dwolatzky

After nearly two years of operating under a work-from-home mandate due to the COVID pandemic, Patrick decided in February 2022 to bring his team of software developers back to the office. It was late on a Friday afternoon when he sent a message to all team members instructing them to be at their desks in their Johannesburg office at 9am the following Monday morning. His message triggered a flurry of panicked responses. Of the fifteen members of his team only eight responded positively. Among the others, five informed him that they had relocated to other parts of South Africa, and two were now living in Europe.

Patrick was shocked! He and his fellow managers had simply assumed that the company’s employees had continued living in Johannesburg throughout the COVID crisis. Nothing in the way they did their work or their attendance at team meetings, which had been taking place on Zoom, indicated that anything had changed. In fact the productivity of the team and the quality of their work had improved significantly.

The scenario described above is not unique to Patrick and his company. A similar situation exists in many South African organisations as the world emerges from the COVID period. In particular companies in the IT sector, or IT departments in other sectors, have suddenly been confronted with the dilemma as to where their employees

are physically located. There is a growing realisation that there is seldom a valid justification to have knowledge workers working together in a physical office environment.

From the perspective of management, the prospect of workers no longer being collocated at a physical workplace poses many challenges. For many, an important role of a manager is to oversee attendance at a work place. Workers are expected to show up and leave at certain prescribed times and to remain at work between those times. Rules and systems have been put in place to regulate and manage attendance and absences from the workplace. The attitude is, “If we are paying someone to work we need to see them working.” The thought of someone popping out to fetch the kids, or going for a jog in the park during a workday is difficult to reconcile with that person “being at work”.

From the perspective of employees, working away from the office offers flexibility and an opportunity to more easily manage a healthy work-life balance. Why live in a large city like Johannesburg or Cape Town, where the cost of accommodation is high, and travelling to and from work is stressful and time-consuming? If one can do one’s job while living in a small seaside town why not do it?

One of the major challenges in the post-COVID new-normal is to rethink and renegotiate what it is to be an employee and how managers will manage. Apart from redefining roles and responsibilities, both employers and employees will need to develop new ways of organising work, and new forms of contractual relationships. The issue also has an international dimension. Where, for example, should Patrick’s team members who now live in Europe pay their income tax?

Other broader issues will also need to be brought into the conversation. A distributed workforce might eventually lead to the breaking up of jobs into tasks. These tasks can then be offered as a work opportunity to anyone available to do them. This gives rise to what has been called the gig-economy. A major disadvantage of the gig-economy is that new entrants into the world of work will no longer have the opportunity to learn on the job by working alongside those with more experience and skills. This could create a vicious circle where those with skills will secure the “gigs”, thus enhancing their potential to get more work, at the expense of those with less experience.

While such extreme consequences are not yet evident in the South African workplace, there is a strong likelihood that the situation will change. When this happens both employers and employees in the local IT sector will need to be ready to deal with both the consequences and the opportunities. Consideration will also need to be given to skills, particularly those skills associated with working remotely and with managing distributed teams.

CONCLUDING REMARKS

This is the twelfth edition of our Survey. The framework of questions directed to the employers of ICT skills and to the practitioners of ICT skills that we devised in 2008 remains the core of our Survey today, enabling us to identify trends through the consistency of the information. This is a significant achievement, as we reflect on the dynamic nature of the ICT industry and the dramatic shifts in technology development and application that have occurred in the last 14 years.

In 2008, the world of work, the state of the economy and the socio-political issues appeared to be simpler environments than the ones we currently occupy. We expected the lights to work, we expected the trains to run, we expected to receive mail via the Post Office. The list of the components of daily living that have deteriorated since then is endless. And yet, the pace of technology change continues unabated, offering opportunities for millions of people to access the miniaturised, portable tools that enable value creation from knowledge and information. The access to data on a global scale enables rapid innovation and dissemination of life-changing additions to our capabilities. This rate of change continues to fuel the ICT skills gap, across the world as well as in our region. In spite of new terminology, many of the technology skills remain the same foundational ones that we have experienced for decades – systems architects and engineers, software developers, programmers and analysts. The scale has increased geometrically but networks, storage and user interfaces are still the building blocks. Enabling each succeeding generation to understand, innovate and implement the tools of the digital world is the responsibility of all of us in education, training and employment in and around the ICT sector.

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