



2019 JCSE-IITPSA ICT Skills Survey

The Tenth Edition

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

Authored by Adrian Schofield, Production Consultant: IITPSA and Consultant: Applied Research Unit, JCSE, and
Professor Barry Dwolatzky, Director, Joburg Centre for Software Engineering at Wits University

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CONTENTS

Executive Summary	1
The ICT Sector	1
ICT Skills Environment	2
The South African context	2
4IR and its Impact on Skills in South Africa	3
Survey Process.....	5
Corporate Responses.....	6
Provinces	6
Respondent Level	7
Type of Enterprise.....	8
Size of Enterprise	9
Analysis of current MICT SETA analysis of the sector	9
Sectors	11
Sector Skills Plan Correlation	12
MICT SETA	12
The Fourth Industrial Revolution and its Change drivers in the MICT sector	13
Cloud Computing	13
Internet of Things (IoT)	14
Virtual and augmented reality	14
Big data analytics	14
Information Security	15
Skills Gaps	15
Vendor Programmes	15
Other SETAs	16
AgriSETA.....	16
BankSETA	16
CATHSSETA.....	19
CETA	19
CHIETA	20
EWSETA.....	20
ETDP SETA	20
FASSET.....	21
FoodBev SETA	22
FP&M SETA	22
HWSETA	23

INSETA.....	24
LGSETA.....	25
MERSETA.....	25
MQA.....	27
PSETA.....	27
SASSETA.....	28
Services SETA.....	28
TETA.....	29
W&R SETA.....	29
Sector Consolidation.....	30
ICT Priorities since 2008.....	30
Staff Dynamics.....	32
Corporate Preferences.....	34
Recruitment Value.....	34
Local Recruitment.....	34
Training Methodologies.....	35
Management Development.....	35
Skills Needs.....	36
Impact of Skills Shortage on Business.....	37
Re-Skilling for the Digitalised Age.....	38
Corporate Summary.....	38
Practitioner Responses.....	39
Practitioner Profile.....	39
Practitioner Practices.....	41
Multi-tasking.....	42
Skills Acquisition.....	43
Concluding Remarks.....	45
Bibliography.....	46

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 62-years old professional body for the sector, recognised by SAQA and accredited by the International Professional Practice Partnership (IP3). This is the JCSE's tenth edition of its survey of skills trends in the South African information & communications technology (ICT) sector and its second in full partnership with the IITPSA.

The South African economy is in dire straits. Over the last two years it has dipped into technical, if not actual, recession, only to be "saved" by exceptional performance in one or two sectors. However, these "upticks" do not appear to be sustainable in an environment where government (meaning the country) is overburdened with debts that it cannot afford to service, never mind repay, and there is no effective plan to reverse the increasing levels of unemployment.

In the last year, we have seen government focus on the Fourth Industrial Revolution (4IR or Industry 4.0) as the potential catalyst for improvements in productivity and as the driver of innovation and enterprise development. Our analysis endeavours to separate the evolutionary components of this "revolution" from the cutting edge, quantum leaps arising from digitisation at scale, in the context of the requisite skills pool.

Although many stakeholder groups are making concerted efforts to improve the competency and employability of young people through some excellent initiatives, the results tend to be counted in terms of hundreds or maybe thousands of candidates when what is needed is opportunities for hundreds of thousands or millions of people. However, these numbers can only be achieved in a stable, investor-friendly environment. 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 role-players.

Among the contributing factors that should long ago have been addressed is the delayed rollout of broadband access across the country. The failure to achieve the objectives of SA Connect is denying millions of South Africans access to broadband services and severely restricting the government's capacity for service delivery through offices that are unconnected.

This Survey has repeatedly highlighted the poor state of education in South Africa and in particular the very low number of learners achieving competence in STEM subjects. There are many initiatives attempting to address this issue but they tend to be in relatively small pockets and are not resolving the underlying lack of appropriate curriculum, relevant teaching materials and skilled teachers.

THE ICT SECTOR

The MICT (Media and ICT) SETA provides the following information in its current Sector Skills Plan. South Africa's GDP at constant 2010 prices is estimated at R3.125 trillion in 2017 (StatsSA, 2017). The MICT sector is estimated to have a combined GDP exceeding R300 billion (almost 10% of national GDP). The economic performance in the MICT SETA sectors are briefly discussed below:

- At the end of 2018, the overall ICT market in South Africa is forecast to reach R248 billion (\$21.4 billion), and R273 billion (\$23.4 billion) by 2021. This represents a CAGR of 2.9% (IDC, 2017). This is around 8% of GDP.
- The total GDP contribution of the film industry in 2016/17 was R5.485 billion (NFVF, 2017).

- Revenue in the South African Advertising industry is forecast to increase to R54.194 billion in 2021 from R45.283 billion in 2016, which represents a 3.7% compound annual growth rate (CAGR) (PwC, 2017).
- Revenue in the Electronics and Media industry is forecast to show a CAGR of 8.8% between 2018 and 2022 (Statista, 2017).
- The CAGR, over a three-year period between 2015 and 2017, shows an increase in revenue by 5.5 per cent for the total telecommunication sector (ICASA, 2018).

Gartner presents a slightly different view, referring to IT spending of R303,46 billion in 2019 (3,9% increase on 2018). This includes devices at R46 billion, software at R32 billion and the remainder in services and support (IT-Online, 2019).

ICT SKILLS ENVIRONMENT

In 2016 the phrase “Fourth Industrial Revolution” entered our vocabulary when Klaus Schwab, Founder and Executive Chairman of the World Economic Forum (WEF), published a book with that name. WEF’s annual Davos conference in 2016 focussed on the theme “Mastering the Fourth Industrial Revolution”, with world leaders and CEOs discussing the potential impact of the rapidly emerging wave of technological innovation that is radically transforming entire systems of production, distribution and consumption. Digital technology strongly underpins the Fourth Industrial Revolution (or “4IR”) and there has been a great deal of discussion about the impact of 4IR on skills and jobs in the ICT sector.

THE SOUTH AFRICAN CONTEXT

Both public and private sectors in South Africa have taken up the banner of 4IR and have set up forums and structures to develop strategies to respond to its impacts and benefits. Some notable national initiatives include the appointment by President Cyril Ramaphosa of a “Presidential Commission on Fourth Industrial Revolution” and the launching of an initiative called “4IRSA” which is a “platform that creates space for stimulating dialogue, understanding and action to shape a coherent 4IR plan for South Africa”. In April 2019 4IRSA convened a multi-stakeholder event called the “Digital Economy Summit”. Many companies and government departments are drawing up 4IR strategies and plans. Barely a day goes by without something in the news about 4IR.

While there is no doubt that digital technology is having a significant transformative impact on many organisations and institutions, the term “4IR” is somewhat misleading. It is used, in South Africa at least, as a catch phrase referring to all aspects of digital adoption and transformation, only some of which relate to the cutting-edge “revolutionary” innovations dealt with in Schwab’s book. Much of what is spoken and written about in relation to 4IR is part of an ongoing process of evolutionary digital transformation.

A simple scenario will help in explaining the difference between “evolutionary digital transformation” and 4IR:

ABC Logistics is a mid-sized (hypothetical) logistics business. It has offices in a number of South African cities and runs a fleet of vehicles. It specialises in supporting international firms and other organisations running large projects in South Africa by moving people, equipment and material around the country. ABC Logistics has been in business for 40 years. All of its processes were paper-based until the early 2000’s when digital systems were introduced in an *ad hoc* manner. Some of these systems were specifically developed for ABC while others are “off-the-shelf” packages, such as its payroll and accounting systems.

In 2018 the ABC Logistics board initiated a digitalisation strategy that aims to modernise and integrate all of its IT systems. It also aims to leverage value from the large amount of data generated by the

company's systems. The CIO has developed a plan to replace key systems with modern packages, move most of the IT operations onto the cloud and create a central data repository. She has hired two data scientists to develop management dashboards based on this data. She is also planning to fit the company's vehicles with IoT sensors.

While some of the technologies that are commonly associated with 4IR (e.g. cloud, big data and IoT) feature in the proposed digital transformation, the CIO's strategy is **evolutionary** rather than **revolutionary**. It follows a trajectory that can be traced back to the dawn of the computer age. We have constantly seen new tools, platforms and processes replace older ones.

It is our contention that the label "4IR" should be used to describe technological systems that represent a radical departure – both in terms of the business model they support and the way in which technologies are combined – from what has gone before. 4IR systems are characterised by four critical design features, **all** of which need to be present to create something different enough to carry the label "4IR". These four design features are: Interconnection (also called "the Internet of Everything"); digital twins; hierarchical control; and, digital assistants (or robotics). In the above example the CIO's digital transformation strategy would need to look something like the following:

All people associated with each ABC Logistics project, both clients and staff, will be digitally connected via the internet. In addition, all of ABC Logistics' vehicles and all of the equipment and material being moved around the country will be fitted with IoT sensors. These will also be digitally connected via an expanded internet (the Internet of Everything). All real-time and historical data from ABC's interconnected entities will be combined with other data sources, such as traffic, weather, etc. This rich data repository will be combined with models and algorithms that accurately represent in the digital world all of ABC's operations in the physical world. These "digital twins" will support real-time optimisation of ABC's work-flows using AI, Machine Learning and other techniques. Some of ABC's sub-systems will operate autonomously. The work of ABC's staff will also change significantly. They will interact with robots and autonomous devices that will assist them with tedious, physically demanding or dangerous tasks. Chatbots will also take on tasks such as interacting with clients via messaging platforms and over the telephone.

This type of digital transformation would be revolutionary and representative of something associated with the Fourth Industrial Revolution. Adopting the latter scenario would certainly represent a disruptive change to the company's operational model.

4IR AND ITS IMPACT ON SKILLS IN SOUTH AFRICA

In the scenario presented above, the differences between evolutionary and revolutionary digital transformation should be clear. Most South African companies and organisation are similar, in terms of digital adoption, to ABC Logistics. Any efforts towards digital transformation in such companies are more likely to be characterised as **evolutionary** i.e. similar to the CIO's first strategic plan. The types of skills needed for such digitalisation programmes are mostly those with which we are already familiar, such as developers, database administrators and user interface designers. We will need to add new skills associated with emerging technologies such as big data, cloud computing and IoT.

There remains a chronic shortage of all types of digital skills in the South African ICT sector. Skills associated with the current set of emerging technologies are the scarcest. This has been a key finding in each of our previous ICT Skills Surveys, and has been observed again in the 2019 Survey.

There is, however, a significant change sweeping through South Africa's digital economy. Most of the SETAs have made reference to significant changes in the digital landscape in their most recent Sector Skills Plans (SSPs). While these changes are largely seen as important and potentially disruptive, we are yet to see a

coherent and coordinated strategy from the SETAs to address these future skills needs. Our Survey also confirms that both companies and individual practitioners are aware that skills and jobs are heading into uncharted territory. Since developing skills in the numbers and at the levels they will be required can take several years it is critically important for all stakeholders to urgently address future skills needs. Having said that, however, “legacy” skills are still in huge demand and will remain so for the foreseeable future.

[Authors’ note: the words “digitisation” and “digitalisation” appear in this report. Where we are quoting other writers, we hope the correct meaning appears in context. Where we use these words, they have the following meanings:

- Digitisation is the conversion of data / information into digital form, whereby the data / information may be captured, stored and manipulated in and between digital devices.
- Digitalisation is the application of new processes within and between enterprises to take advantage of the digitised data / information.]

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 2019, as for the previous five surveys, we were assisted in this regard by Eduflex (a Cape Town 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 with 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.

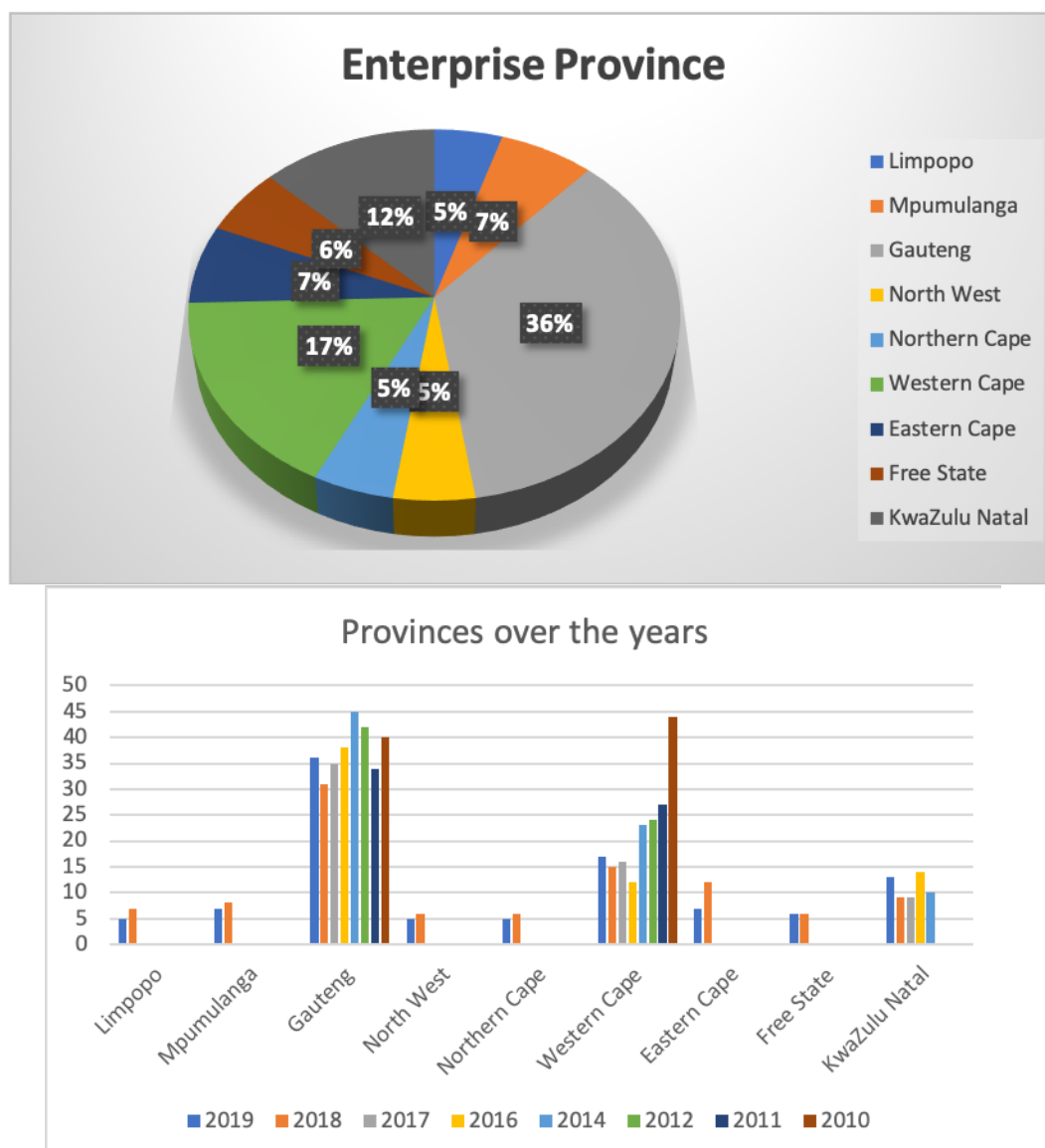
The data gathered from the questionnaires is put into context by an environment scan and literature review.

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CORPORATE RESPONSES

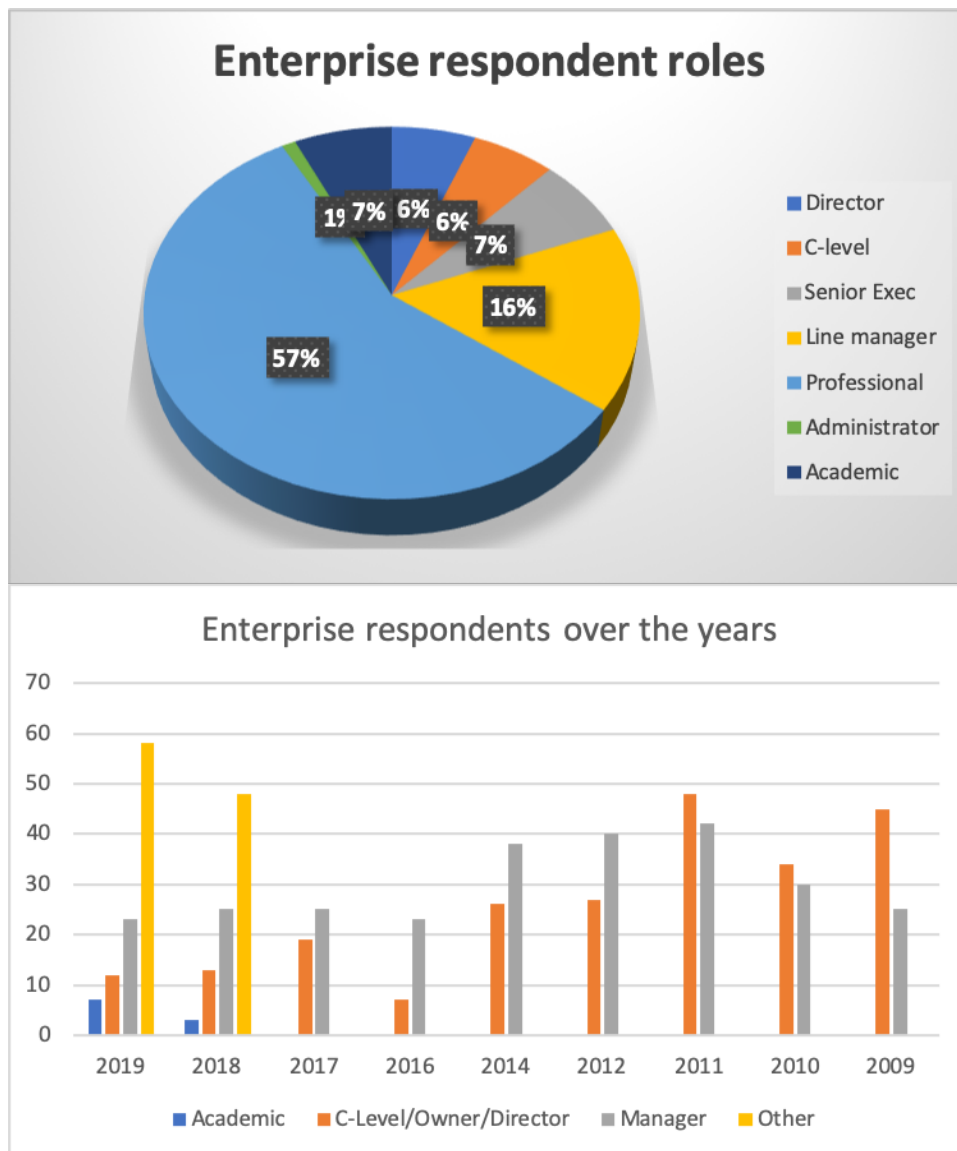
In this section of the report, we analyse and comment on the responses received from employers, usually from the executives and managers responsible for ICT creation, implementation and support functions. Corporate response levels in 2019 are similar to those experienced in the previous surveys.

PROVINCES



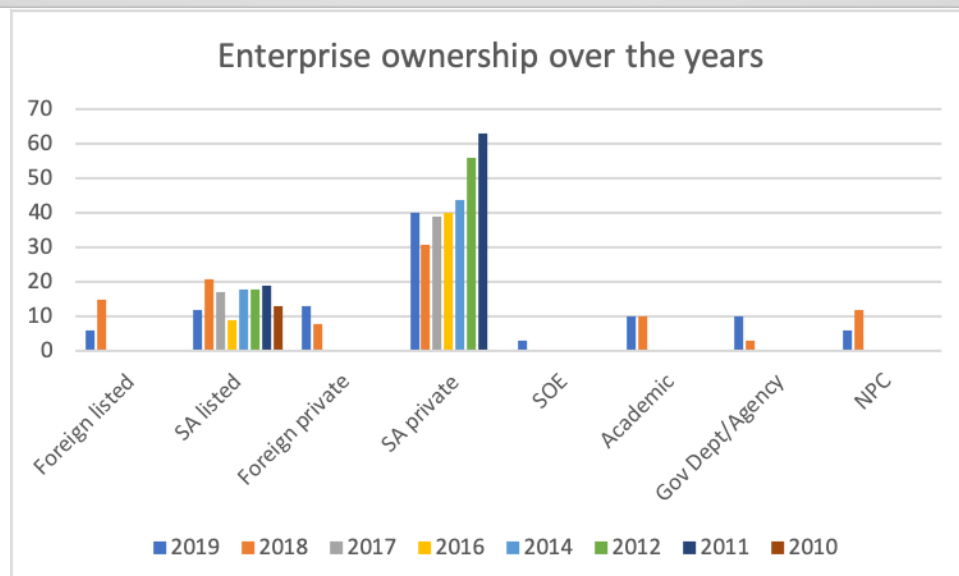
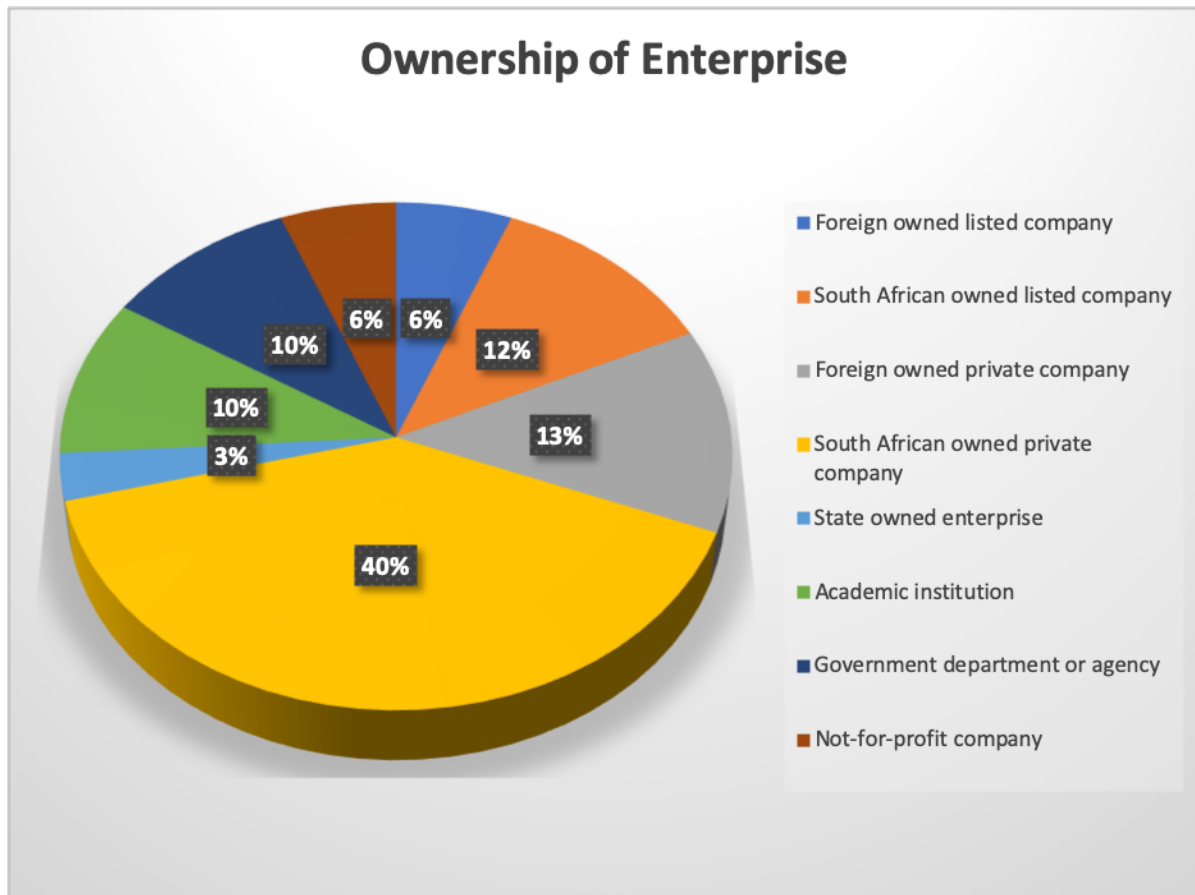
This pattern is a reasonable reflection of the geographical distribution of ICT enterprises in South Africa. Gauteng and Western Cape continue to dominate the sector. We previously commented on the unusually high Western Cape representation in 2010.

RESPONDENT LEVEL



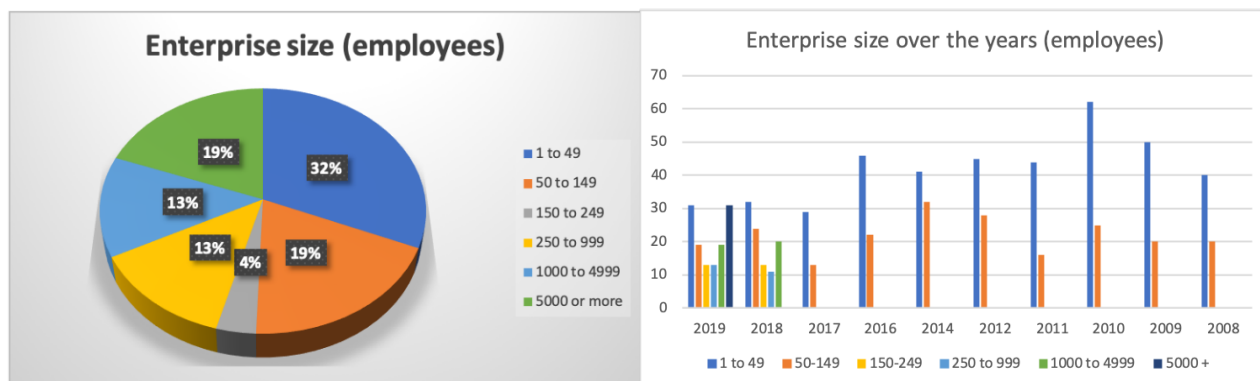
While managerial and executive level respondents have remained reasonably constant for four years(having declined from the high levels of 2009-2011), we see a rise in the number of professional level practitioners telling us about their enterprises (a statistic we began to track in 2018).

TYPE OF ENTERPRISE



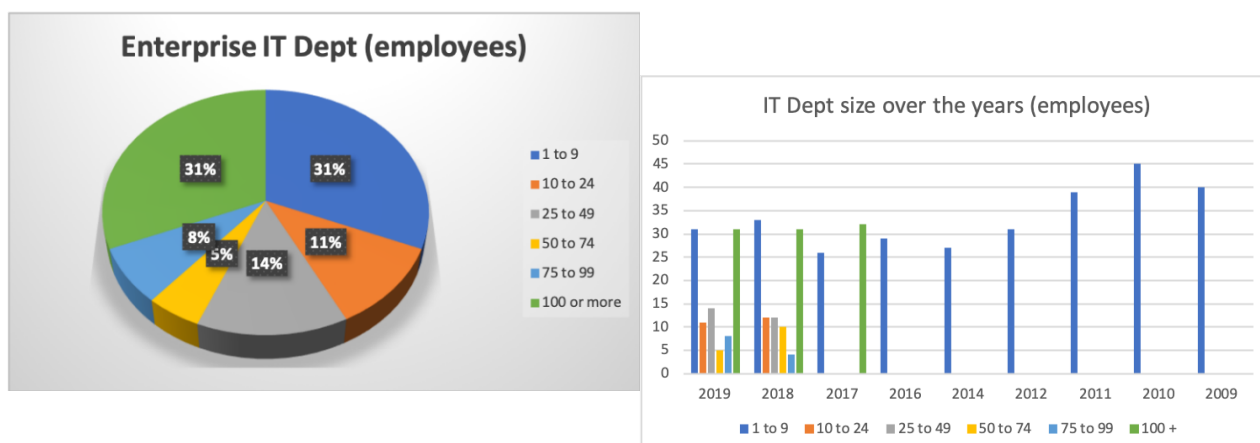
52% of enterprises responding to the survey are South African private enterprises and 19% are foreign-owned private enterprises.

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!



ANALYSIS OF CURRENT MICT SETA ANALYSIS OF THE SECTOR

Table 1: The MICT sector size of employers per Sub-Sector

Sub-Sector	Large (150+)		Medium (50-149)		Small (0-49)	
	2017	2018	2017	2018	2017	2018
Advertising	18	19	53	52	2 831	3 029
Electronics	76	77	113	113	2 946	3 173
Film and Electronic Media	47	55	56	56	2 615	2 827
Information Technology	170	171	351	357	12 178	12 881
Tele-communications	54	64	100	109	2 493	2 922
Grand Total	365	386	673	687	23 063	24 832

Source: The MICT SETA OGS, 2018

As in previous editions of this survey, we include the sector statistics from the MICT SETA in an effort to contextualise our results against the overall state of the sector. The table and figure numbers are from the MICT SETA's Sectoral Skills Plan (SSP).

Figure 1: Number of employees by Sub-sector 2017-2018

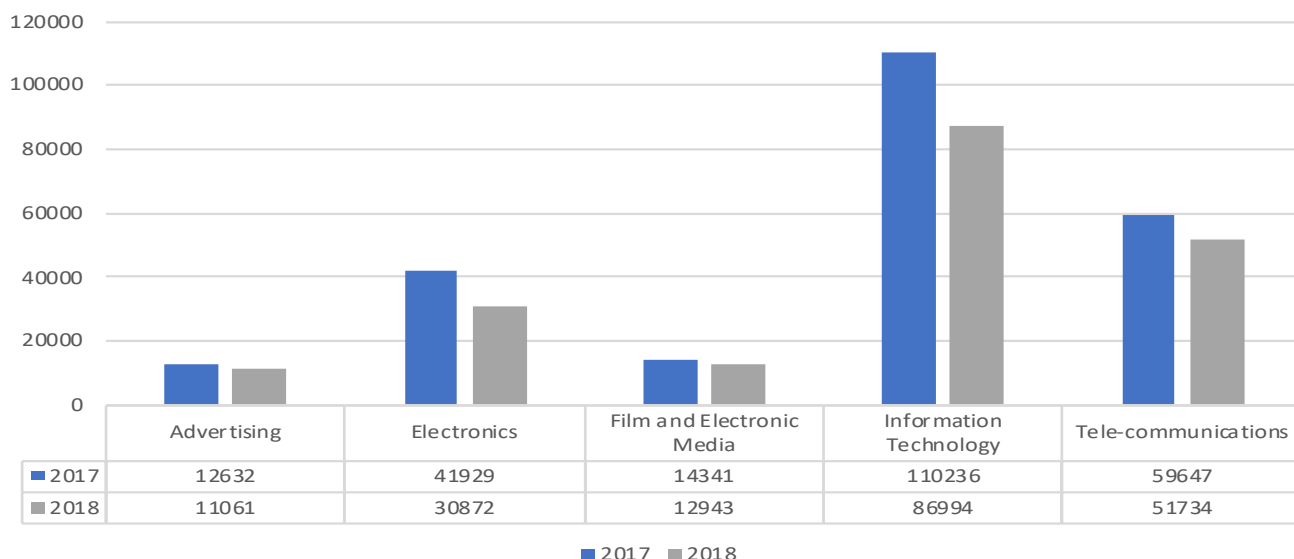
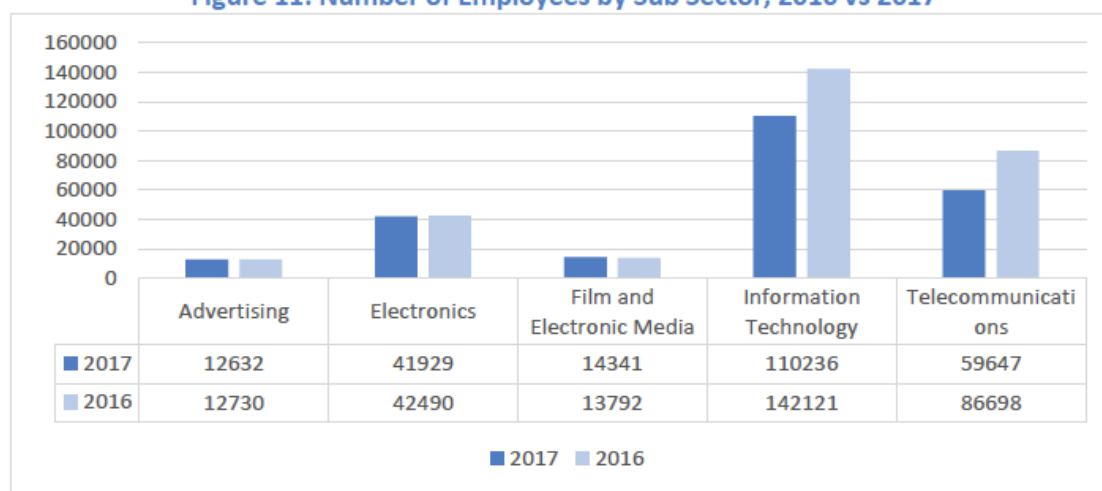
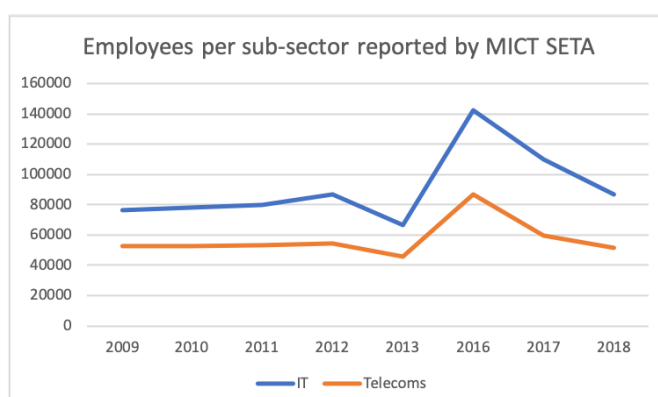


Figure 11: Number of Employees by Sub Sector, 2016 vs 2017



Source: MICT SETA OGS, 2017

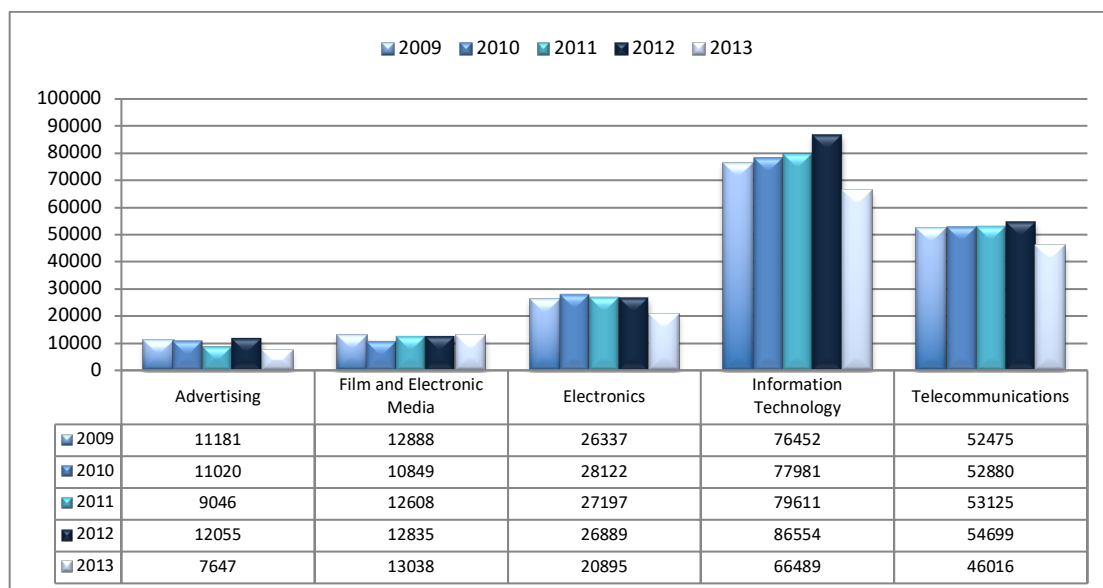
We note that the current SSP does not include the historical data on employee numbers, so we have retained the charts from the 2017 (above) and 2014 SSPs (see below) for comparison purposes.



In this chart, we show the fluctuations reported by the MICT SETA during 2013 to 2017 and we are unable to explain why the numbers varied so significantly. The number of enterprises has not reflected this degree of change.

The numbers reported in 2018 appear to be returning to the pattern established from 2009 to 2012.

Number of Employees by Sub-sector, 2009 to 2013

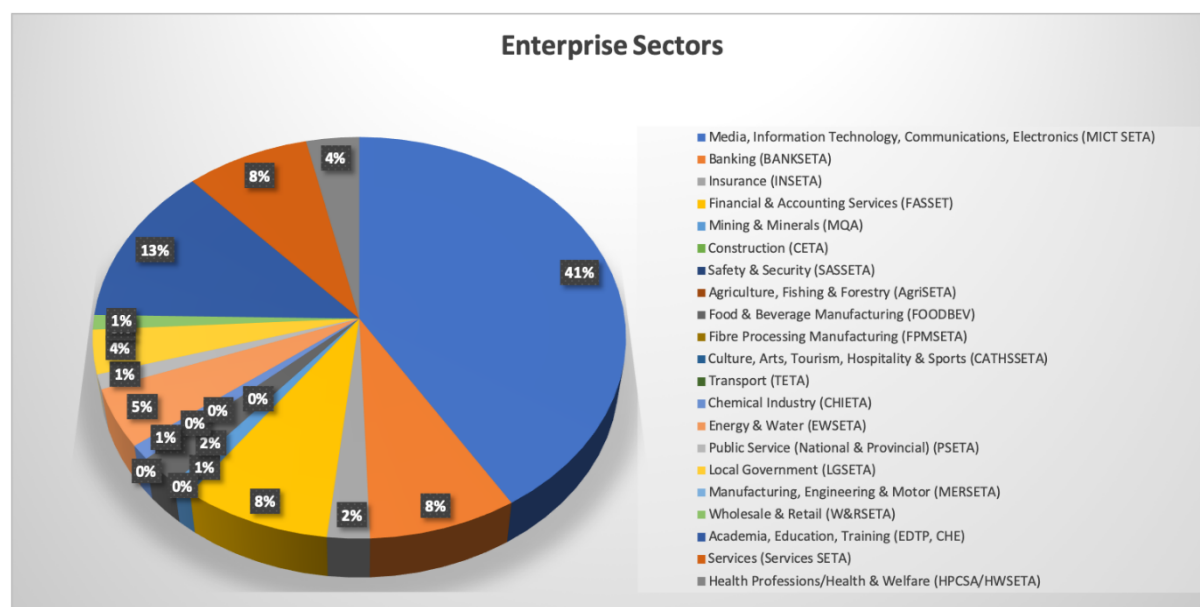


Source: The MICT SETA OGS

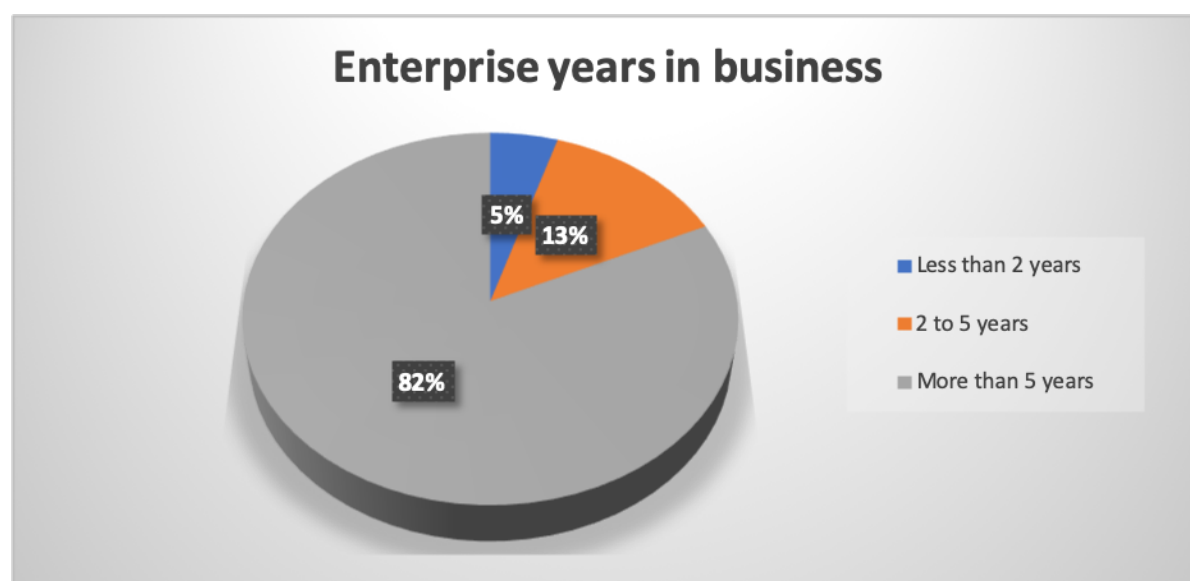
We note that it can be difficult to measure the effect of interventions concerning employment in the ICT sub-sectors, given the variations in employment numbers appearing in these reports.

Based on information supplied by levy payers, the MICT SETA suggests that 41% of employees in the MICT Sector are female but this is not broken down into sub-sectors. This is a very high proportion. Overall, the ICT Sector locally and globally reflects a female proportion around the 20% mark. The MICT SETA also indicates that 34% are White, 43% Black and the remainder almost equally split between Asians and Coloured people.

SECTORS



Our corporate respondents represent most of the sectors where ICTs play a significant role in their operations. More than 80% of them have been in business for longer than 5 years.



SECTOR SKILLS PLAN CORRELATION

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' approaches to ICT skills. In the following sections of this report, we extract the information available from the latest published SSPs. We note the shift in emphasis from Scarce and Critical Skills to Hard-to-Fill-Vacancies (HTFVs). The focus on the Top Ten HTFVs means that there is often no mention of ICT skills in those sectors where they don't make it to the head of the list.

MICT SETA

In common with several other SETAs, the MICT SETA published a SSP (MICT SETA, 2018) in August 2018 for the period 2019 onwards. The information in this section is gleaned from that document and is attributed to the MICT SETA.

"The MICT sector is currently made up of almost 29,000 companies spread across the five sub-sectors. These estimates represent only companies allocated to the MICT SETA through the SARS registration process. About 50% of the sector employer base is constituted by organisations in the Information Technology sub-sector, followed by Telecommunications with 18%, Electronics with 14% and Advertising with 11%. Contributing the least from the sectors is the Film and Electronic Media with 7%. Overall, the number of levy paying employers has increased by 10.2% in 2018 (7089 employers), up from 6602 the previous financial year.

Economic growth in the MICT sector has been lagging. While the Film and Electronic Media as well as the Electronics sub-sectors have been vibrant, the other sub-sectors have not performed as they might have been expected to.

There is also a general perception that there has been an adverse trend on the labour market. Employer data submitted in 2018 reflects employment at 193 604 down from 238 785 people employed in companies submitting WSPs in 2017.

“Skills Demand, Supply and Scarcity

The following is a list of top 10 occupations with hard to fill vacancies in the MICT sector (and the quantity needed).

- Software developer (1131)
- Computer Network and Systems Engineer (352)
- ICT Systems Analyst (316)
- Programmer Analyst (165)
- ICT Security Specialist (150)
- Business Analyst (126)
- Multimedia Designer (121)
- Advertising Specialist (106)
- Database Designer and Administrator (91)
- Telecommunications Network Engineer (91)”

[NB These figures are now a year old. In August 2019, Career Junction reported a 27% drop in ICT sector jobs in the previous year – a deeply concerning development in this normally resilient sector. IT as a sector remains highest in the demand table at over 30% vacancy level against a supply level of 8% (Career Junction, 2019).]

“Key Skills Issues

THE FOURTH INDUSTRIAL REVOLUTION AND ITS CHANGE DRIVERS IN THE MICT SECTOR

The MICT sector in South Africa is an important cog of the national economy. While the sector contributes positively to the GDP, there is a global phenomenon termed the ‘Fourth Industrial Revolution’ which alters the way communities live and work through a fusion of technologies, blurring lines between the physical, digital, and biological spheres. It is a complex application of Science, Technology, Engineering and Mathematical (STEM) knowledge at its core. In its simplicity it is an extension of ‘Industrial Revolution 1, 2 and 3’ with an addition of Artificial Intelligence (AI) built into machines that can think and do most things that were the sole prerogatives of the human species in the past. With South Africa pushing to be an E-Skilled economy as outlined in the National Development Plan, Vision 2030, key trends or change drivers that affect the MICT market and the Socio-economic systems are identified and discussed below:

CLOUD COMPUTING

‘Cloud Computing’ is a key driver of digital transformation in South Africa. It is a disruptive delivery model of Information Technology (IT) services that is based on a business model that is flexible and on-demand. Microsoft defines cloud computing as the delivery of computing services—servers, storage, databases, networking, software, analytics and more—over the Internet (“the cloud”). Companies offering these computing services are called cloud providers and typically charge for cloud computing services based on usage, similar to how utility services such water or electricity are billed.

The manner in which cloud computing evolves puts pressure on skills development, not only in South Africa, but globally. For example, cloud computing has taken to another level where, instead of deploying the software on the application, experts have a new type of technology called Kubernetes where a type of container can be quickly deployed on any infrastructure. People 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. A study by the International Data Corporation (IDC) reveals that in South Africa more than 90% of South African organizations are either already engaged in developing these skills or in the process of planning for development of such skills.

INTERNET OF THINGS (IoT)

The 'Internet of Things (IoT)' is another change driver in the MICT sector that comes with the '4IR'. It refers to the ever-growing network of physical objects that feature an internet protocol (IP) address for internet connectivity, and the communication that occurs between these objects and other Internet-enabled devices and systems. The IoT allows for remote management or monitoring of connected devices. The IoT will continue to grow as the cloud computing and cloud app offering space expands in the coming years.

In certain industries, the emergence of IoT technology is likely to result in job losses as certain processes performed by humans are automated through internet connectivity. For example, drone technology is already being deployed to conduct video coverage of major events as compared to handheld cameras. This will impact those that have been trained on the skill set of handling cameras for video coverage, thus, making their skills less relevant.

VIRTUAL AND AUGMENTED REALITY

With continuous efforts to solve social and economic problems daily, lines between 'Virtual (VR) and Augmented (AR)' reality are becoming increasingly blurred. 'VR' is an artificial, computer-generated simulation or re-creation of a real-life environment or situation. It immerses the user by making them feel like they are experiencing the simulated reality first-hand, primarily by stimulating their vision and hearing. While, AR is a technology that layers computer-generated enhancements atop an existing reality to make it more meaningful through the ability to interact with it, this is often through mobile applications.

Although experts highlight that with AR and VR new skills sets will become available without the need for qualified professionals to always be physically present, there will be increased demand for multimedia designers who can develop AR and VR functionality. For example; in the training industry flight simulators have become a way to easily train people without having to fly a real plane. Fewer, industry players have adopted this technology since it is expensive. But with the strong emergence of this technology it could prove to put training instructors at risk of losing their jobs as there will only be a few that will be needed to facilitate these training programmes.

BIG DATA ANALYTICS

With the emergence of the '4IR', properly managing 'Big Data' has become an important assignment for many organizations. According to experts in the field 'Big Data analytics' can be understood as a new generation of technologies and architectures, designed to economically extract value from very large volumes of a wide variety of data, by enabling high velocity capture, discovery or analysis.

In South Africa many organizations have started to realize the potential of 'Big Data and Analytics'. However, limited IT budgets and the dearth of skilled resources impede 'Big Data and analytics' initiatives across organizations in the country. Many organizations have started to consider internally developing skills by sharing resources, undertaking training programmes, and partnering with vendors. This will play a crucial role for organizations to establish a data-driven culture and encourage knowledge sharing to develop internal capabilities (IDC, 2017). The demand for highly

qualified big data analysts is exceeding supply to the point where it can take many months to fill vacancies. The root problem of this is that big data analytics is a new field and the existing workforce is having to re-train in order to work with large sophisticated datasets. Competition also plays a role as big companies recruit new graduates as they are graduating, thus, making it hard for small MICT companies to keep up with the changing labour market.

INFORMATION SECURITY

Increasing digitisation has come with greater security risks. Given the increasing dependency on ICT systems, and the growing complexity of connected environments, there is strong demand for and diffusion of software and tools to ensure IT systems security at all levels. According to PWC (2017:4) South African organizations are experiencing challenges with cybercrimes. There are dire financial implications as the affected organisations are spending ten times more on investigations as the original amount lost to economic crime. The report published by PWC revealed that about 19% of organizations have had to spend between twice and ten times as much on investigations. The supply of cyber security experts is lagging not only in South Africa but globally. Law enforcement agencies currently lack the ability to swiftly investigate and prosecute these crimes whilst organisations have to constantly improve their security features to fend off potential attacks. Frost and Sullivan therefore expect backup and disaster recovery services to be the fastest-growing segment in 2018 and cyber security skills will need to keep pace.

SKILLS GAPS

The MICT sector is increasingly operating in an ever-changing environment where new trends are emerging all the time. Workers in the sector have to constantly upgrade their skills to keep abreast of the latest developments. At the same time as people skilled in technologies move on or retire, there is still a need for maintenance of these systems based on old technologies. That means gaps exist for old technologies where new entrants lack such skills as well as for all the new technologies being rapidly introduced. The broad categories of critical skills gaps that exist amongst employees working across the five sub-sectors of the MICT are management and leadership skills, customer service skills, technical skills and production efficiency skills.

VENDOR PROGRAMMES

The significant demand for improving or adding to ICT skills is through vendor programmes. These are usually short courses offered by software and hardware companies and designed to introduce new technologies to those already in the industry. However, Vendor programmes can be longer courses that include generic skills and may be offered by TVET colleges and HEIs.

Vendor courses have the benefit of keeping up to date with rapidly changing technology. But for the same reason, these courses can quickly become obsolete if the product turns out to have a short shelf-life. There is also a concern that training content is focused on the vendor's products and therefore not generic enough to educate on the underlying principles. Consequently, there has been an apparent increase in the demand for customised training solutions rather than more comprehensive off-the-shelf training that covers a broader range of technology solutions. At the same time, stakeholders in the sector reported that employers increasingly want employees to cross-certify with multiple vendors. Having multiple skills is lately becoming an inherent job requirement.

To respond to the persistent demands for vendor certificates, the MICT SETA is mapping these programmes (such as Microsoft, CompTIA N+ and A+, and Cisco certificates) against existing NQF qualifications.”

OTHER SETAS

As previously, 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 only mention of ICT related skills in the AgriSETA SSP (AgriSETA, 2018) is in a table of Top Emerging Skills and Future Demand Needs, which includes “Information Technology” under the Horticulture sub-sector, without any further elaboration.

BANKSETA

As they usually do, the BankSETA stakeholders report in some depth on the technology skills required to enable and support an increasingly digitalised sector. The following passages are quoted from the BankSETA Sector Skills Plan for 2019/2020 (BankSETA, 2018).

BANKSETA has identified the following five strategic skills development focus priorities to which relevant projects are implemented and the sector skills needs are aligned in the SSP:

- Technology, Digitisation and Innovation
- Compliance and Risk Management
- Management and Leadership Development
- Markets, Products and Services
- Customer Centricity

Currently the South African banking sector is comprised of 18 registered banks, two mutual banks, 14 local branches of foreign banks, and 43 foreign banks with approved local representative offices. The Alternative Banking Sector comprises over 10 Development Finance Institutions (DFI), 3 Co-operative Banks, 24 registered Co-operative Finance Institutions (CFI), a large number of credit providers, credit bureaus and debt counsellors registered with the National Credit Regulator (NCR), over 100 financial technology (Fintech) companies and over 800 000 stokvels operating throughout South Africa.

Fintech Companies

Financial technology, also known as FinTech are companies that use new technology and innovation with available resources in order to compete in the marketplace of traditional financial institutions and intermediaries in the delivery of financial services. Financial technology companies consist of both start-ups and established financial and technology companies trying to replace or enhance the usage of financial services.

Change Drivers

The fourth industrial revolution is at the heart of five key drivers of change impacting the banking sector. The Five major change drivers are: Digitalisation and Technology; Changing Customer Expectations; Regulation, Risk and Cybercrime; Disruptors in banking and Political, Economic and Societal Shifts.

Driver 1: Digitalisation and Technology

Digital banking is the incorporation of new and developing technologies throughout the financial services sector to provide enhanced customer services and experiences effectively and efficiently. Digitisation in banking is driven by three major factors: Technology push, customer experience and economic benefits. Customers’ adaptation to the digital environment, forces banks to relook their products and services. Digital technology is rapidly influencing the way customers engage in banking activities.

‘Digital’ is a collective term which refers to an integrated and collaborative platform that allows consumers, suppliers and organisations to transact using various electronic devices or technologies. It brings together emerging technologies which include social media, cloud, analytics and mobile to provide a cost effective and convenient distribution channel for consumers to use.

The use of technology to better interpret the complex and evolving needs of customers so as to better engage with them is an area that the banks are expected to continue to invest in with a view to strengthening their capabilities through smarter and deeper use of predictive data analytics and better harnessing the wealth of information that already exists within their systems.

Technological innovation is revolutionising the banking industry. There is no getting away from the fact that banks are under threat unless they can keep pace with technology. Some of these innovations are great for banks. Cloud computing, for example, can reduce costs and promote low-cost innovation. But some advances disrupt banking in a big way, like crypto-currency, which skips banks in the payment process. The four technological advances that are changing the face of banking, for better or for worse are social media, mobile banking, cloud technology and crypto-currency.

Banks traditionally operated in silo channels, with different business areas operating independently of each other. The introduction of open banking and PSD2 will see a new way of banking emerge. It will allow the industry to innovate and enhance customer service and help new entrants (fintechs) gain a share of new financial products and services. Large banks have built their technology and data around individual products and channels and are beholden to legacy systems.

To overcome this, banks must invest in technological capabilities and incorporate the right architecture to respond quickly and drive an agile culture throughout the business.

Driver 2: Changing Customer expectations

Today's connected consumers have embraced technology to such an extent that it has become an extension of them. Influence of mobile technology, social media, rising customer experience and service expectations and lower switching costs for customers to take their business elsewhere have dramatically changed the competitive landscape for banks. With ready access to information, influence of online retail experiences and adoption of new technologies, customer expectations are rapidly changing. This is driving a shift in the market and forcing organizations to develop new interaction models that deliver deeper personalized service and improved customer care.

Banks need to put the customer at the heart of the design process and take new products to market quickly. They also need to be more attuned to their customers' needs—determine how they can better engage with their clients, know the products they want and predict what's needed rather than wait and react. This means embracing social media, giving customers more ways to interact with the business, rethinking traditional marketing tactics and mastering analytics. Tech-savvy customers are increasingly seeking a user experience that aligns to their individual needs.

Central to a bank's success in the digital economy is therefore the data they accumulate about customers and intelligent ways of processing it. Data is only useful if banks can use it effectively. Banks must ensure they have easily accessible, high-quality data. It is not about the volume of data but the application that will make banks successful. By gathering meaningful insights, they can create audience segmentation and deliver innovative, customised products in a way that appeals to customers. Banks need to reach a point where they understand the needs of the customer, without taking any direct feedback.

Driver 3: Regulatory Changes, Risk and Cybercrime

Criminality and technology risk are becoming increasingly concerning for banks given the rise in new competitors who are challenging traditional ways of doing things and operate using more nimble systems and lower overheads. The IT systems of the banks are now the focus of determined criminals who can transfer millions of pounds (or indeed any currency) within seconds to different accounts and move money across jurisdictions and borders with a few strokes of a keyboard. With IT systems of the larger banks under scrutiny for failures and inadequate controls, it is open to question whether the level of security and infrastructure will be sufficiently robust to withstand the challenge of cyber-crime. To improve cybersecurity, banks will be forced to devote greater resources to enhance the security, vigilance, and resilience of their cybersecurity model.

Driver 4: Disruptors in Banking

Retail companies have a daily relationship with consumers. Consumers flock to retail stores. Retail companies strive to increase consumer average consumer purchases: they have created consumer credits subsidiaries to increase consumer spending power. Doing so, retail companies entered a new market (the consumer credit and cards market) to the expense of banks that used to enjoy a monopoly on the consumer credit market. Now large retailers are entering the payment and Digital Wallet Market. With the large number of Fintech companies offering online payment solutions, this could potentially grow the market share of retail companies.

The second disruptors are telecommunication companies. They are offering consumers and merchants payment services and digital wallets through their mobile devices using telecommunications networks and extending to-up initial functionalities. This is the second element that's slipping away from the hands of retail banks. Telecom companies have a much larger client base than banks, which provides them with the power to transform markets.

The third disruptors are internet giants, like Google, Amazon or PayPal. Google is working on the Google wallet. It wants to be able to account for every single purchase people make, and leverage the payment data for marketing, using its strong "Big data" capabilities. Whether or not blockchain technology or software would pass the legal and regulatory hurdles which exists in the South African banking sector is yet to be determined. A thorough legal investigation needs to be undertaken in South Africa in order to understand whether this technology and virtual currency system falls within the scope of the Banks Act, 1998, its regulations, the South African Reserve Bank Act, 1990, and the National Payment System Act, 1998.

Non-traditional players are increasingly exploring new opportunities, enabling them to challenge incumbents and continually change the state of banking in South Africa.

Implications for Skills Planning

Drivers of change means that the skills demanded will also change. For driver 1: digitisation and technology, the implications for skills planning is that the skills that will be in demand will be for high skills in computing technology, software development, artificial intelligence, robotics, etc. There will be a need for reskilling employees to meet the changes brought about by digitisation and technology. For driver 2: changing customer expectations, implications for skills will focus on the appropriate ways to deal with customer queries and challenges. Customers are changing their expectations of banks and banking services and employees who work with customers must possess skills to communicate effectively with customers and resolve their queries in the shortest possible time. For driver 3: regulatory changes, risk and cybercrime, the implications for skills planning is a greater focus on the new regulatory framework for prudential and conduct authorities, cyber security as a risk that all banks must address by ensuring they have the appropriate skills to manage these risks. For driver 4: disruptors in banking, the implications for skills planning is that agility skills and skills to develop a multi-disciplinary employee is important. For driver 5: political, economic and societal shifts, the implications for skills is mostly within management and leadership ensuring that leaders possess skills to manage their teams in turbulent times ensuring they are capable of leading change within their work environments.

The change drivers listed above indicate that a change in the occupational landscape is emerging. Many new occupations with a strong technological flair like data management, data analytics and data scientists are emerging in the sector. In addition, the soft skills required are changing to include skills like agility, innovation, creativity, problem solving, etc. Career fit seems to be the buzz word in terms of the skills needed in the banking sector where re-skilling and upskilling for new job roles is currently underway.

The BankSETA table of Hard-to-fill-vacancies includes the following ICT roles, with reasons for scarcity:

251101 ICT Systems Analyst – lack of relevant experience

251201 Software Developer – equity considerations, poor remuneration and poor job location

251203 Developer Programmer – lack of relevant experience, lack of relevant qualification, equity considerations

252101 Database Designer & Administrator - equity considerations, poor remuneration and poor job location

252301 Computer Network & Systems Engineer - lack of relevant experience, lack of relevant qualification

252901 ICT Security Specialist – lack of relevant experience

The BankSETA adds the following comment on the education system (op.cit):

The South African education system has not 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. The data provides an astounding indication that for every one hundred learners who enter the schooling system, only thirty-seven pass matric and only four finally complete with a full complete university degree. A further examination indicates that when these individuals enter the skills supply pool, of a hundred job seekers, only 4 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 high skill individuals. This is evident from the types of occupations that are in high demand as discussed in the previous section.

The BankSETA's Pivotal List includes the following information about planned interventions:

Occupation Code (OFO)	Occupation	Specialization / Job	Intervention Types Planned by SETA	NQF Level
2015-251203	Developer Programmer	<ul style="list-style-type: none"> • ICT Programmer • Applications Developer • ICT Developer • Software Developer 	Bursary	6
2015-252101	Database Designer and Administrator	<ul style="list-style-type: none"> • Database Architect • Database Analyst • Database Administrator • Data Administrator 	Bursary	5
2015-252301	Computer Network and Systems Engineer	<ul style="list-style-type: none"> • Network Engineers • Systems Engineers 	Bursary	7
2015-251101	ICT Systems Analyst	<ul style="list-style-type: none"> • ICT systems Designer • ICT Systems Specialist • ICT Business Systems Analyst • ICT Systems Consultant • Computer Analyst • Systems Programmer • LAN/WAN Specialists • ICT Systems Strategist • ICT Systems Architect 	Bursary	7

CATHSSETA

The CATHSSETA covers Culture, Art, Tourism, Hospitality and Sport. Its SSP (CATHSSETA, 2017) discusses the role of technology in some depth, as quoted below, but does not specify in any detail the specific skills required to implement and support that technology.

Technology is a key driver of change for businesses within the CATHSSETA sector and the impact of technological advancement is seen within all the six sub-sectors. An example of this within the Gaming industry is the increase of online betting which, although illegal, has tended to widen their offerings and attract new types of customers. The proliferation of Electronic Bingo Terminals, or stand-alone mini casinos, is also widening the offerings. Within the lotteries industry, the impact of technological change is seen in the increasing availability of online platforms - such as mobile phone applications, and website and mobile banking applications – through which customers may purchase lottery tickets.

In the Tourism and Hospitality sub-sectors, technological advances have resulted in the use of electronic tourist passes, global IT booking systems, satellite-enabled environmental management, the sustainable management of tourist resources, telecommunications integration, energy-efficient microsystems, food hygiene control systems for hotels and restaurants, the equipment and systems to improve accessibility for disabled persons, electronic translation devices, and thalassotherapy equipment for hotels (International Labour Organisation, 2014). Other key technological changes affecting the industry include the growing use of the internet to purchase services, the growing popularity of User Generated Content websites (such as Tripadvisor), the use of database mining techniques to target consumers, and the increased utilisation of social networking websites as marketing tools.

In the Hospitality industry, the availability of the internet has seen an increase in the online booking of accommodation as well as the number of establishments providing Wi-Fi. Most recently, hotels are adopting digital systems that allow service automation such as mobile check-in and room service, as well as upgrading guestroom technology to support the devices guests use. There is also a move towards creating a personal experience for guests which entails leveraging data from social media, mobile apps and on-premises sources to meet guests' preferences. The implication of these advances is increased investment in both capital infrastructure and the availability of skills to service such technology.

A review of the tourist guiding and car rental industries indicates that the role of technology has become increasingly more important here. To improve on the product being offered to tourists, employees in these fields need to be able to use technology. An example of this is a Tour Guide having immediate, online access to information on key points of interest when guiding tourists, including remote listening devices that tourist guides use when guiding visitors.

The Sport, Recreation and Fitness sub-sector has also become more technologically driven, with technological advances in gym equipment, electronic media and the manner in which sports events are covered. The use of technology in sporting games is on the rise and encompasses various technologies, such as Hawk-Eye Technology, high-tech aids that help referees in decision making and numerous software packages designed to enable fitness and nutrition professionals to organise data and produce reports. In distance running programmes, trainers use smart clothing (humionics) to monitor distance and body functions. There is also an increase in the use of assessment devices by personal trainers to create body imaging for clients.

Advancement of technology has also changed how people view or gain access to sport. The internet and cellular technology now allows people to receive match results instantaneously, at the same time allowing for new ways of advertising through sport.

The implications of these technological advances is the need for new skills set for traditional occupations. In the Conservation sub-sector, curators and conservation biologists require information management skills. As a result, there is a growing demand for crosscutting trans-disciplinary skills. This calls for tailored professional development programmes to support the traditional higher education curricula, which should also offer programmes of specialisation at post-graduate level. The increased use of technology is likely to reduce the need for some physical human resources while at the same time driving the demand for new skills and roles to be generated. In the Arts, Culture and Heritage industry there is a move towards increased use of digital communication in editing and post-production tasks, which will likely impact the human resources required. Similarly, the use of virtual fitness instructors within the Recreation field will likely see a decrease in the use of Fitness Instructors and fitness facilities.

CETA

The Construction SETA (CETA) refers to technological advances in its SSP (CETA, 2016) in the following terms:

2.2.1 Technological Advances

The world is increasingly moving towards a more digitised world. The advent of technologies such as the internet of things is changing how society engages with the world. The change in traditional building methods is fast changing with developments in construction such as “Offsite construction¹⁰” gaining ground as an alternative building method that offers the benefits of reduced construction time, less waste and possible cost savings. Building Information Modelling¹¹ (BIM) has been a growing trend for years, as it is no longer relegated to just the largest firms but is seen as providing tangible business benefits such as more consistent, more accurate and less time consuming project document generation.

Building and Construction industry (and its professionals) require advanced skills to cope with and optimally utilise technological advances in the industry, such as off-site prefabrication, laser scanning, 3-D printing, dry walling and projector plastering. A few recently completed projects in South Africa utilised these technologies such as the SANRAL building, Diepsloot housing project and the Cell C JHB campus at Waterfall Business Estate.. It will require form institutions of learning to be at the forefront of technology and impart such knowledge to young people studying to enter the construction sector, either as professionals (architects, quantity surveyors, engineers) or in management (project managers, planners and schedulers, quality assurance specialists)

The CETA also says that advanced mechanisation, robotics and digitisation have some serious implications for the skills needs in the sector, in that workers may require digital skills to operate in the sector. This will require higher level skills, upskilling of the existing workforce, partnership with Universities and engagement with industry.

CHIETA

The Chemical Industries Education & Training Authority (CHIETA) has a short section on technological development and innovation in its SSP (CHIETA, 2018), as quoted below.

The fourth industrial revolution is ushering a digital revolution characterised by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres. Some of the critical breakthroughs will be in various fields such as artificial intelligence, robotics, the Internet of Things, autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage, and quantum computing (Schwab, k.2016). Advanced technology is extremely important in the Chemicals Industry and continuous improvement, breakthrough and development in technology is one of the key rudiments of the industry. New technological developments usually require that the skills of current staff have to be upgraded or new people with the relevant skills have to be recruited (these skills may not always be readily available).

The industry’s dependence on R&D also means that it is dependent on highly skilled professionals and scientists – some of which are in short supply in South Africa. Although there are job opportunities linked to technological development, employers argue that the use of technology for continuous improvement is very expensive. At the same time labour unions are concerned about the possible loss of jobs if technological advancement were to bring further mechanisation, particularly artificial intelligence. Furthermore, they have raised concerns regarding the possible resistance from current labour to e-learning opposed to traditional class learning. Research is needed to; establish how new technology can be embraced in the industry, develop a new mind-set for jobs of the future, and conduct a skills analysis against a competency framework that will assist in digitizing and synergizing current occupations to jobs of the future (CHIETA Strategic Scenario Planning Workshop, 2017; CHIETA Stakeholder Interviews, 2018).

However, CHIETA has only one reference to ICT skills in its HTFV list – 251101 ICT Systems Analyst, giving lack of relevant experience as the reason for being hard-to-fill.

EWSETA

There is no mention of ICT skills in the Energy & Water SETA SSP.

ETDP SETA

The Education Training & Development Practices SETA refers to the influence of the 4th IR in its SSP (ETDP SETA, 2018-08), noting that educational institutions are not immune to the influence of the Revolution, as

described by Professor Klaus Schwab. Technology impacts on teachers and learners, with potential enhancements arising from e-learning, multimedia, social media and new devices.

ETDP SETA also mentions that IT Managers for political parties are among the HTFVs, together with ICT Systems Analysts at PHETIs.

FASSET

The Finance and Accounting Services SETA (FASSET) SSP update for 2018-2023 (FASSET, 2017) (quoted in our 2018 report remains unchanged) for the financial and accounting services sector includes several references to ICT skills, as would be expected. Under “Change Drivers in the Sector”, they include Developments in Technology, with the following comments:

“Developments in information and communication technology have had and continue to have a profound effect on the work of professionals in the Fasset sector. It has, in many respects, made their work easier – for example accounting software has simplified the work of accountants (Attolini, 2014) and SARS’s online tax platform has simplified the work of all tax practitioners. However, accountants, auditors and many other professionals in the financial field need to stay abreast of changing technology and the associated business risks. At the same time they need to advise their clients on how to manage the risks and apply new skills to use technology effectively.

“Data security is becoming a crucial issue and all businesses have to introduce additional measures and controls to safeguard data security and to ensure statutory compliance with the manner in which information is collected, stored, used and destroyed. This drives the need for information technology professionals and technicians in the sector.”

After Accountants and Auditors, ICT Professionals are the occupations most in demand, with almost 600 (down from 1 000 in the previous update) requirements identified in roles including programmers, analysts and managers. If we add together the similar roles of programmer analyst, developer programmer, software developer and applications programmer, they constitute half of the ICT occupations in demand in this sector. 21 ICT occupations have been identified as suffering shortages in 2017.

121905	Programme or Project Manager
133101	Chief Information Officer
133102	ICT Project Manager
133103	Data Management Manager
133105	Information Technology Manager
216603	Multimedia Designer
243403	ICT Sales Representative
251101	ICT Systems Analyst
251201	Software Developer
251202	Programmer Analyst
251203	Developer Programmer
251301	Multimedia Specialist
251302	Web Developer
251401	Applications Programmer
252101	Database Designer and Administrator
252201	Systems Administrator
252301	Computer Network and Systems Engineer
252302	Network Analyst
252901	ICT Security Specialist
252902	Technical (ICT) Support Services Manager
351301	Computer Network Technician

FOODBEV SETA

The FoodBev SETA makes the following comment on technology in its Annual Update to the SSP for 2018-2019 (FoodBev SETA, 2017):

The impact of technology on the Food and Beverage Manufacturing Sector yielded a paucity of primary data. A separate research project that investigates the impact of the changing technological landscape and its impact on future skills needs, is therefore warranted.

Stakeholders from all sub sectors during the focus group sessions and in-depth interviews, mentioned that manufacturing plants are increasingly becoming automated, to decrease human-error. This is evidence by the increasing level of automation and associated complexity in the beverage manufacturing sub sector. In addition, technology is driven by innovation and regulatory pressure for healthier food in the baking, cereals and snacks sub sector. In contrast, in the poultry sub sector, the level of automation is not as pronounced as the other sub-sectors, as labour intensive processes are still in existence. The skills implications for increased automation are firstly; the need to upgrade the skills of operators who need to operate complex machinery. Secondly, the need for instrumentation control and automation capability skills amongst artisans is necessary. Finally, skills in laboratory analysis are relevant due to the impact of regulations on technology.

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:

“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.”

Included in the Hard to fill vacancies in the FP&M sector:

2015-216603 Multimedia Designer (90) Technological improvement.

“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

There is no mention of ICT skills in the Health & Welfare SETA SSP.

INSETA

The Insurance SETA (INSETA) SSP for 2018-2019 (INSETA, 2018) includes significant commentary on the effect of emerging technologies on the skills sets required in the Insurance industry. The following is an extract from this SSP:

1 Introduction

This chapter focuses on the key skills issues that impact the insurance sector. In 2014, INSETA commissioned research to look into the key change drivers within the sector; various professional bodies and industry associations were consulted. In 2015, the resulting report on key drivers affecting the insurance industry was released. A series of preliminary interviews conducted have shown that the majority of these change drivers are still prevalent in 2017.

The main overarching theme that will be followed throughout this year's research within INSETA is around Artificial Intelligence (AI) and Robotic Process Automation (RPA) technologies that aim to enable automation across a wide variety of tasks, processes, job functions, business areas and industry sectors. INSETA will focus research around the impact of skills for the future given the technological revolution we are faced with.

2 Change Drivers

The insurance industry has gone through its own digital transformation over the past five years. With a general acceptance that digital is here to stay, most insurers have incorporated digital into their organizations, implementing ad hoc capabilities to make their business faster and cheaper, creating online tools to further engage their distribution channels, and implementing table stakes technology in areas such as marketing, digital portals, customer self-service capabilities, and automation of some back-end processes. As we move into 2018, digital is continuing to reshape the way insurers do business (PwC, 2018).

Transformational technology

Sophisticated and universal technologies are both changing the way humans interact with each other, and creating floods of information with the potential to change the way sellers interact with buyers. Short-term and life insurance sector participants believe smart phones and tablets will present the most important opportunities for technological innovation over the next five years. In particular, they predict improved direct insurance and online distribution, new actuarial systems and real-time data mining.

Bringing new skills into the industry

Employers within the life insurance sector found an unexpected benefit in the technology-driven changes within the insurance industry. It is now believed that the industry needs a set of brand new skills – and this need is helping to drive the transformation process. Some employers are importing skills that are scarce because they are urgent/critical needs or to meet future demand through skills transfers. These trends create a need for a new high-tech skill set within the insurance industry. Key trends include the use of

- Big data
- Automated underwriting
- Technology in marketing, sales and service provision

Transformational effect of big data defined by available skills

But, to translate this data into insights that lead to more effective relationships within the market, the insurance sector needs an influx of technological talent with strong business skills, and there is a global shortage of people with the mix of IT and other diverse skills to manage big data.

HTFVs reported by INSETA include:

2015-251203 Java/Oracle Developer, including Program Developer

2015-251101 Business Analyst/ICT Systems Analyst

Reasons for hard-to-fill vacancies

2. *Applicants lack sufficient and/or appropriate work experience required for the post*
3. *The remuneration and employment conditions are not appropriate for the level of the post*
7. *Equity considerations (race, gender and/or disability)*

The skills gap associated with the Developer Programmer with the highest level of representation is Analyst Developer, Application Architect and Senior, System and Technical Developers. The next gap involves writing programs in a variety of computer languages, debugging programs and using computer-assisted software.

LGSETA

The Local Government SETA comments on technology in relation to the “smart cities” concept in its 2019/2020 SSP (LGSETA, 2018).

Technology is a ubiquitous driver of change in almost every facet of the economy. In local government, the adoption of new technologies has been variable. The bigger metros have introduced new technologies in the delivery of municipal services in areas such as water and electricity metering. Other uses include electronic billing, notices of service interruptions, etc. Apart from customer interfaces, the role of technology in modern municipal infrastructure is likely to gain importance as ageing equipment gets upgraded and replaced. Other developments include the introduction of the “smart cities” concept, adopted by many municipalities within South Africa, and digitalisation.

The smart city concept integrates information and communication technology (ICT) and various physical devices connected to the network (the internet of things or IoT) to optimise the efficiency of city operations and services and connect to citizens for a smart economy, smart mobility, a smart environment and smart people – revolutionising how the key basic services such as water, electricity, sanitation and roads are delivered. (SALGA, 2018).

Digitalisation and e-government initiatives have been implemented in governments across the world, although the extent and scale of their implementation varies significantly (Fang Zhao, 2015). An example of digitalisation within government in South Africa is where municipalities have partnered with Vodacom in order to develop a water management system that tracks and manages the municipality’s delivery of clean water. This system has led to improved service delivery and has allowed municipalities to engage more effectively with citizens (TechFinancials, 2018). One of the most important skills implications of the ever-increasing role of technology is that the minimum skills requirements in many occupations are increasing. The use of technology in a function increases the minimum skills required to participate in that occupation. This poses an on-going risk for the number of poorly educated unemployed, whose number of entry level occupations is decreasing.

The SSP also indicates a medium to high need for top-up IT skills in the Professionals and Managers staff groups.

MERSETA

The Manufacturing, Engineering & Related Services SETA focuses on what it refers to as “Industry 4.0” and the expected impact of technological advancements on manufacturing processes in its 2019/2020 SSP Update (merSETA, 2018). The following passages are extracts from that document:

Industry 4.0: Impact on Manufacturing Processes and Skills

Globally, we are at the brink of a new era where technological developments such as advanced manufacturing are radically transforming the labour market across all industry sectors, especially the manufacturing sector. The manufacturing sector as a whole, traditionally has been a major source of employment, providing both high-skilled and low-skilled jobs. As technological advancements are continually transforming the labour market, it is seen as a major change driver. South Africa needs to develop the skills needed to successfully leverage the technological advances of tomorrow in conjunction with the tenets of inclusive economic growth, reduced poverty and unemployment as entrenched across national strategies and plans.

This shift towards advanced manufacturing will produce new interaction models among other things that go beyond simply automating production (Deloitte, 2017). South Africa’s manufacturing industry is still at a foundational stage when it comes to the adoption of smart technologies that accelerate industry 4.0 (Figure 21) (Deloitte, 2017; merSETA Supply and Demand Study, 2018). Further technological advancements expected in the near future include advanced analytics or manufacturing analytics “MAalytics”, advanced robotics, increased adoption of 3D printing and 5G which is the fifth generation internet network relating to the concept of the internet of things (IoT) (Deloitte, 2017).

The increased adoption of robots and artificial intelligence in the South African manufacturing sector related to industry 4.0, has already affected jobs. Workers find that their skills are made redundant and they either face retrenchment or redeployment in areas where their skills can still be utilized. These realities faced by the current workforce must be taken into account to assist in job preservation and growth through realignment of skills where necessary. The expected future technological advancements in the sector will have devastating effect on an already stressed labour force if active steps are

not taken to equip them with the necessary future skills such as IT skills and blended skills through (re-)training or upskilling these employees to understand and operate new and smart technologies (Deloitte, 2017).

The advent of the 4th industrial revolution must not be viewed as a threat but an opportunity. Contrary to beliefs that technology will eventually replace the human worker, it brings with it many gains such as the adoption of new ways of production, creation of new jobs that were non-existent and expansion of markets. Technology enhances worker productivity and firms use new technologies to improve capital utilization, overcome information barriers, innovate and allow for more efficient management of firm operations (World Bank, 2018). Failure to respond to these changes and opportunities by putting in place appropriate mechanisms such as industrial development policies and strategies and skills development strategies is what constitutes a threat.

Future ready curricula must be developed in time to meet the demands of the future. With this in mind there is an emphasis on science, engineering and technology, increasing digital fluency and using technology to solve complex problems.

- These new or improved curricula must account for broad areas with respect to: predictive analytics, artificial intelligence, additive printing, the internet of things (5G), nanotechnology, automation and robotics.
- Professions in the future will typically center on the following types of jobs: motor manufacturing technicians, wind turbine service technicians, flexible app developers, computer programmers, artificial intelligence and robotics specialists, and cloud computing specialists among others.

Training to meet the needs of industry 4.0

The SSP has identified the fourth industrial revolution and skills requirement to meet the needs of advanced manufacturing practices as key drivers for the “mer” sectors. The SETA is an intermediary mandated to ensure that a competent workforce is developed in line with industry requirements, as such a key focus is the development of the current workforce, this needs to pay cognizance to the current economic situation, align to government strategy and meet employer needs at a practical level. In order to ensure that we develop a workforce that is future ready, the merSETA cannot omit the need to upskill, reskill and (given recent research findings) multi-skill the workforce. Schwab (2015) affirms that technological breakthroughs that have been made in fields such as artificial intelligence, data mining, robotics, the Internet of Things (IoT) and 3-D printing etc. will continue to shape the future of production and ultimately the labour market.

Frey et al (2013) postulates that more sophisticated software technologies are disrupting labour markets by making workers redundant and routine jobs are replaced by machines. The manufacturing sector has been hard hit in this regard, as evidenced through mass retrenchments (particularly in the metal sector) and the need to support industry through support schemes such as the Training Layoff Scheme (TLS) and a merSETA initiative in partnership with labour organisations called the Retrenchment Assistance Programme (RAP). It is critical to assess and take stock of necessary interventions to prepare the workforce for the opportunities offered by the Fourth Industrial Revolution. It is clear that workers must have the ability to be adaptable to new tech systems and remain employable. Therefore we raise the need to understand the concepts of reskilling, up-skilling and multi-skilling.

As the basis to provide the workforce (both the current workforce and new labour market entrants) with access to education that is relevant and contextual in the Fourth Industrial Revolution, an ICT course can be added as a pre-requisite module. In addition, Science, Technology Engineering and Mathematics (STEM) continues to be a critical need to address the country's skills problems. According to Paul Dunne, chief executive of Digital Skills Academy, cited in Mail and Guardian (2017) skills that would be in-demand in future globally will include computational thinking, or the ability to manage data processed individually and identify patterns; understanding data analytics, computer programming and design skills, customer-centred digital design skills, new media literacy and digital innovation skills. Some of the skills that will be added to specialised skills within occupations involve soft skills like problem solving, interpersonal skills and analytical skills.

In discussion with sector stakeholders, even high level strategists have intimated that it is difficult to predict what specific occupations will emerge in the near future but they all seem to confirm that there need to be a shift in mindsets in line with the notions of being agile, adaptable and emotionally intelligent as well as the need to ensure that workers are able to grasp concepts of big data analytics, ICT and artificial intelligence which leads to greater efficiencies and improved quality of production. Therefore, the merSETA must ensure a focus on both skills gaps (critical and top up skills) as well as technical abilities to carry out occupational requirements. It was suggested that dual trades could offer workers more possibilities in terms of lateral movements as well as horizontal movements as they navigate their career pathways.

Beyond the commentary above, the merSETA SSP does not make specific reference to any ICT skills needs.

MQA

The mining and minerals sector is also subject to the influence of technological change. In the Mining & Minerals Sector (MMS) Skills Plan Update for 2019-2020 (MQA, 2018), the Mining Qualifications Authority includes the following:

The integration of new and advanced technological applications in mining process and operations is transforming the landscape of the skills demand within MMS. This change places a new demand on the type, level and mix of skills and qualifications required by the sector. To meet this emerging demand, it is becoming imperative for employers to equip employees with relevant emerging skills to ensure that they are well versed with the digital and technologically advanced space brought by the fourth industrial revolution. A focus, for example, could be starting to train plant operators and elementary workers to operate new machinery and coordinate new processes that support their progression towards technical occupations.

Technology

Technological change remains at the forefront of the sector's ability to become as safe, efficient and sustainable as possible. The integration of new technological applications into operations in mining is transforming the landscape of the MMS as it places a new demand on the type, level and mix of skills and qualifications required. Technological innovation and moving into the digital space influences how work is organised, the materials and tools of trade to be utilised which create a new work paradigm. The technical complexity and communicative competences that come with emerging technology increases the need for communication skills that require medium to high level literacy competencies, ICT expertise and social communication in the workplace (Meyer & Wildschut, 2017). There is a critical need to upskill the workforce in the MMS through a range of skills in the context of lifelong learning as well as development and innovation systems to fit well in a fast-paced technological economy. As a result of technology, stakeholders mentioned that the industry is forced to look at alternative mining methods and technologically advanced methods of mining to ensure continuous profitable production and possibly increase the lifespan of existing mines. This comes with inherent job requirements and at times may result in job losses. With the use of the new machinery, methods of operations have shifted from owner/operator model to owner/outsourced operator model wherein outsourced businesses take a short view with small investment in skills development. To alleviate this challenge, it will be imperative for employers to equip employees with emerging skills to ensure that they are well versed with the digital and technologically advanced space brought by the fourth industrial revolution. A focus for example, could be starting to train plant operators and elementary workers to operate new machinery and coordinate new processes that support their progression towards technical employees.

The MQA has recognised the state of Mathematics and Science as a national challenge and have thus, taken active steps to improve the situation. The MQA's Maths and Science Project was established with the objective to support Grades 10, 11, 12 Maths and Science learners to achieve results that will allow them access to HET and TVET institutions to enrol for mining and minerals related qualifications. In 2017-18, the MQA committed to support 1 200 learners, to which 1 484 learners were assisted, thus contributing to a 124% achievement above the target. This was attributed to the organisation's willingness to support more learners.

The MQA is therefore, encouraged to continue supporting such initiatives to address the national aim of improving Maths and Science in schools. In addition, stakeholders suggested that these programmes should be monitored for impact, and that the lessons learnt be incorporated into the programme to ensure effectiveness. A popular suggestion from stakeholders was to also focus efforts on the development of teachers to ensure improvement of pass rates and quality of the subjects.

PSETA

The Public Service SETA includes technology as a major factor impacting on skills demand and supply in its SSP Update for 2019-2020 (PSETA, 2018).

"The role of technology as a key driver of change cannot be ignored. Technology has enabled many service delivery functions to shift towards more automated systems such as electronic record keeping, automated leave systems, online services, etc. It is increasingly becoming more expectant that government, in delivery of services, provide the same quality of customer service that citizens encounter in the private sector. Thus, integrating consumer preferences, with technology is one way of meeting expectations. This places a demand for new skills and innovation within the sector. One example of technological innovation within the Public Service sector is within the Gauteng provincial Department of Education where an online platform has been introduced for parents seeking school placement opportunities for their children. Information and Communication Technology (ICT) is seen as a key enabler to government departments to deliver better and more efficient services. The digitisation of the Public Service sector through e-government forms part of the move towards improved ICT systems within the sector."

The SSP goes on to comment on implications for skills planning:

“Technology as a driver of change in the Public Service sector has enabled most government departments to shift towards more automated systems such as electronic record keeping, automated leave systems, online services, etc. This places a demand for new skills that are ICT related. Further reskilling and retraining employees to be able to adequately engage and utilise new systems will be required. With the introduction of ICT systems for delivery of services, citizens require technical expertise to access and use such systems. Thus, any department introducing innovation ICT systems or platforms needs to have adequately capacitated employees to be able to support the implementation of such systems.

“In the Public Service space, technology in the form of e-learning has been identified as a crucial mechanism to delivering skills development in a cost effective and efficient manner. This delivery mechanism allows for skills development to evolve in terms of being more accessible and available to especially employed people within the sector.’

In the PSETA HTFVs are ICT Systems Analyst (10) and Information Systems Auditor (8), noting that the private sector offers better salaries.

SASSETA

The Safety & Security SETA reflects on the changing nature of crime and the criminal justice environment in its SSP Update for 2019/20 (SASSETA, 2018).

They state 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.

“Cybercrime investigations are complex and time-consuming and require highly skilled human resources. The sector needs to develop the technological and professional capacity to address cybercrime. Law enforcement agencies, prosecutors and public sector cyber professionals must receive training on current and anticipated cybercrime trends and techniques.”

The SSP also notes that there is an ongoing need for an integrated information system for the justice cluster, supported upgraded ICT infrastructure, emphasising the negative impact of the prolonged duration of the ICT system integration problems.

SERVICES SETA

The Services SETA SSP for 2018/19 (Services SETA, 2017) refers to ICTs as change drivers in the following terms:

The influence of technology cuts across all the subsectors. In 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 to access, compare and utilise information. The implications of such a trend is that real estate agents and property managers not only require information about the product that they are selling but they now need to have knowledge about brand management, digital sales, marketing and social media.

For business services subsector, ‘big data’ requires that managers and professionals acquire higher levels of analytical skills to use data strategically. General consulting services benefit from advancements in technology in two ways, namely, increased flexibility for work to continue outside of the traditional work 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. 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. Skills needs in this sector include IT and logistics.

Research indicates that 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, research indicates that the industry is seeing higher levels of automation of certain tasks and with customers becoming more technologically savvy, there is a growing trend in the reduction of the number of contact centre call agents. These developments have implications for the Services SETA. There is a need to develop relevant qualifications for contact centres.

The following are included in their HTFVs:

2015-251101	ICT Systems Analyst	ICT Systems Advisor, ICT Systems Consultant, Internet Consultant / Specialist, ICT Business Systems Analyst, ICT Systems Strategist
2015-251201	Software Developer	Software Designer, ICT Risk Specialist, Information Architect Software, Software Engineer, Software Architect
2015-251301	Multimedia Specialist	Digital Media Specialist, Digital Media Specialist, Multimedia Programmer, Multimedia Developer, Graphical Programmer

TETA

The Transport sector is yet another industry that acknowledges technology and innovation as change drivers in its SSP for 2019/2020 (TETA, 2018).

The transport sector is heavily influenced by innovation and international trends. It is widely accepted that new advancements in the technological space are shaping the direction of skills required in the global and domestic labour market (Spulber, 2016). Technology has led to the introduction of new players in the sector as witnessed through the growth and popularity of app-based cab services, such as Uber and Taxify (O'Toole & Matherne, 2017). The introduction of Uber and Taxify services has changed the level of competition. Literature also alludes to the fact that improvement of GPS technology has made it easier for transport businesses to gain real-time information about goods and/or people in transit. Hereby improving transit security and improving timing of delivery.

Most significantly, technology has shaped competition levels in the sector, placing convenience, security, travel-time and affordability among the various considerations in transit services. This position has been affirmed by group discussions especially in the North West where it emerged that there was a growth of taxi services operating through technology such as in the emergence of Eduze (Student Run mobile App for requesting Taxi's). Flexibility and affordability were the main justifications cited for the growth and popularity of technology-driven taxi services. With the opportunities presented by technology, there needs to be recognition that there are also associated threats to human resources especially on occupations that require low-level skills. Continuous automation of industries leads to the reduction of the workforce as many of the operations become machine-operated/managed. This is a major area of caution by trade unions in various commentaries. It is observed that skills demands are gradually moving towards the highly technical end. The automation of some functions poses job-security threats to occupations that require low and semi-skilled individuals (Ford, 2015). It is important that

transport sector skills planning takes into account emerging and future technological trends in designing skills development interventions. Undoubtedly, advancements in technology create the need for upskilling the existing workforce towards adapting to emerging technological trends.

Developer Programmers are included in the TETA HTFVs.

W&R SETA

Finally, the Wholesale and Retail sector also notes that technology is changing their industry in the W&RSETA SSP for 2019-2020 (W&RSETA, 2018). These changes include mobile applications, on-line shopping, big data, social media, cybercrime, mobile phones and Internet usage.

Although they mention the following occupational needs, none of them made it "above the median" in their list of HTFVs, except IT Manager (in 28th place):

Software Developer / Web Designer / Web Administrator / ICT Security Specialist / Programming / Machine device management

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. Although the specific skill sets and job roles derived from the 4IR environment have yet to be identified in Workplace Skills Plans, it is evident that many SETAs are aware of the potential impact on their initiatives in the future.

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.

The Department of Basic Education is reported to have trained 40 000 teachers in “computer skills” and will now begin bringing them up to speed with the coding curricula, in a programme to be rolled out to 1 000 schools in 5 Provinces from 2020.

There are many examples of private sector-driven initiatives to strengthen the resources that will enable learners to acquire at least the fundamentals of computer science. One such is CS First, from Google South Africa, aiming to train more than 30 000 learners in one year. Targeting grades 4 to 8, students watch instructional videos and build projects using Scratch. Further along the learning pipeline, Samsung, Microsoft, the University of the Western Cape and Wits University’s Tshimologong Digital Innovation Precinct target unemployed youth (matriculants and graduates) to equip them with coding and workplace skills. Cisco recently announced R140 million to be invested in their incubation centres, skills development and cybersecurity, indicating they have already had 71 000 students participating in Network Academy courses, 16 000 of them in the last academic year.

We believe there is an urgent need for coordination of these public and private sector activities, so that there is a clear relationship between the forecast skills needs and the pipeline to fill those needs. The Presidential 4IR Commission may be an opportunity to create the coordinating framework.

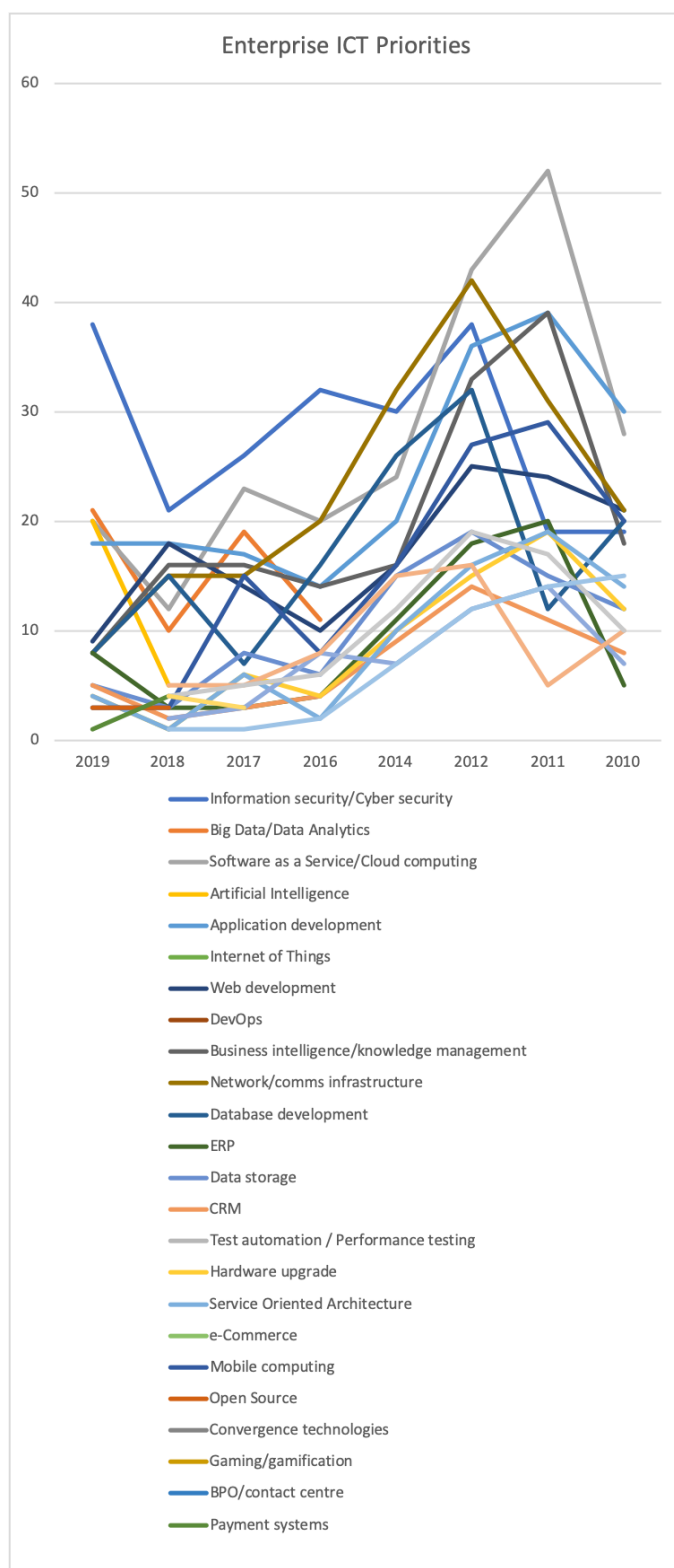
ICT PRIORITIES SINCE 2008

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 are: 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.

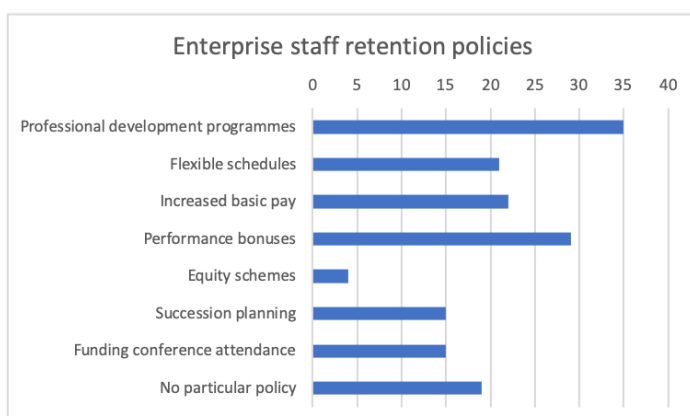
Our **2017** results showed two “top” priorities, **Information Security** (still the leader) and **Software as a Service/Cloud Computing** (up from 3rd place in 2016). Then, there was a group of 6 priority areas that all received similar ratings from our respondents. They were: **Big Data/Internet of 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.

The **2019** graphic (see previous page) shows the latest rankings on the left, with the historical data extending to the right. Clearly still the top priority, **Information security/Cybersecurity** has received even more attention than in 2018. Then there is 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 have fallen into the third level on the priority scale, well below the first and second levels.

South Africa must factor in the global demand for these priority skills. Australia is estimated to need 18 000 more cybersecurity practitioners by 2026 but can only graduate 500 such specialists each year, so will look to the international markets to close the gap. This is only one of the attractive emigration destinations available to skilled South Africans.



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 of corruption and introduction of new and improved technologies. In this section, we look at the ways in which employers approach the skills

pool conundrum.

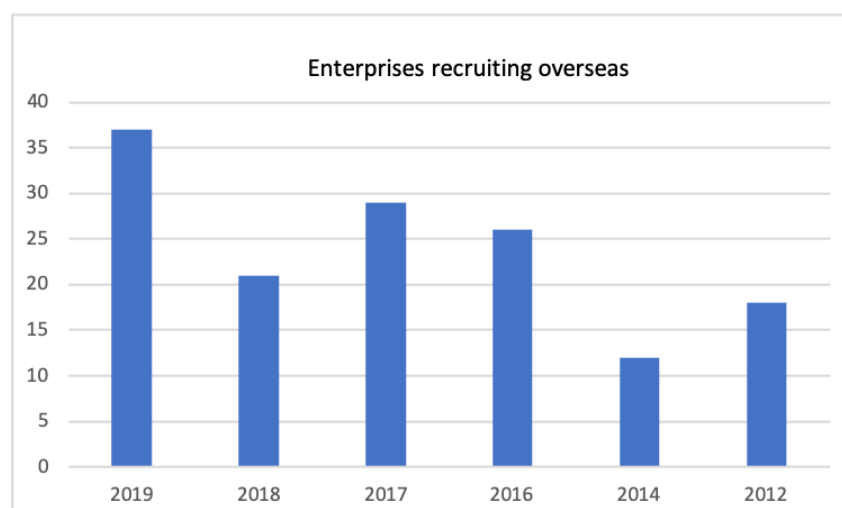
The pattern of staff retention policies in 2019 is very similar to previous years. Professional development programmes and performance bonuses continue to lead the preferences, with flexible schedules and increased basic pay grouped together. Funding of attendance at conferences appeared in this list for the first time in 2017. The low incidence of equity schemes may indicate low impact of BEE legislation on transformation of ownership in the sector. Comments from respondents place the emphasis on developers and programmers as the toughest to retain.



There continues to be a mix of line managers and senior executives holding the responsibility for training, with the 2018 respondents moving away from last year's equal share (just more than 20% each) between senior executives (C-level and Directors) and specialist HR talent and training managers towards 35% at the senior level and 25% within the HR/training camp. JCSE suggests that line managers should be able to identify training needs among their teams but the responsibility for executing the training

programmes should rest with a manager whose role is focused on this activity.

The percentage of respondent employers recruiting overseas in 2019 has dramatically risen to 37%, restoring the longer term trend. With the 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. 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. Sadly, the events in Q3 in South Africa may take the gloss off its attractiveness. It also remains to be seen if the proposed revisions to the "critical skills list" used by the Department of Home Affairs have any significant effect on the type and level of immigrant skills in 2020.



CORPORATE PREFERENCES

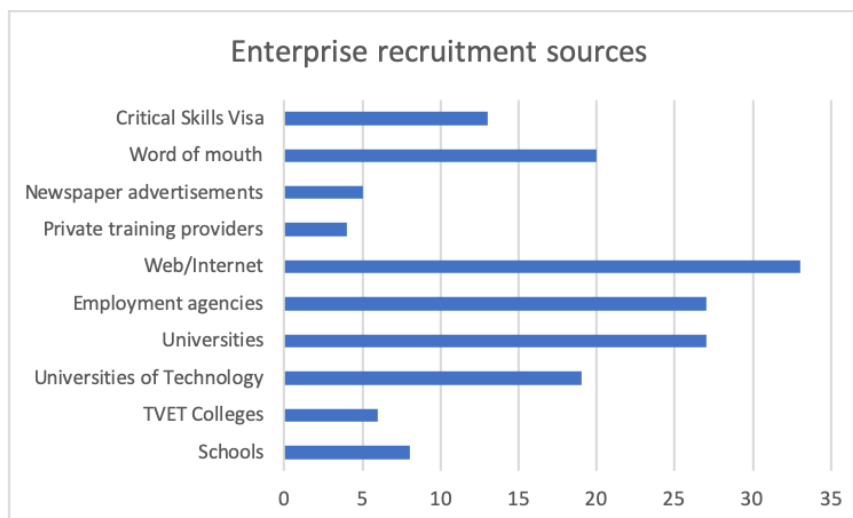
RECRUITMENT VALUE



Graduate degrees continue to be the top preference when setting recruitment criteria (as was the case in our last three reports). Post-graduate qualifications and diplomas are still valued, as is the application of international standards.

LOCAL RECRUITMENT

Since 2010, when this question was introduced, employment agencies have been the most preferred source, except in 2010, 2016 and now in 2019 when on-line was at the top.



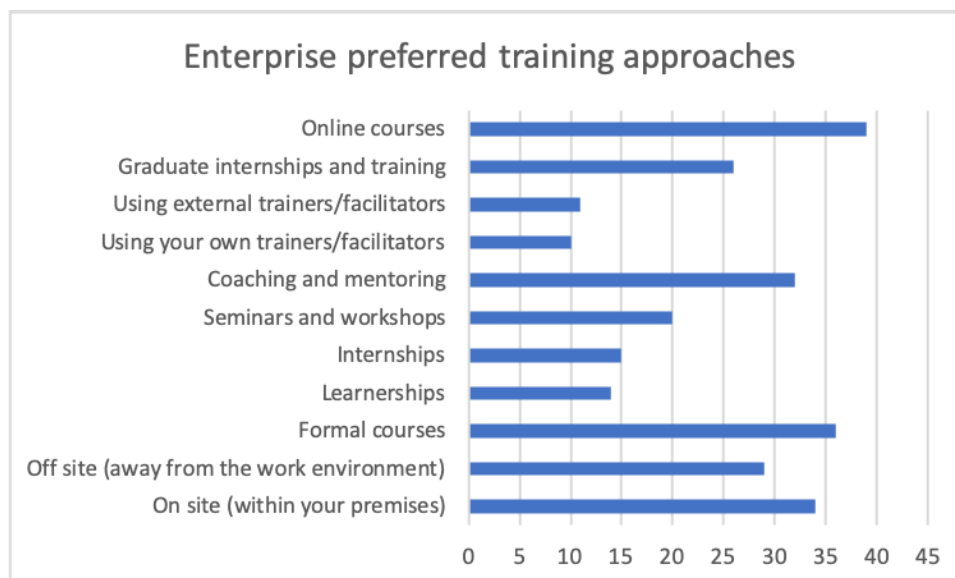
In 2017, we added Word of Mouth to the choices and it remains high in the rankings, falling between the two University categories. Employment agencies have taken second place in 2019.

Last year, we added the Critical Skills Visa to the question and it clearly represents a significant source of skills, reinforced by the increase in enterprises choosing to recruit overseas.

Universities continue to head the choice of institutional sources, and it is encouraging to see the maintained popularity of the Universities of Technology.

Newspaper advertisements, private training providers, TVET colleges and schools have all shown low popularity for the last three Surveys.

TRAINING METHODOLOGIES



The pattern of preferences for skills transfer in 2019 from the employers' perspective shows a balance between on-line and formal courses and a closer correlation between offsite and onsite venues than previously.

MANAGEMENT DEVELOPMENT



This year, mentoring and coaching have moved back behind formal courses as the preferred approach to management development. This repeats the findings of the 2017 Survey, which indicated that formal management courses moved ahead of the other approaches to management training, with mentoring and coaching taking second and third places. In 2016, mentoring was the preferred approach to management development, followed by continuing education and formal management courses. In the 2014 results, formal management courses took the lead from mentoring as the preferred approach to developing management skills, continuing the trend shown in 2012, when this approach moved from fourth to second place.

It is now four years since the appointment of the B-BBEE ICT Sector Council, and three 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. The 2018 report (B-BBEE ICT Sector Council, 2018) shows only a 50% achievement of the Management & Control targets. As with the

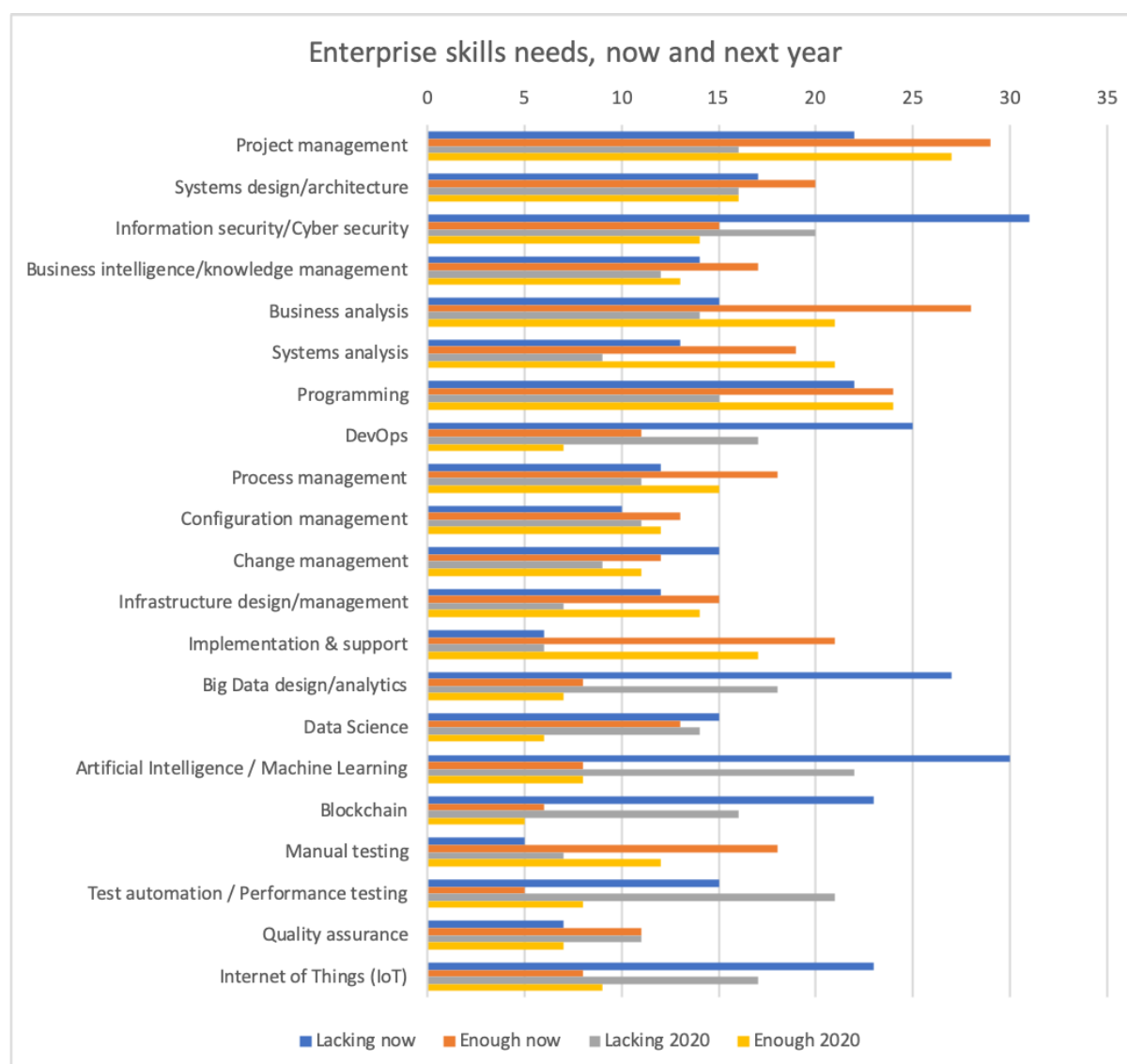
Generic Codes, the Sector Code will be amended before the end of 2019 to shift the emphasis between the elements of BEE.

SKILLS NEEDS

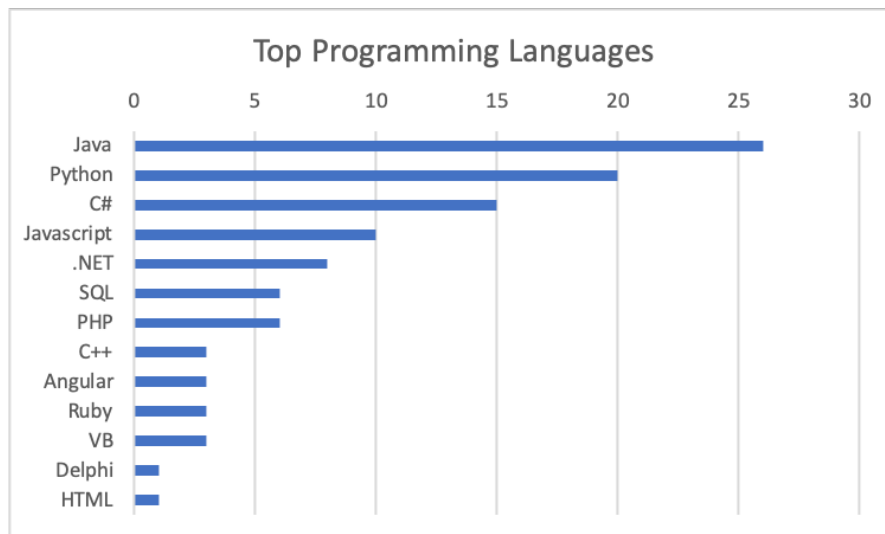
The chart below shows our respondents' view on which skills are most needed now and which in a year from now. The indicators to look for are where the blue (now) and grey (next year) lines are clearly longer than the orange and yellow lines, which suggest a sufficiency of those skills.

Significant shortages are indicated in the following areas:

- Information Security / Cybersecurity
- DevOps
- Big data design / analytics
- Artificial intelligence / machine learning
- Blockchain
- Test automation / performance testing and
- Internet of Things



Last year, the shortages were headed by Blockchain, Artificial Intelligence, Data Science and Big data design / analytics. Data Science is still showing a greater need than supply in 2019/2020 but not to the extent shown last year.



The pattern of demand for programming languages in 2019 sees **Python** move into second place behind **Java** and ahead of **C#**.

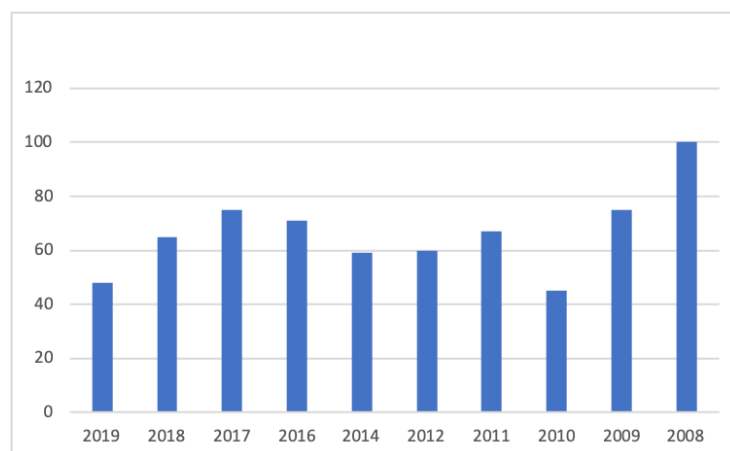
In 2018 **Java** was in the lead, followed by **C#** and **Python**. **.NET**, **C++**, **HTML** and **SQL** followed.

In 2017 was **Java** the clear leader and **C#** 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 ON BUSINESS

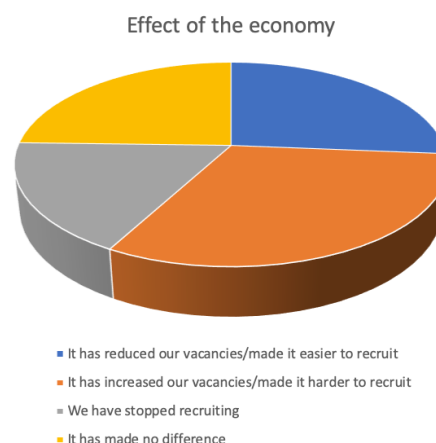


In continuing to track this opinion from our respondents, it is worth noting the improving trend of the last three years, with now less than half of the enterprises reporting a major effect.

In 2008, all respondents indicated that the skills shortage was having at least a major effect on their business. On average, the picture is better since then. Several factors can influence this trend. On the negative side, the stagnant

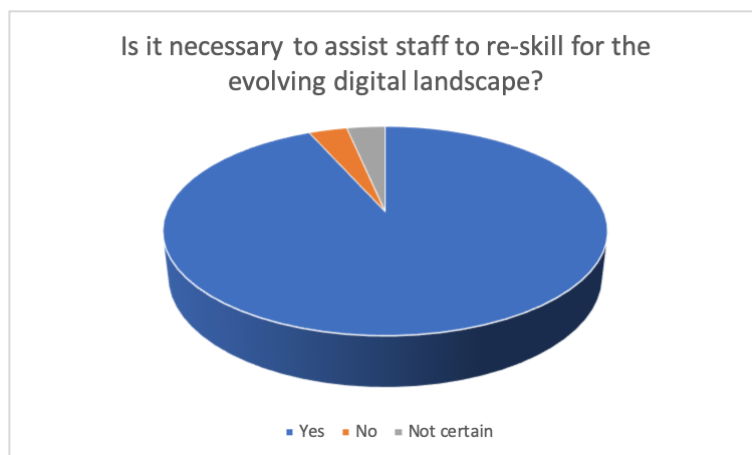
economy has reduced the business prospects of the employers, thus reducing the demand for skills, although that is not borne out by the number of respondents saying the opposite..

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.



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 an overwhelming “yes”.

CORPORATE SUMMARY

Our overall sense of what is happening in the ICT skills field from the employer perspective is that there is a slowing in the 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.

Some of the picture is made murky by the impact of non-technological factors – local and international politics, local and international growth rates and local societal issues of violence and crime.

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.

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. As with education initiatives, there are examples of job creation that offer hope for the future.

T-Systems has expanded its Midrand Service Desk to Hazyview, creating work for graduates of the Hazyview Digital Learning Centre. Amazon Web Services is expanding its Cape Town operations, bringing on board software developers, support engineers, UX designers, data scientists and security experts.

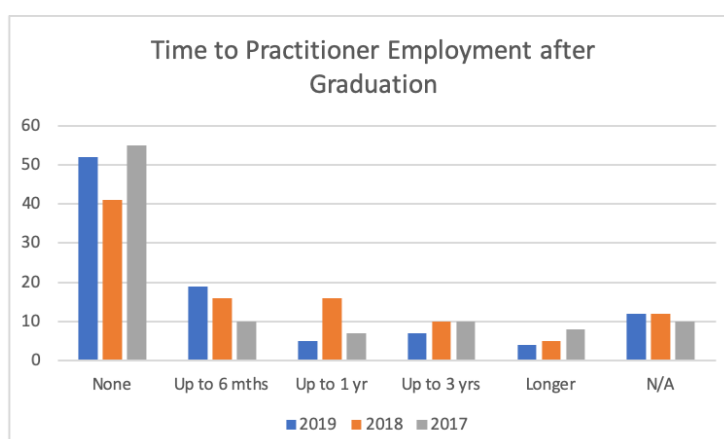
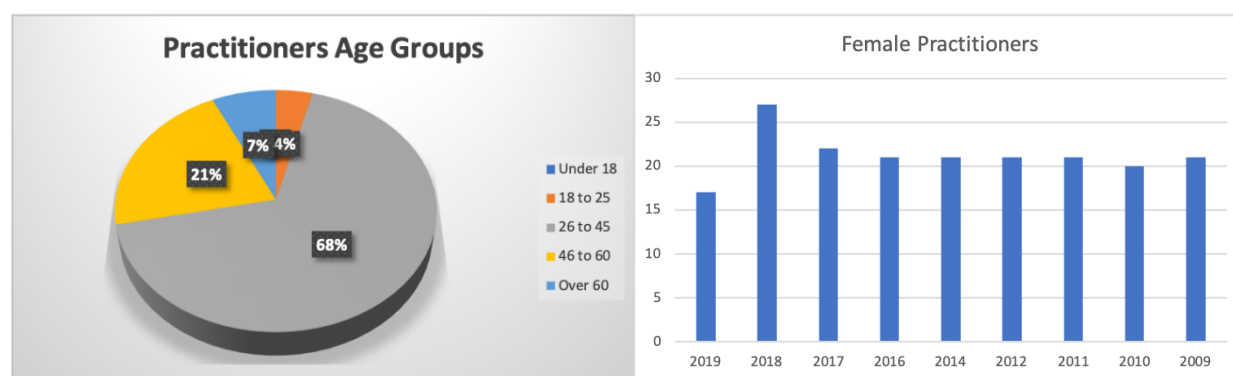
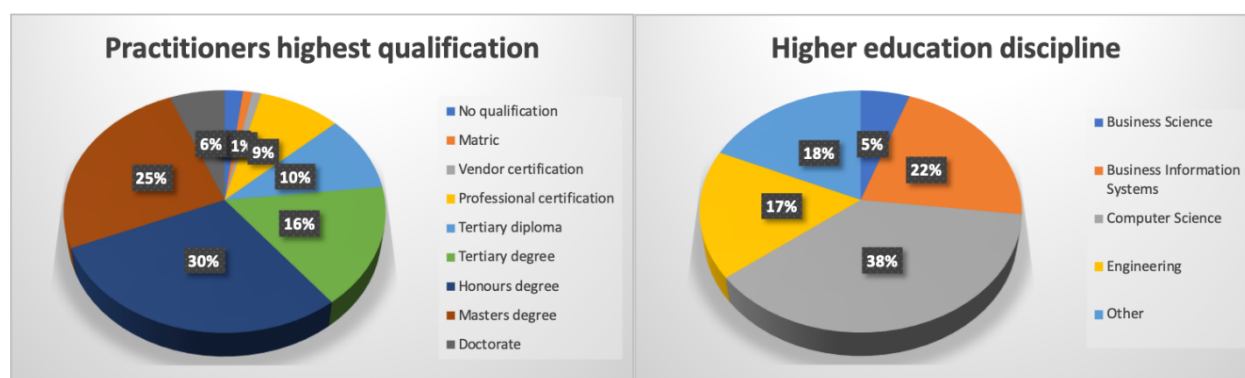
In themselves, these (and the many other) initiatives are impacting relatively small numbers but added together they can have a significant impact on the contribution of the ICT sector to economic growth in the South African context.

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 2017; 2016; 2014; 2012; 2011; 2010; 2009 results, respectively.

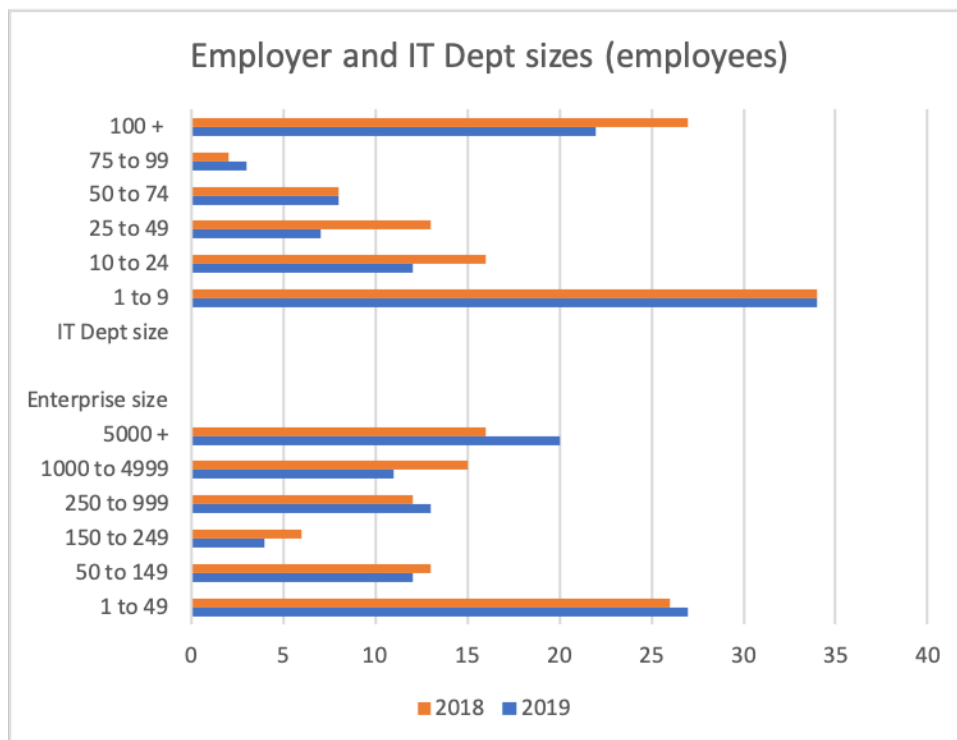
PRACTITIONER PROFILE

Our “average” practitioner respondent has changed a little in the last 12 years. He’s now in his early-30s, lives in Gauteng, is highly qualified, has more than 5 years’ experience (not quite as well established as in earlier reports) 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.

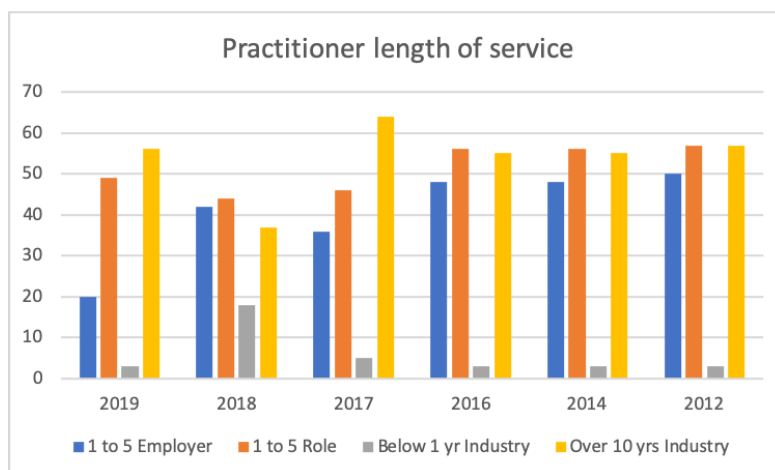


We inserted this question into the JCSE-IITPSA ICT Skills Survey in 2016, asking practitioners how long it took them to become employed, after they had completed their studies.

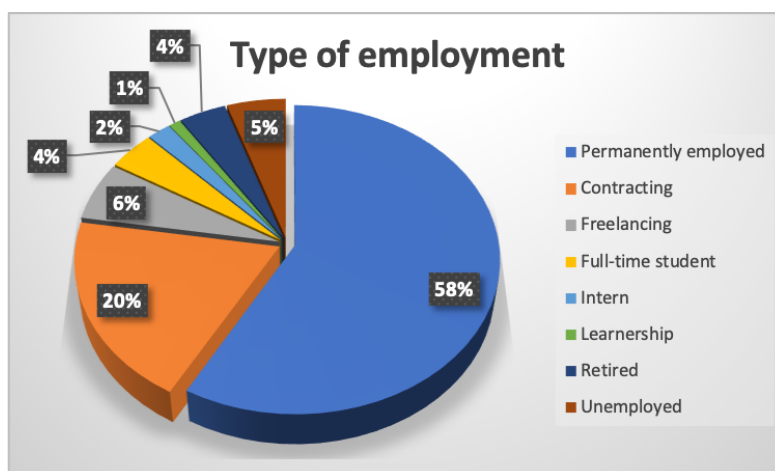
In spite of the perception that graduates are not “work ready”, it is pleasing that most see no delay in taking up employment.



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

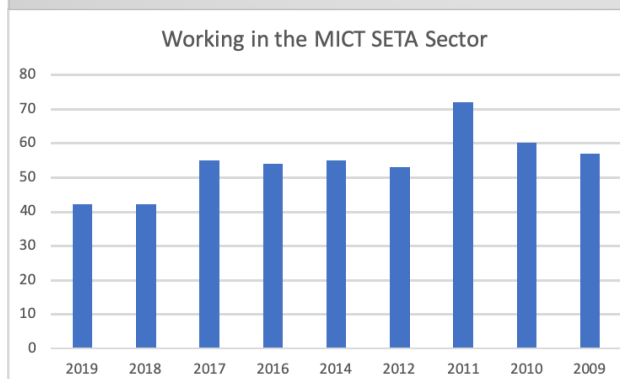
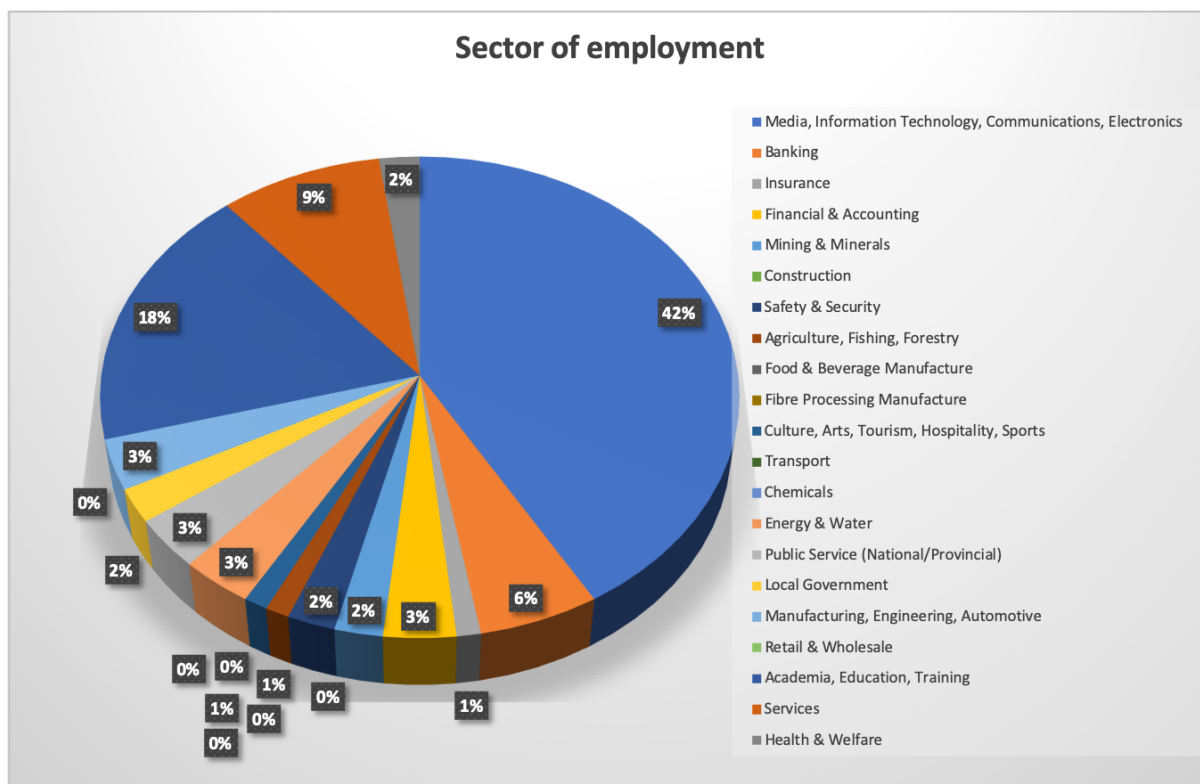


Almost half have performed their current role for between 1 and 5 years, Only 20% (about half of the average for the preceding years) have worked for their current employer for between 1 and 5 years and a small percentage have been in the industry for less than a year, reverting to the trend shown during 2010-2017. Over 55% of responding practitioners have been in the industry for more than 10 years – recovering from the dip shown in 2018.



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 and 2018. This is repeated in 2019. The flexibility of skills resourcing offered by the existence of the contractor pool now at 20% (25% last year, 15% in 2017, down from

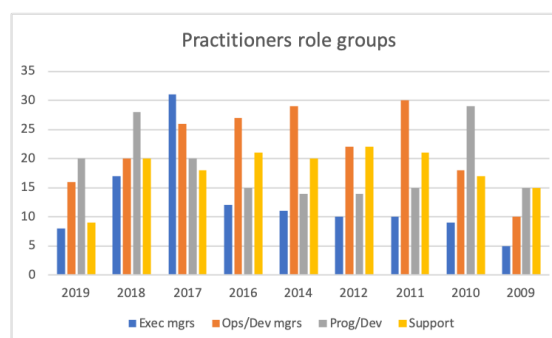
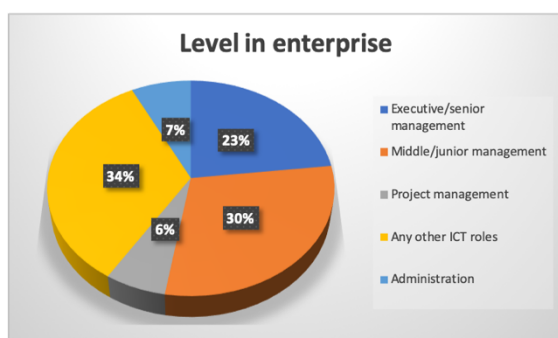
17% of respondents in 2016) is a long-standing vital component of the ICT industry's ability to apply labour where and when it is needed.

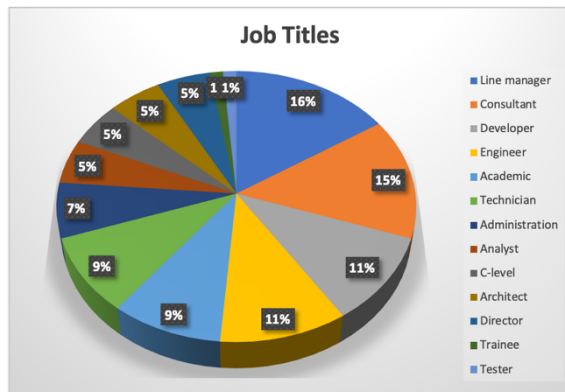


With more than half of practitioners working in other sectors, this underlines the pressing need for the coordination of data from ALL stakeholders in a formal, credible methodology. We continue to suggest that the SETAs set up a trans-sector mechanism that acknowledges the pervasive nature of ICTs and the skills required to support the various technologies.

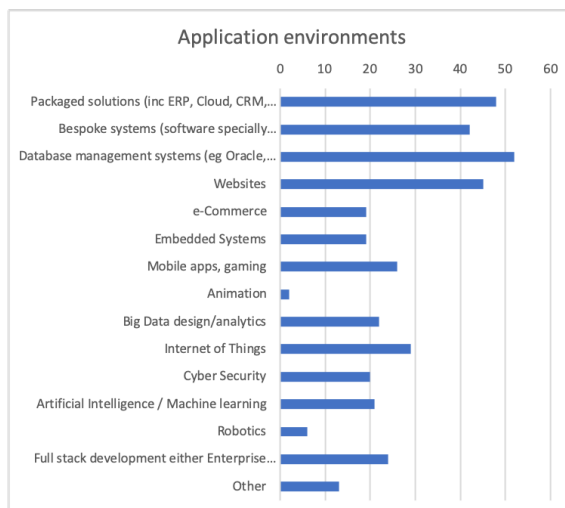
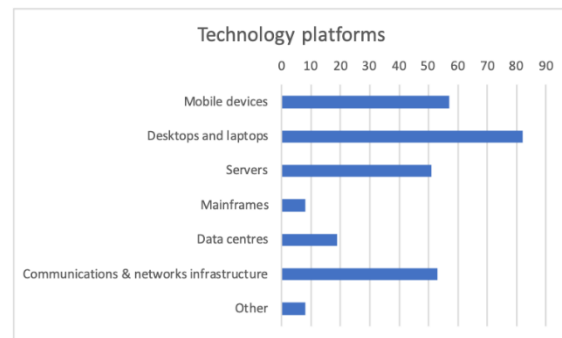
We continue to hope that there can be urgent progress with standardising the nomenclature of job roles and functions across sectors to make the planning of skills interventions more meaningful. Reliance on the inaccurate and misleading OFO codes can lead to poor policy and decision-making.

PRACTITIONER PRACTICES



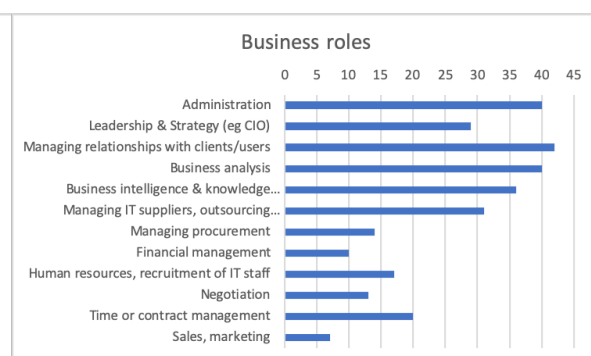


There are some inconsistencies between how respondents view their level in the enterprise and the job title that they hold. This issue further emphasises the need for rationalisation of the job titles and job roles used in industry and the Organising Framework for Occupations (OFO) codes used by the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



The vast majority of our practitioner respondents are working in the PC/laptop and mobile device environments. A growing number are engaged in applications that are perceived to be in the 4IR domain, such as Big Data, IoT, AI/Machine Learning and Robotics. The mainstream of practitioners are still engaged in what may now be described as traditional applications – enterprise solutions, databases and bespoke systems.

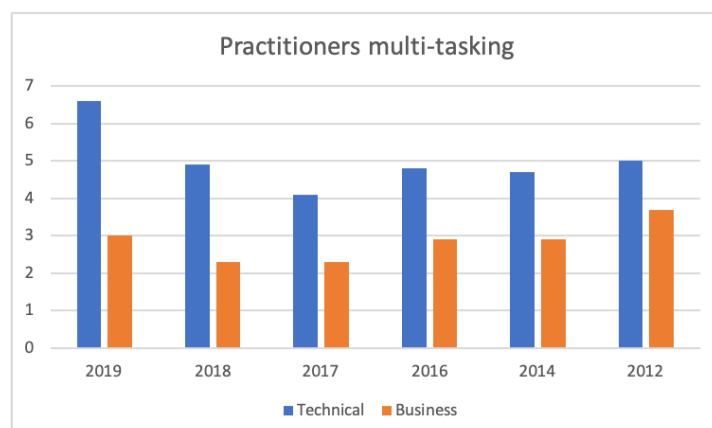
MULTI-TASKING



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

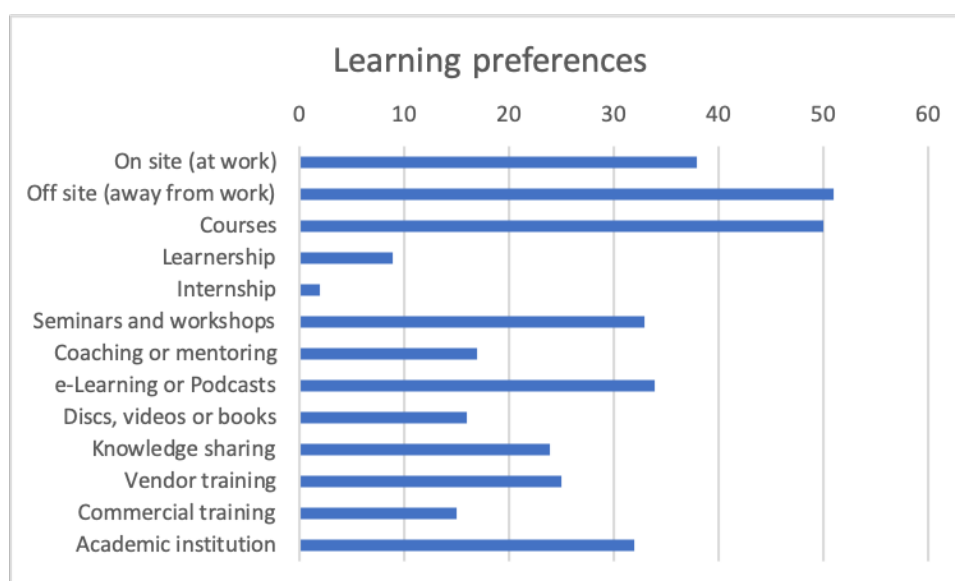
As in all the previous surveys, respondents showed how they had acquired their skills in the past, to qualify them for their current post, and how they intended to acquire skills in the future, to maintain their value in the job market.



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, it has leapt to more than 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.



In 2017, we observed a shift away from on-site learning to offsite, when 53% of respondents preferred the latter. In 2018, the pendulum swings, and we show 57% of respondents favouring on-site again. In 2019, the pendulum swings again with 51% preferring off-site. 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.

This year, 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. Again, the overwhelming answer was “yes”. 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.



CONCLUDING REMARKS

In this Tenth Edition of the ICT Skills Survey, it is appropriate to look back, at least a little. In 2008, the JCSE was still growing into its role as the driver of process improvement in South African software engineering. The opportunity to add value to that role through the addition of the Applied Research Unit opened the door to the conduct of a survey to examine the “skills shortage” issues.

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 12 years.

The sector has long been prone to the use of buzzwords and buzz-phrases to mark the latest “new and improved” techniques, practices and products and often these turned out to be a thin veneer on the underlying “same old” of the previous version. We tried to examine if the real skills shortage was related to these new flavours or more anchored in the traditional roles of analysis, design, programming, testing and support.

We have Klaus Schwab of the World Economic Forum to thank for introducing the 4th Industrial Revolution (4IR) into the lexicon of not just the ICT sector but the broader arenas of political strategy and economic policy. In South Africa, this equates to a Presidential Commission to oversee how best to leverage “4IR” for the country’s benefit and a broader audience using acronyms like AI, M2M and IoT. Fundamentally, recognition by policy-makers and industry strategists that South Africa must rapidly acquire the skills to take advantage of the shift in production and business practices is only a tiny step towards putting that knowledge into the hands of people who can turn it into economic value.

The ICT skills gap in South Africa is real. In Australia, they talk of needing 100 000 more ICT practitioners on top of the almost 800 000 they have now. Here, we have two parts to that number – perhaps 50 000 more ICT practitioners in the short to medium term but millions of people must be up-skilled to use the technology that is made available by the practitioner community.

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