



ICT TALENT DEVELOPMENT FOR THE DIGITAL SOUTH AFRICA

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Forword

While the world is struggling to chart the way forward in terms of social and economic development in the post-pandemic era, it is more apparent than ever that technological innovation driving the digital transformation can be leveraged to unleash the potential of economic development and national prosperity across all sectors. ICT talent of all types, including IT professionals in ICT industries and people working in other economic sectors with ICT competencies are key to the successful digital transformation of national economies. Thus, the cultivation of a pool of qualified ICT talent has already featured as an integral part of the national strategy in many countries and is supported by dedicated upskilling and reskilling initiatives.

Under this backdrop, the timely launch of the South Africa ICT Talent White Paper draws attention to the important issue and pressing needs of building ICT talent in South Africa to become more responsive to the rapidly advancing demands.

It aims to provide evidence-based perspectives to the South Africa policy makers and relevant stakeholders to develop policies and strategies to orient people towards the labour market demand and economic development considerations of tomorrow.

The intent of this White Paper is to contribute to the ICT talent strategy and actions in South Africa and provide insights for policy makers, academics, private sectors and international organisations involved in the ICT talents ecosystem nationally and globally.

We are now at a historical moment when the decisions and choices we make today will determine the future of national development and prosperity. By working together, more and more countries including South Africa will benefit fully from the technological innovations and digital transformation.

The White Paper has been compiled with the assistance of EY as a research partner.

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List of abbreviations

4IR	Fourth Industrial Revolution
ABET	Adult Basic Education and Training
AI	Artificial Intelligence
CET	Community Education and Training
CETC	Community Education and Training Colleges
DBE	Department of Basic Education
DHET	Department of Higher Education and Training
DFI	Development Finance Institution
DWA	Digital Work Accelerator
GCI	Global Connectivity Index
GETC	General Education and Training Certificate
GENFETQSF	General and Further Education and Training Qualifications Sub-Framework
HEI	Higher Education Institutions
HEQFS	Higher Education Qualifications Sub-Framework
ICT	Information and Communications Technology
IDC	Industrial Development Corporation
IDI	ICT Development Index
ITCR	Instituto Tecnológico de Costa Rica
MICT SETA	Media Information and Communication Technologies Sector Education and Training
MIS	Management Information System
NDP	National Development Plan
NFV	Network Functions Visualization
NQF	National Qualifications Framework
NSC	National Senior Certificate
NSFAS	National Student Financial Aid Scheme
OECD	Organisation for Economic Co-operation and Development
OQSF	Occupational Qualification Sub-framework
PC4IR	Presidential Commission on the Fourth Industrial Revolution
PSET	Post-School Education and Training
QCTO	Quality Council for Trades and Occupations
RPA	Robotic Process Automation
SAQA	South African Qualifications Association
SARB	South African Reserve Bank
SET	Science, Engineering and Technology
SITA	State Information Technology Agency
SMMEs	Small, Medium and Micro Enterprises
TVET	Technical and Vocational Education Training
WEF	World Economic Forum
WPPSSET	White Paper for Science, Technology and Innovation and Post Education and Training



Introduction to the study



Along with the rest of the world, the South African economy experienced considerable strain over the last two years with the contraction of the Gross Domestic Product (GDP) in 2020, the increase in unemployment rates and pressure on household incomes. As GDP was hit hard in 2020, the return to normality in 2021 resulted in a bigger GDP in percentage terms (otherwise known as bounce back). In 2020 GDP growth came in at -6.4% and grew by 4.9% in 2021 (Statistics SA, 2022). Compared to historical levels (where GDP averaged around 1.5%), 4.9% growth appears elevated, but this was only due to the statistical effect of a low 2020 GDP number (Statistics SA, 2022). In level terms (Rand billions), the economy is only expected to reach 2019 GDP levels at the end of 2022. This is largely attributable to structural issues in the South African economy such as electricity supply constraints, low skilled labour, high unemployment, and low levels of investment, etc.

Despite this, the ICT sector has remained resilient and has continued to positively contribute to South Africa's GDP growth despite the

challenges of the pandemic. However South Africa is still facing severe skills gaps in the ICT sector. The skills gap has been exacerbated due to the accelerated implementation of several 4IR technologies such as 5G and the Internet of Things (IoT) within the ICT sector which have been fast-tracked by COVID-19 (2021 JCSE-IIPSA ICT Skills Survey, 2021). These technologies are critical to meet the growing need for communications and collaboration in the modern working era.

The ICT skills shortage in South Africa poses a challenge for employers in the ICT sector and requires urgent attention and collaboration from the ICT ecosystem, with all its predominant stakeholders (government, education, and industry), to be sufficiently responsive to the ICT skills demands of the country (Malinga, 2021). The current approach by key stakeholders within government, ICT and the education sector to address the skills gap in the South African ICT ecosystem, appears to be sub-optimal to solve for the ICT talent gap. Although the various stakeholders are contributing significantly to many

initiatives individually, what is required is a more coordinated effort, where all stakeholders are aligned and committed to their respective mandates and roles within the talent development process.

The purpose of this white paper is to outline the extent of the ICT skills gap in South Africa and to propose recommendations as to how key players in the ecosystem can collaborate to yield sufficiently skilled talent in the ICT Sector and enable South Africa to become more responsive to the rapidly advancing demands. This is done through assessing the current situation, trends, and challenges in the ICT sector as well as the talent development situation, trends, and practices.

In the context of this white paper, ICT includes ICT manufacturing industries (operational) and ICT services. As a developing country, South Africa uses the operational definition of ICT rather than the OECD definition as defined for EU countries. This is due to Statistics South Africa aggregating data from a service perspective under storage and transportation categories, and on the hardware side, ICT hardware not being reported on its own but being included under another category such as communication equipment. It is on this basis that information provided in the Media, Information and Communication Technologies (MICT) Sector Skills Plan was accessed to quantify the contribution of the ICT Sector in South Africa.

Analysis within this White Paper was informed by interviews conducted in November 2021 with stakeholders within government, educational institutions, and organisations in the ICT Sector, as well as desktop research.

Twenty percent (20%) of the interview participants were from government, 35% from the Education Sector and 45% from industry. Information provided was reviewed to ensure anonymity of participants. In addition to interviews, various desktop data sources were used to develop insights, trends and challenges within the South African economy, ICT sector and talent development landscape.

We have included a case study outlining how a tech company's investment and presence had a positive impact in Costa Rica's ICT sector enabling upskilling of individuals and significant job creation.

Our research and analysis indicate the importance of government, education institutions, and organisations in the ICT Sector proactively collaborating to resolve the ICT skills supply shortage and rapidly advancing the demands of the ICT Sector to meet the future skills requirements.



1. ICT sector situation, trends and practices

This section provides an overview of the situation of the ICT sector, trends and practices in the context of the South African economy as provided in The South African Economic Reconstruction and Recovery Plan.

The South African economy has experienced heightened strain over the last two years, evidenced by contraction in GDP and growing unemployment. Despite the contraction of the SA economy and the challenges of the pandemic, the ICT sector has been resilient and has contributed to GDP growth and employment.

The ICT sector is faced with a variety of infrastructure, services, skills and data challenges which have been accentuated by the ever-expanding adoption of new emerging 4IR digital technologies.

From a skills perspective, a holistic analysis of the current workforce mapped to future needs could be regularly performed, together with the education sector and industry to address skill gaps.

1.1. Overview of the South African economy

The South African economy is highly industrialised, technologically advanced and diversified. Following a decade of growth in Gross Domestic Product (GDP) averaging 1.7% between 2010 and 2019, the last two years have seen significant volatility (The South African Reserve Bank, 2022).

Despite the recovering GDP growth in 2021, the economy is yet to return to 2019 GDP levels

The South African economy contracted by 6.4% in 2020 from 0.1% growth in 2019. Although the 2020 outcome (-6.4%) was better than the initial predicted contraction of 7.8% as per the National Treasury's 2020 Medium Budget Policy Statement, South Africa lost R1.2 trillion economic output in

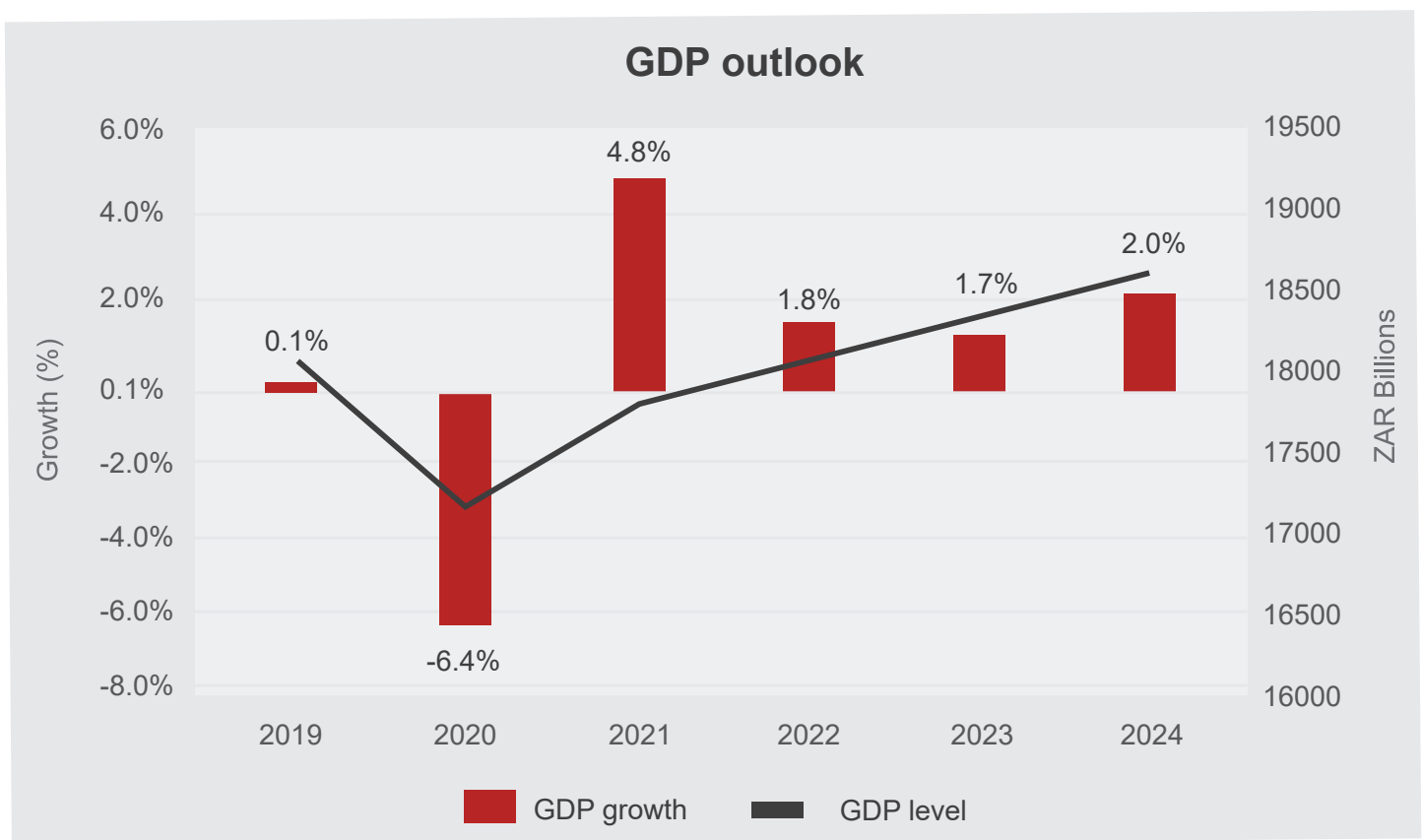
this period (National Treasury, 2020). The economy grew by 4.9% in 2021 according to the latest statistics (Statistics SA, 2022). Real gross domestic product (GDP) grew by 1.2% in the fourth quarter of 2021, with personal services, trade, manufacturing, and agriculture the key drivers of growth. An increase in demand for goods and services drove up the expenditure side of the economy, with exports and household expenditure the most significant contributors to growth. The pandemic also worsened South Africa's unemployment rate, as many industries struggled to cope with restrictions, supply constraints and lower demand. South Africa's unemployment rate increased from 28.7% in 2019 to 34.9% in the third quarter of 2021, which equates to 7.6 million unemployed people (Statistics SA, 2022).

The SARB forecasts that the GDP will grow by 1.7% in 2022, 1.9% in 2023 and 2.0% in 2024 as indicated in Graph 2 below (The South African Reserve Bank, 2022).

The economy is expected to reach pre-pandemic levels in early 2023. The outlook for jobs is strongly tied to the economic recovery, but there are more fundamental drivers of South Africa's systemically high unemployment levels which the pandemic has worsened, which need to be addressed. The main downsides can be attributed to the country's negative credit rating, state debt load and significant currency weakness in what was already a weakened economic environment.

The government remains under pressure to introduce a Basic Income Grant to support households (Dludla, 2022). However, social spending needs to be managed within government's fiscal consolidation drive to bring borrowing costs down.

Further risks to economic growth include electricity supply constraints, vulnerable global supply chains, rising inflation in advanced economies, higher levels of unemployment and poverty spurring further bouts of unrest and the brain drain because of the 'Great Resignation' as skilled labour continue to emigrate.



Graph 1: GDP Outlook (Statistics SA and SARB, 2021)

1.2. Overview of the ICT sector in South Africa (contribution to GDP and employment levels)

As outlined in the National Development Plan (NDP), ICT is expected to underpin the development of an inclusive dynamic information society and knowledge economy through the development of a comprehensive and integrated ICT-strategy that reflects the cross-cutting nature of ICTs by 2030 (National Planning Commission, 2020).

The MICT SETA is a public entity established in terms of the Skills Development Act, 1998 (Act No. 97 of 1998). The mandate of the MICT SETA includes five sub-sectors namely advertising, film and electronic media, electronics, information technology and telecommunications. The MICT SETA Sector Skills Plan provides a credible source to access the contribution of the ICT sector in terms of economic growth (MICT SETA Sector Skills Plan 2021/22, 2020).

There are more than 20 000 companies in the ICT sector who contribute about 8% to South Africa's GDP (Business Wire, 2021). The MICT SETA Skills plan further indicates that South Africa's nominal GDP at market prices in 2018 was R4,9 trillion which is a R220 billion increase from 2017 (Statistics SA, 2019). The MICT sector is estimated to have a combined GDP exceeding R300 billion. At the end of 2018, the overall ICT market in South Africa is forecasted to reach R248 billion, and R273 billion by 2021. This represents a compound annual growth rate of 2.9% (IDC, 2017). In this context, the ICT market is comprised of ICT manufacturing industries (operational) and ICT services.

The continued growth in the South African ICT sector, despite the

challenges of the pandemic is in line with global trends. This was in part driven by the need for organisations to become more industrious, utilise ICT to solve for challenges and harness opportunities that the pandemic has exposed.

ICT spending is projected to maintain a growth trajectory until the end of 2025. The ICT software and services segments are expected to provide a boost owing to increased demand from public and private sector organisations looking to digitalise their operations. Growth will also be driven by enterprises leveraging the growing availability of cloud-based solutions to drive cost-cutting and efficiency gains in their operations as well as a rising demand for advanced data services.

There is also a growing emergence of small/niche ICT companies as a result of digital drive in the economy which is likely to increase the demand for 4IR skills (and experience). According to the Fintech Times's Middle East & Africa 2021 Report, South Africa also has a flourishing FinTech industry underpinned by a sophisticated and supportive ecosystem (The Fintech Times, 2021). The report highlights that the bulk of FinTech solutions are in payments (30%) and B2B tech support (20%), Insuretech solutions accounting for 9% and Financial Planning and Advisory counting for 7%. Further to this, according to the Financial Times as at 31 July 2021, South Africa has the highest penetration of fintech in the African continent, where around 94 per cent of the population having regular access to the internet and a mobile phone penetration of over 100 for every 100 people (Santosdiaz, 2021). With



the growing investment in FinTech's in South Africa, there will similarly be an increased demand for 4IR skills.

Despite the above, South Africa's ICT ranking has dropped over the period 2016 – 2019. As per the ICT Development Index, South Africa ranked 88 out of 176 countries in 2016, while in 2019, South Africa ranked 104 out of 141 countries for fixed broadband connectivity. This index monitors and compares developments in ICT between countries over time (The ICT Development Index (IDI): conceptual framework and methodology, 2017).





Further to this, the Global Connectivity Index (GCI), which tracks the progress of deployment of digital infrastructure and capabilities, ranked South Africa 56 out of 79 economies and first out of 12 African economies in 2020 (Global Connectivity Index, 2020). Morocco and Egypt rank second and third after South Africa. The GCI uses data to rank economies both vertically and horizontally against metrics that encompass the entire chain of ICT development and digital transformation and provide a 360-degree view of the digital economy.

Four pillars: supply, demand, experience, and potential.

Four technology enablers: which form the cornerstones of a digital economy: High-speed broadband, cloud services, big data analytics, and the Internet of Things (IoT).

The extent to which each country has developed and adopted these enablers determines its productivity, competitiveness in the world arena, and the stage of innovation that the country is in.

The four pillars and four technology enablers are summarised in diagram 1 below:

	Supply  Measures current levels of supply of ICT products and services used for digital transformation.	Demand  Gauges demand for connectivity in the context of users and activities relating to digital transformation initiatives	Experience  Comprises variables for analyzing the experience of connectivity for end users and organisations in today's digital economy.	Potential  Comprises a forward-looking set of indicators that point towards the future of the digital economy
Foundation	ICT Investment Telecom Investment ICT Laws International Internet Bandwidth Security Software Investment	App Downloads Smartphone Penetration E-commerce Truncations Computer Households Secure Internet Servers	E-Government Services Telecom Customer Services Internet Participation Broadband Download Speed Cybersecurity Awareness	R&D Expenditure ICT Patents IT Workforce Software Developers ICT Influencing New Business Models
Broadband	Fiber Optic 4G&5G Connections	Fixed Broadband Subscriptions Mobile Broadband Subscriptions	Fixed Broadband Affordability Mobile Broadband Affordability	Broadband Potential Mobile Potential
Cloud	Cloud Investment	Cloud Migration	Cloud Experience	Cloud Potential
IoT	IoT Investment	IoT Installed Base	IoT Analytics	IoT Potential
AI	AI Investment	AI Demand	AI Creation	AI Potential

As shown in the Global Connectivity Index (2020), in 2020 South Africa compared to the average score of all measured economies across the four pillars with the following results:

- **Supply:** 32 out of 41 (*average*)
- **Demand:** 44 out of 55 (*average*)
- **Experience:** 44 out of 61 (*average*)
- **Potential:** 42 out of 50 (*average*)

When looking at the four Technology Enablers, South Africa compares to the average as follows:

- **Broadband:** 36 out of 62 (*average*)
- **Cloud:** 48 out of 42 (*average*)
- **Artificial Intelligence (AI):** 24 out of 30 (*average*)
- **IoT:** 27 out of 40 (*average*)

South Africa's progress against the four pillars during the periods tracked by the GCI is indicated by the diagram below:

Four pillars	2015	2016	2017	2018	2019	2020
Supply	26	28	29	30	32	32
Demand	25	30	36	42	44	44
Experience	43	46	50	52	44	44
Potential	38	38	38	39	38	42

Table 1: Progress in terms of Four Pillars (GCI, 2020)

South Africa's supply and demand have remained consistent over the period 2019 to 2020. However, the Experience pillar dropped over the period 2018 to 2020 which is attributable to the drop in fixed and mobile broadband affordability from 2018 – 2020. South Africa's progress in terms of the Potential pillar improved during the period 2018 – 2020. The increase in the Potential pillar is largely attributable to the increase of Cloud, AI and IoT potential over the periods 2018 - 2020.

South Africa's progress against the four Technology Enablers is indicated by Table 2 below:

Four Technology Enablers	2015	2016	2017	2018	2019	2020
Broadband	39	44	45	50	36	36
Cloud	33	36	39	48	48	48
AI	18	18	21	21	21	24
IoT	27	24	24	24	24	27

Table 2: Progress in terms of Four Technology Enablers (GCI, 2020)

South Africa's progress in AI and IoT has improved slightly in the periods 2015-2020. Progress in cloud computing has remained consistent over the periods 2018 to 2020. However, progress in broadband dropped during the period 2018 – 2020 (Global Connectivity Index, 2020).

Currently South Africa's ICT results and impact indicate that South Africa's digital infrastructure and capabilities will not be sufficient to realise the ambitions of the NDP (the National Planning Commission, 2020). South Africa will need to prioritise ICT infrastructure development to reach the objectives of the NDP by 2030.

1.3. SA ICT sector policies

The South African ICT policy landscape is continuously evolving as industry requirements change and new relevant policies are published. Various ICT Policies and related Acts have been released to address a variety of socio-economic challenges that South Africa faces, such as unemployment, crime, weakened economic environment and increasing state debt load etc.

1.3.1. National Development Plan (NDP)

The NDP is a long term South African development plan which is compiled by the National Planning Commission together with core stakeholders. The NDP sets out goals for poverty reduction, economic growth, economic transformation, and job creation, including skills development as one of the fourteen priorities of the NDP. It shapes how national budget is allocated and what institutional arrangements are put in place to drive economic growth, economic transformation, job creation and skills development at a provincial and local government level.



By 2030, ICT will underpin the development of a dynamic and connected information society and a vibrant knowledge economy that is more inclusive and prosperous” (NDP, 2020). The NDP further outlines “ICT is a critical enabler of economic activity in an increasingly networked world. As a sector, ICT may provide important direct opportunities for manufacturing, service provision and job creation, but their main contribution to economic development is to enhance communication and information flows that improve productivity (NDP, 2020).



Hence ICT is key to the achievement of development goals. For South Africa to be globally competitive it needs an effective ICT infrastructure and skills need to be accessible at a reasonable cost and quality.

The NDP recognises that ICT has the potential to accelerate human progress and the ability to bridge the digital divide through making the best of 4IR opportunities such as Cloud computing, the Internet of Things (IoT), Robotics Process Engineering (RPA) and Big Data Analytics.

1.3.2. Integrated ICT Policy White Paper

The Integrated ICT Policy White Paper captures government's belief that information and communications technologies can facilitate the achievement of the objectives of the NDP. It also sets out how government plans to enable this process. Currently the White Paper is still a policy document and will require legislation to implement (Insights from Parliament: Focus on the ICT White Paper, 2021).

The White Paper is an all-encompassing document covering computing and information technology, telecommunications technology, the internet, as well as traditional means for communication such as the postal service.

The focus of the current White Paper is aimed at:

- Expanding internet access;
- Promoting a digital society;
- Opening access to ICT infrastructure;
- Promoting ICT Industry growth; and
- Creating a regulatory framework that supports technological convergence.

1.3.3. SA Connect

SA Connect, the national broadband policy and associated strategy and plan, gives expression to South Africa's vision in the NDP of "a seamless information infrastructure by 2030 that will underpin a dynamic and connected, vibrant information society and a knowledge economy that is more inclusive, equitable and prosperous" (Electronic Communications Act, 2005 (Act No. 36 of 2005)). The aim of SA Connect is to meet the technology goals of the NDP by creating an inclusive information society and positioning the government to play an enabling role in the provision of broadband to bridge broadband connectivity gaps. SA Connect is being administered via a four-pronged approach, which includes:

- The re-structuring of market and sectoral institutions;
- Expansion of existing networks to unserved areas;
- Creation of a national wholesale broadband network; and
- Implementation of programmes related to education, research and development (R&D), innovation and entrepreneurship.

Ultimately, the government aims to create an affordable national broadband network providing universal accessibility to its citizens while developing associated ICT infrastructure and services to promote government connectivity, local content production, e-literacy and national competitiveness (Government Gazette, 2013).

Phase 1 of the Connect SA Plan gave effect to the country's Broadband Policy which was adopted by Cabinet in 2013 and served as a pilot phase to provide a 10 Megabits per second (Mbps) broadband service to approximately 970 critical government facilities. Cabinet approved the roll-out of the second phase of the SA Connect project at a Special Cabinet Meeting of 27 and 28 January 2022. The approved second phase will be rolled out using state-owned entities (State Information Technology Agency [SITA]), Broadband Infraco and Sentech) and the industry. It is envisaged that over the next 36 months, the project will connect the remaining government facilities, communities and households to the broadband service assisting to bridge the digital divide.

1.4. Trends

The ICT sector in South Africa has experienced a transformational shift from the ICT manufacturing sector to the ICT services sector. The ICT services market consists of sales of ICT services and related goods by entities that apply technical expertise and knowledge to enable organisations to create, manage and optimise their IT processes. By 2022, services sales are forecasted to reach \$ 3.40 billion and software sales to reach \$ 1.58 billion according to Fitch Solution Industry Report South African IT Forecast 17 May 2021.

The following macro-ICT trends have a couple of things in common. Coupled with new technology, they will all place greater connectivity demands to enable seamless connectivity, require low latency, and need high bandwidth ultra-resilient networks which enable inter-operability across devices, platforms, and networks.

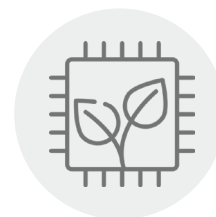
Key macro trends are summarised below:



Fifth-Generation Mobile Networks



Edge Computing



Adoption of Green Technologies



Open-Source Software Gaining Ground



Network Functions Virtualization (NFV)



Increasing Investments in Smart Cities

Fifth-Generation Mobile Networks



The 5G coverage currently available in South Africa is primarily deployed by individuals and it still is likely to take some time before it is optimally available to organisations. However, 5G is seen as pivotal to accelerate and enable rapid advancement of digital transformation journeys and innovation at scale within organisations. 5G has capability such as improved network speed and better latency needed to enable enhancements to different aspects of businesses and seize opportunities introduced by the IoT revolution. 96% of South African companies who participated in a recent ITWeb survey said 5G would transform IT operations within the next three years. 37% of participant indicated that their organisation had plans to invest in 5G technology in the next 18 months while 30% indicated that they had already invested in 5G (Mzekandaba, 2022).

Larger organisations are also looking to integrate Artificial Intelligence (AI) into cloud-based technologies which will require new levels of speed and interoperability across applications which 5G can deliver.

Indoor 5G coverage will be required to deliver on digital trends driven by growth in the Metaverse and retail such as use of AR and VR.

To enhance capabilities, improve customer satisfaction and realise growth ambitions, ICT organisations must work with government to accelerate the deployment of 5G technology and prepare workforces to meet ICT manufacturing and service demands associated with fifth-generation mobile networks.

Edge Computing

While the adoption of Cloud computing by organisations is still growing, Cloud computing has become mainstream and no longer is an emerging technology trend. Edge is. In a recent ITWeb survey 97% of companies indicated that Edge computing is essential to digital transformation (Mzekandaba, 2022). Edge computing addresses the latency evident in

Cloud computing and provides the ability to process time-sensitive data with low latency speeds. Edge computing is preferred over cloud computing in remote locations, where there is limited or no connectivity to a centralised location.

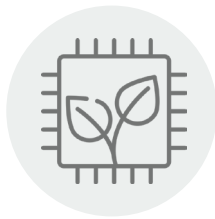


As the importance of, and competitive advantage of data continues to gain recognition and as the quantity of data organisations is dealing with continues to increase, the shortcomings of Cloud computing in some situations will become increasingly evident which will drive demand for Edge computing. Edge computing can work hand in hand with the cloud to provide a flexible solution based on the data collection and analysis needs of each organisation which will also drive demand.

The CB Insights Market Sizing tool estimates that by the end of 2022, the global edge computing market is expected to reach \$6.72 billion (CB Insights, 2018).

Adoption of Green Technologies

As global attention focuses on sustainable practices in the wake of COP26, organisations need to seek ways to cut their carbon emission output and reduce their overall environmental impact. Because ICT has driven innovation that has such a positive impact on personal, social, and business operations globally, its utility has often overshadowed the detriment it may have on the environment. However, the rapid increase in energy consumption is a major threat to environmental protection and sustainable development. Communications hardware accounts for about 2%-4% of the total global carbon emissions (Business Wire, 2021).



Access to the high-speed internet provided by next-generation wireless networks and increased smartphone usage, data traffic has increased significantly. This has triggered a significant expansion of network infrastructures and increased the energy demands. As is the case with all organisations worldwide, ICT equipment manufacturers will be under pressure to adopt green networks to limit energy consumption and reduce associated carbon emissions.

Aside from traditional ICT skills, organisations will need skills to be able to project, minimise and manage their environmental impact.

The Industrial Development Corporation (IDC) plans to inject billions of Rand into green industries over the next five years as part of a larger disbursement plan (IDC, 2017). The IDC has indicated that the green economy has emerged as a primary focus for the development finance institution (DFI), owing to its potential to create jobs and lower the carbon intensity of the South African economy.

Open-Source Software Gaining Ground

Software companies are increasingly offering their products on open-source platforms to increase its presence and share in the market. 78% of companies use open-source solutions and 64% participate in open-source projects indicating an increase in open-source software platforms to build applications. According to CB Insights' market sizing Tool, the open-source services industry is set to exceed \$17B in 2019 and expected to reach nearly \$33B by 2022 (Business Research Company, 2018).



Open source encourages innovation through collaboration and has become a preferred platform for developing new technology. It has and will continue to transform the way software is built and implemented, at scale. As technology transforms, skill requirements could also transform, at scale, placing increased pressure on an environment which already has skills constraints.

Network Functions Virtualisation (NFV)



NFV is receiving significant investment from wireless telecom service providers. Network functions virtualization (NFV) is the replacement of network appliance hardware with virtual machines. The virtual machines use a hypervisor to run networking software and processes such as routing and load balancing.

NFV technology supports the virtualisation of components allowing a flexible network infrastructure that enables applications and services to be moved to the cloud. NFV brings in agility, efficiency to networks and business operations and helps operators to support dynamic subscriber demands efficiently and economically. Many companies are also offering tools and professional services to assist operators to migrate to NFV. Wireless telecoms service providers are adopting NFV technology to increase their operational efficiencies and increase profit margins.

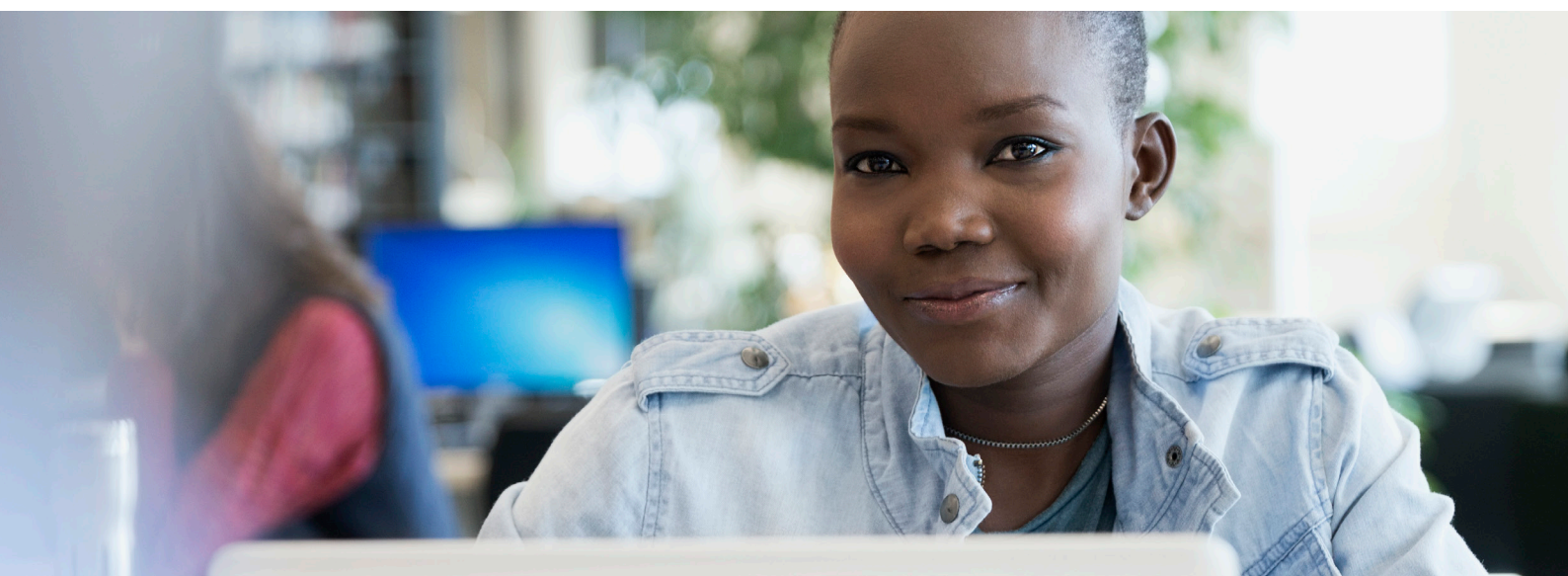
Increasing Investments in Smart Cities

The ITC market will be aided by rapid growth in investments in smart city projects. Smart city technologies use information and communication technologies to efficiently manage and operate urban services including transportation systems, water supply and law and order. These technologies are enabled through IoT technology. IoT is a convergence of computing devices, mechanical and digital objects. This system facilitates the transfer of data over a network without human interaction and minimal human to computer interaction.



In South Africa, provincial governments are currently planning/working on three 'smart city' projects in Mpumalanga, Gauteng/North West, and the Eastern Cape (Business Tech, 2022).

Given the trends listed above, the ICT sector needs to adapt to be able to support business to utilise emerging technology to enable social and economic developments.



1.5. Challenges

The ICT sector is faced with a variety of budgetary, infrastructure, services, skills, and data challenges. These have been exacerbated by the ever-expanding adoption of new emerging 4IR digital technologies.

- **Budgetary challenges** due to nominal increases in budget allocation in 2021/22 despite ICT being prioritised as a key driver to give expression to South Africa's vision in the NDP. According to South Africa's budget in 2021/22, the ICT sector was allocated a budget of 8.4% in 2021. This was an increase of only 0.8% from 7.6% in the prior year. However National Treasury had originally forecast that the ICT sector would be allocated a budget increase of 5% year on year until 2024 (National Treasury, 2021).
 - **Infrastructure and spectrum constraints**, which is further aggravated by the increased demand for additional sophisticated infrastructure required by 4IR technologies such as 5G.
 - **Additional demands for reliable sources of electricity.** SA continues to experience electricity supply constraints which impacts economic development. Research suggests a strong correlation between electricity use and access and economic development.
 - **An increased demand for 4IR skills (and experience)** to meet the demand by industry. There is a great demand for technology skills in South Africa, however supply falls short which endangers the digital economy and 4IR progress. The Network Readiness Assessment Index of 2021, which ranks South Africa 70th out of 130 countries, indicates that there has been a slight growth in technology accessibility and development but notes that ICT skills have become a major barrier to technology adoption (Portulans Institute, 2021). South Africa has a significant skills gap as the demand is far greater than supply. The South African government may seek to strengthen the economic environment and support initiatives that enable citizens to empower themselves with the necessary future-fit skills.
 - **Continuous and increasing brain drain** resulting in loss of key ICT talent as people emigrate. This is increasing the existing skills gap in advanced technology skills, such as AI, robotics, etc. This is also contributing to stunted business growth and innovation and limiting national development.
 - **Lack of readily available ICT industry data** makes it difficult to accurately assess the changing realities on the ground which could lead to erroneous conclusions about the direction that the ICT industry and segments are taking.
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2. Talent development situation, trends, and practices

2.1. Current ICT talent development situation

This shortage of essential digital skills starts with the education system and its alignment to what is required for a digitally transformed and enabled society. To meet the demands of such an economy, education must provide for higher order cognitive skills such as agility, curiosity, problem-solving, resilience and flexibility. Upon this foundation hard skills can then be built (Harambee, 2020).

ICT Talent in South Africa is cultivated by two systems, namely the Department of Basic Education (DBE) and the Department of Higher Education and Training (DHET) who are responsible for education in South Africa (Macha & Kadakia, 2017).

2.1.1. Basic education

The DBE deals with all schools from Grade R to Grade 12, and adult literacy programmes, while the DHET deals with universities, and other post-school education and training.

South Africa's estimated 26,000 schools and 425,000 educators are overseen by the DBE. District and provincial DBE offices in nine provinces and 86 districts administer these schools and have considerable influence over the implementation of policy (Macha & Kadakia, 2017).

Primary education in South Africa lasts eight years and requires the completion of grades R (or reception year, which is equivalent to kindergarten) through to grade 7.

Secondary education in South Africa is five years in duration (grades 8 to 12). At the end of successful completion of Grade 9, learners qualify for a General Education and Training Certificate. At the start of upper secondary school in grade 10, students are streamed into one of two tracks – academic (general) or technical. At the end of Grade 12, learners are issued with a National Senior Certificate.

Education is compulsory from grade 1 to 10. Thereafter, educational is optional and can also be obtained through specialist technical, community or private colleges. Primary and secondary schools in South Africa are most often public, and account for the bulk of enrolments. Independent private schools exist in South Africa and are becoming increasingly popular as an alternative to struggling public schools (Macha & Kadakia, 2017).

2.1.2. Higher education and training

The DHET is responsible for post-school education and training in universities, colleges, and adult education centers. The Post-School Education and Training (PSET) system consists of educational institutions – universities, Technical and Vocational Education and Training (TVET) colleges and community colleges, all of which are largely funded directly from the fiscus through grants from the DHET budget.

According to DHET statistics as published in 2020, there were 343 registered and established PSET institutions which offer opportunities to build ICT skills (Department of Higher Education and Training, 2022).

These comprise of:

- **26:** Public Universities, consisting of traditional and comprehensive universities and universities of technology
- **132:** Registered private higher education institutions (HEIs)
- **50:** TVET colleges
- **126:** Registered private colleges
- **9:** Community Education and Training (CET) colleges to complement the TVET colleges and the university sector

Across these institutions, ICT qualifications vary but are all governed by the NQF.

Universities

University is ideal for students who wish to earn a recognised degree, and obtain the knowledge required to enter their profession. A university course is useful for those who want to pursue a more academic or theory-based profession. Students enrolled in Bachelor programmes at universities will develop the relevant theoretical knowledge, but programmes are geared towards the transfer of knowledge rather than development and application of skills. Some universities use individual or group projects to apply theoretical knowledge to develop practical skills relevant to the delivery of technology-based solutions to solve a business problem, and to assess competence.

Entry to University usually requires a National Senior Certificate, i.e., Grade 12. On successful completion of study at University, students will be awarded a degree. Universities offer Commerce and Science undergraduate and post graduate degrees in Information Systems (Informatics), Computer Science and Information Science of varying duration as noted below:

- **Bachelors** - 3-4 years full-time and up to 5 years part-time
- **Honors** - 1 year full-time and 2 years part-time
- **Masters** - 1-2 years
- **Doctorate** - 3-6 years

The Curricula for the Bachelor of Science (BSc) in Computer Science provided by two prominent universities is summarised in Appendix B. There appears to be general alignment in curricula between Universities.

Universities incorporate 4IR into the syllabus through research and academia and bring in industry thought leadership into events and guest lecturers to stay abreast of the emerging technologies and trends. The slant of the curricula is still heavily swayed to knowledge rather than the actual skills required in the workplace. This also results in industry needing to embark on expensive upskilling and reskilling initiatives due to insufficient talent supply from the university educational system and/or importing foreign talent to meet demand.

According to the 2020 DHET statistics published, there has been a continuous increase in students enrolling in HEI Science, Engineering and Technology (SET) programmes with a total of over 323,000 enrolments in 2019 (MICT SETA Sector Skills Plan 2021/22, 2020). However, of the 323,000 enrolments in SET programmes in 2019, only 65,211 graduated (29.1% completion rate). In 2020, of the 319 877 enrolments, only 64 721 graduated (20,2% completion rate).

Throughout the programme, there is limited career guidance provided to students to assist them to develop deeper, relevant skills and improve their marketability. Further to this, there is little support provided to proactively identify students who require extra help which if supported could increase the successful completion rate.

Technical and vocational education and training (TVET)

Technical and Vocational Education and Training (TVET) colleges are administered in terms of the Continuing Education and Training Act, No. 16 of 2006, as amended. TVET colleges are excellent places to learn and develop technical skills in various fields in a chosen trade or industry and aim to equip students to become functional workers in a skilled trade using formal, non-formal and informal learning mechanisms. Entry into TVET colleges requires a Grade 9 certificate. Studying at a TVET college will allow an entrant to earn a certificate of qualification in the chosen profession.

TVET colleges currently offer national certificate qualifications in, Information Technology and Computer Science ranging from NQF level 2-4. The National Certificate (Information Technology and Computer Science) programme is a full-year programme at each of the NQF levels of study. A student is issued with a certificate on the successful completion of each level of study, that is level 2, level 3, and level 4. The programme covers the interpretation of software applications, as well as the installation of network cables together with information technology principles and data processing and integrates academic knowledge and theory with practical skills.



The Curricula for the Bachelor of Science (BSc) in Computer Science provided by two TVET colleges are summarised in Appendix B.

The vocational subjects in Information Technology and Computer Science are:

- Information Systems
- Systems Development and Computer Programming
- Computer Hardware and Software
- System Analysis and Design

Lecturers are often former or practicing tradespeople who can offer insight into the latest processes and tools used in the field. Students are tested on their theory as well as the practical demonstration of their skill. The practical component of the study may be offered in a real workplace or in a simulated workplace environment to provide students with an opportunity to experience work situations during the period of study. At a TVET level according to the 2020 DHET statistics published, the number of students in TVET colleges who registered versus completed the L4: Information Technology and Computer Science qualification was low at a completion rate of 32.4% (301 completed out of 1 074 registered) in 2019 (Department of Higher Education and Training, 2021). In 2020, the completion rate remained consistent to 2019 at 33.5% (353 completed out of 1053 registered). Interviews revealed that TVET colleges provide limited support for students experiencing academic challenges. This is due to a lack of incentives at an institutional level to encourage students to successfully complete their studies.

Furthermore, interview feedback is that despite increased emphasis on science and technology-based curricula and training programmes, ongoing obstacles such as establishment of proper infrastructure, relevance of materials and training resources present further challenges that need to be addressed to keep abreast of ICT industry demands. This also results in industry needing to embark on expensive upskilling and reskilling initiatives due to insufficient talent supply from the TVET educational system and/or importing foreign talent to meet demand.

In addition to this, Community Education and Training Colleges (CETC) have also been established in South Africa to target the youth and adults who have left school and wish to further their learning, improve their skills for employability and/or advancement to opportunities in TVET colleges and university education. Relevant programmes offered at CETC are a National Senior Certificate (NSC) and General Education and Training Certificate (GETC) in Adult Basic Education and Training (ABET). Both would provide learners with the required prerequisites to enroll for other ICT learning in a TVET college.

2.2. Current ICT talent development policies and initiatives

South Africa has several policies and initiatives which govern the development of ICT skills and talent and the award of qualifications. The DHET is responsible for implementing, managing, and overseeing these. The National Qualifications Framework (NQF) Act No 67 of 2008 is outlined in Appendix A.

Government recognises the need to understand the skills requirement as a key imperative to enable South Africa to respond positively to the 4IR. The South African Government's budget in this sector focuses on key interventions to increase the usage of ICT to facilitate socio-economic justice and inclusion, improve competitiveness and prepare for the 4th Digital Industrial Revolution. The Government, via its programmes and agencies plans to embark on an extensive skills development programme aimed at training one million young people by 2030 in Robotics, Artificial Intelligence, Coding, Cloud computing and Networking.

Various commissions and initiatives have been established in support of the 4IR agenda. These are mentioned below:

2.2.1. Presidential Commission on the Fourth Industrial Revolution (PC4IR) and the Artificial Intelligence (AI) Institute

The PC4IR is a committee led by President Ramaphosa which includes 30 members ranging from various sectors of society. It was established in April 2019, with the purpose of identifying relevant policies, systems and actions plans which will place South Africa as a worldwide player for 4IR.

The main priorities of The Presidential Commission as outlined in the Presidential Commission on the Fourth Industrial Revolution (Government Gazette, 2018) are to:

- Develop an integrated country strategy and plan to respond to 4IR including detailed interventions to be carried out to achieve global competitiveness of the key economic sectors (agriculture, finance, mining, manufacturing, ICT, and Science, Technology, and Innovation);
- Advise on strategies for skills development and future of work;
- Advise on a technology research and development programme to advance 4IR;
- Recommend an institutional framework and mechanism to coordinate 4IR programmes;
- Recommend relevant infrastructure required for SA to participate in the digital economy;
- Recommend approaches to address inclusivity and the digital divide;
- Advise on strategies to mobilise resources to support the implementation of 4IR interventions;
- Recommend mechanisms to quantify the impact of interventions on 4IR; and
- Recommend interventions to enable innovation and entrepreneurship, and for SMMEs to take advantage of the 4IR.

The AI Institute is an initiative recommended by the PC4IR (Government Gazette, 2018). The aim of the AI Institute is to advance the use of AI to tackle the ICT challenges that South Africa faces. The AI Institute seeks to enable the generation of new knowledge and creative technology applications in sectors such as health, agriculture, education, energy, manufacturing, tourism, and ICT, among others.

The AI Institute's mandate includes training, to be delivered across various sections of society, as well as ensuring positive social impact.

2.2.2. Digital Work Accelerator (DWA)

The Digital Work Accelerator (DWA) Programme is a digital and ICT coalition enabled by a public and private partnership established by Harambee. It aims to realise inclusive and sustainable learning opportunities for young people in the digital and ICT economy. It was motivated by a lack of prioritisation, coordination, and alignment among the many siloed projects currently underway. The DWA is fully endorsed by the Presidency and is categorised as a sub initiative under the Presidential Youth Employment Intervention.

There are numerous industry partners, committed to the charter under the DWA (Digital Work Accelerator, 2021).

To date the DWA has achieved the following:

- Gained leadership buy-in and adoption through ongoing engagement and socialisation and endorsements from the Presidency, Boards and ExcOs and created a national narrative around the importance of access to the Digital Economy for young people in South Africa;
- Identified an initial set of priority projects which meet specific criteria;
- Identified leads and owners from Government and Industry for the priority projects;
- Secured funding from the economic stimulus and social investors for some of the projects. Projects are classified as follows:
 - Earning Opportunities: Programmes that will unlock inclusive and sustainable earning opportunities for youth, at scale.
 - Skilling for Earning: Programmes that will address the skills gaps in the digital economy.
 - Enabling Access: Programmes that will enable more affordable access to digital technology and/or infrastructure for work-seekers.

Many of the priority programmes of the DWA are still in the conceptual phase.

2.3. Trends

2.3.1. ICT skill demand trends

(Influenced by 4IR technologies and New Ways of Working)

There is an increased demand for advanced ICT skills as South Africa strives towards a more e-skilled economy brought on by the 4IR. Thought leadership provided by EY confirms that 65% of global IT spending is expected to be driven by demand for emerging digital technologies by 2024 which in turn, will lead to demand for individuals in the ICT sector at an accelerated rate.

The Future of Work Survey 2020, published by the World Economic Forum, highlights that the ability of organisations to harness the growth potential of new technological adoption is hindered by skill shortages. Organisations are experiencing a skills gap in the local market and the inability to attract the right talent remains among the leading barriers to the adoption of new technologies.

Emerging technologies/disciplines in the ICT Sector have brought about the demand for new roles. Job roles in demand in the ICT market from a South Africa perspective are summarised in table 4 below:

Emerging Technologies/Disciplines	Job Roles in demand in the ICT Market
Cloud Computing	<ul style="list-style-type: none">• Cloud Solution Architect• Cloud System Administrator• Cloud Developer• Cloud Product Manager• Cloud Security Manager
Robotics Process Automation(RPA)	<ul style="list-style-type: none">• Process Automation Specialists• RPA Analyst• RPA Engineer
Artificial Intelligence(AI)	<ul style="list-style-type: none">• AI Engineer• AI and Machine Learning Specialist
Big Data Analytics	<ul style="list-style-type: none">• Big Data Analyst• Big Data Specialist
Encryption and Cybersecurity	<ul style="list-style-type: none">• Cyber Security Analyst• Cyber Security Engineer
Internet of Things (IoT)	<ul style="list-style-type: none">• IoT Developer• IoT Embedded System Designer• IoT Infrastructure Architect• IoT Solution Engineer• IoT System Administrator
Data Science	<ul style="list-style-type: none">• Data Architect• Data Engineer• Data Analyst• Data Scientist
Software Development	<ul style="list-style-type: none">• Software Developer• Developer Programmer• Systems Engineer

Table 4: Emerging Technologies/Disciplines/Roles (Future of Work Survey 2020 as published by the World Economic Forum as well as the MICT SETA Skills Plan 2022/23)



As per the Harambee research, which seeks to map out digital and ICT roles and demand in SA, there was a forecast demand for approximately 66 000 people in digital and ICT roles during the period 2021, some of which will be latent demand. This forecast demand consists of an estimated 44,200 entry-level jobs (67%), 12,471 intermediate jobs (19%) and 9,156 advanced jobs (14%) (Harambee, 2020).

The forecasted demand for the various jobs at entry, immediate and advanced levels are summarised below:

Entry level (44 200 jobs)		Intermediate level (12 471 jobs)		Advanced Level (9156 jobs)	
Role	Number	Role	Number	Role	Number
Junior Software Developer	22%	Cyber/IT Security Specialist	28%	Lead Solutions Architect	10%
Data Analyst	6%	Systems/Solutions Architect	5%	Senior UX/UI Designer/Developer	9%
Data Scientist	5%	Mid-Level DevOps Engineer	5%	Senior Software Developer	7%
Machine Learning Engineer/Specialist	5%	Mid-Level Project Manager	5%	Director	5%
IoT Specialist	4%	Desktop/Support Technician	4%	Senior Quality Assurance Analyst	5%
Cloud Architect Specialist	3%	Data/Big Data Analyst	4%	Project Management	5%
Quality Assurance	1%	Network and Infrastructure Specialist	3%	Network and Infrastructure Engineer	3%
DevOps Engineer	1%	BI Developer	3%	Data Scientist	3%
		IoT Technician	3%	Data Scientist	3%

As reflected in the MICT SETA Skills Plan 2021/22 and 2022/23 there is demand for the top 10 sectoral priority occupations:

Top 10 sectoral priority occupations	MICT SETA Skills Plan 2021/ 2022 (Quantity Required)	MICT SETA Skills Plan 2022/ 2023 (Quantity Required)
Software Developer	2740	1277
Computer Network and Systems Engineer	1780	1296
ICT Systems Analyst	1498	828
Business Analyst	504	N/A
ICT Security Analyst	385	182
Multimedia Specialist	360	N/A
Programmemer Analyst	351	N/A
Developer Programmer	306	349
ICT Project Manager	174	N/A
ICT Sales Representative	78	171
Telecommunications Technician	N/A	141
Telecommunications Engineer	N/A	168
Electronics Engineer	N/A	48
Electronics Engineering Technician	N/A	165

These technologies are increasingly being applied across industries. Some examples of how the various 4IR technologies have been applied in the Mining and Banking Industries is provided below as outlined in The Future of Work: The Changing Skills Landscape for Miners (Grimley & Chapman, 2019):



Mining Industry



- Innovations like Robotics and Automation through drones, autonomous vehicles and remote-controlled operational systems are being rolled out widely to enhance exploration and mining efforts.
- There is an expected increase in demand for data and digital literacy across the mining value chain that will require new skills sets or jobs.
- A move towards open pit mining will displace many traditional miners who have worked in the mines underground. This displacement will require that employees upskill themselves in open pit mining technologies, thereby increasing the need for digital literacy.
- Cloud computing, information sharing, and big data enables integrated operating centers so more work can be performed remotely and flexibly.
- AI, Robotic Process Automation (RPA), Blockchain and Chatbots are technologies that have the potential to perform lower value, manual and routine work more efficiently and there has been a rapid uptake of these technologies in mining (EY Report on The Future of Work: The Changing Skills Landscape for Miners) (Grimley & Chapman, 2019). By implication, this will mean that there is a greater demand for ICT skills.
- EY's quantitative and qualitative survey on digital transformation in the Mining industry reported that digital technologies have been widely adopted but not fully integrated.
 - 80% of the respondent companies are planning to invest at least a moderate amount in digital technologies.
 - 46% of respondents do not have the skills within their current workforce to realise the investment on their adopted technologies.
 - 92% of the respondents agree that their company's success will depend upon the ability to reskill.
- On average, 9.8 months is needed to reskill the average worker (Digital Skills Survey, EY) but many organisations cannot afford the time to invest in upskilling or reskilling employees, thereby relying on contingent workers that are already equipped with skills.

Banking Industry



Extensive research conducted by EY around the question: “*Are you shaping your bank’s digital future or is it shaping you?*” reveals that new capabilities in the banking industry are required to get ready for the future (Mastropietro, 2020).

There is a need for more flexible operating models which in turn impacts the types of ICT skills required. This includes digital processing and automation capabilities that will enable improved customer experience and better exception handling.

Multi-channel digital intake, e-signatures, third party aggregators and data services allow for significant reduction in paper.

Further areas of focus include:

- Increased adoption of Cloud based capabilities: To enable agility and innovation.
 - The optimal service ecosystem: This open banking infrastructure is increasingly being used by a large network of Fintechs.
 - A culture of continuous change: Agile/scrum concepts on top of rationalised platforms and reliable data enables continuous change and allows the organisation to keep pace with the speed of innovation.
 - Customer focused operations: Dedicated digital and personalised services aligned to the customer journey to deliver on an improved customer experience.
-

2.3.2. Upskilling and reskilling trends

How organisations are responding – **Diagram 3** below indicates how organisations have responded to shifting skills needs during the period 2018 and 2020. Organisations are increasingly using automation to address skill gaps. Retraining of existing employees in emerging skills is receiving priority. Concurrent to this, there has been an increase in the number of strategic redundancy programmes aimed at reducing the number of employees who lack the requisite skills to use emerging technologies. Additionally, the use of temporary staff and freelancers with requisite skills has decreased.

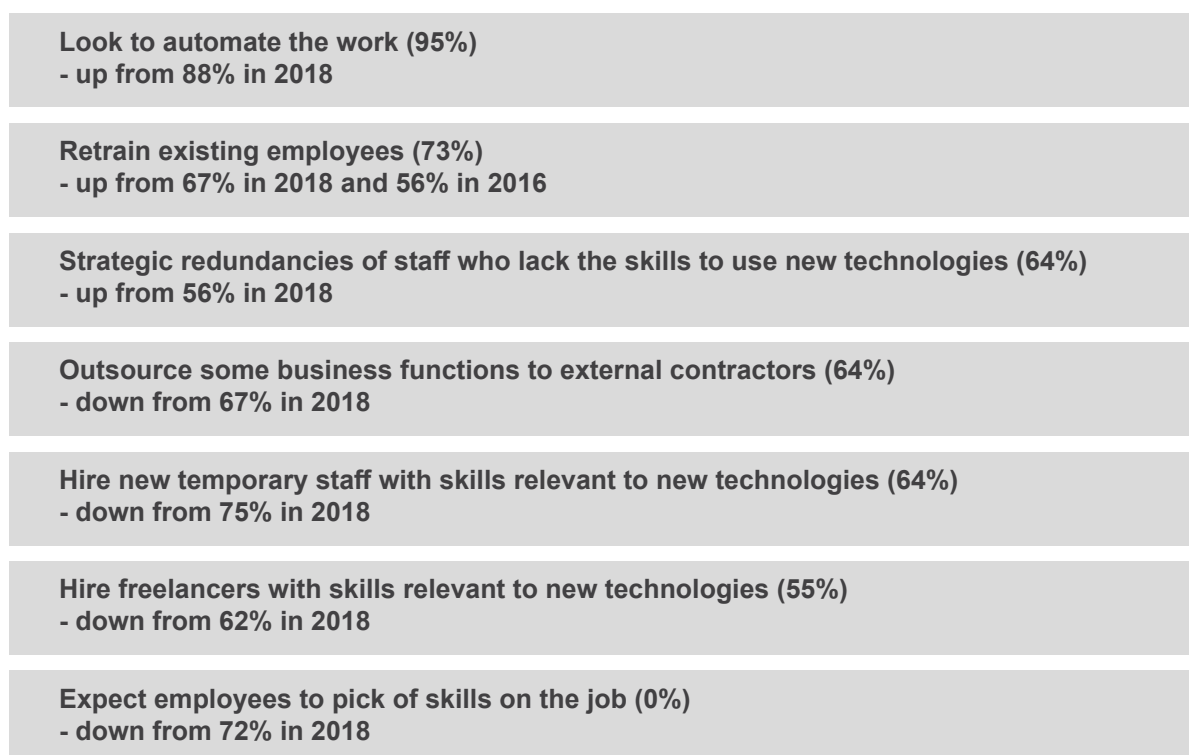


Diagram 3: Summary from Future of Work Survey as published by the World Economic Forum in 2018 and 2020.

Organisations have increased the amount of enterprise-level training, upskilling, and reskilling programmes for employees given the challenges to find suitable candidates with the requisite ICT skills. Reskilling refers to the process of learning new skills and knowledge that enable an employee to either do a different job, i.e., different to the one they had been doing up to a particular point. Upskilling refers to the acquisition of new skills that allow an employee to continue doing the same job they previously did, only in a different way, either because technology, work methods or other circumstances have changed.

The amount of reskilling required as well as the duration spent on reskilling employees has increased (World Economic Forum, 2018) and (World Economic Forum, 2020).

The duration of reskilling as indicated by the share of organisations surveyed within 2018-2020 are summarised below in table 5:

Duration of reskilling	2018	2020
Less than 1 month	12%	15.7%
1-3 months	11%	27.7%
3-6 months	10.5%	18%
6-12 months	10.5%	22.2%
Over 1 year	9%	16.4%
No reskilling needed	47%	0%

Table 5: Duration of reskilling over the periods 2018 and 2020 (Future of Work Survey as published by the World Economic Forum in 2018 and 2020)

Noteworthy is that 47% of organisations surveyed in 2018 indicated that no reskilling was required. In 2020 all organisations surveyed indicated that some form of reskilling was required across all measured durations and dimensions ranging from less than 1 month to over 1 year (World Economic Forum, 2018) and (World Economic Forum, 2020). There was an increase in reskilling over all dimensions indicating that micro-credentials are gaining traction with employees favoring shorter, competency-based recognition in favor of traditional learning methods.

The 2016 World Economic Forum Future of Skills Report outlines talent strategies that are adopted at enterprise/sector level. According to trends (as reflected in diagram 4 below), 56% of the executives surveyed in South Africa recognise that reskilling is crucial. Competition and demand for ICT talent is growing across every industry and all industries have a talent shortfall. The survey reveals that the skills gap, even among current ICT specialists is a widely acknowledged barrier to technology adoption.

Strategies

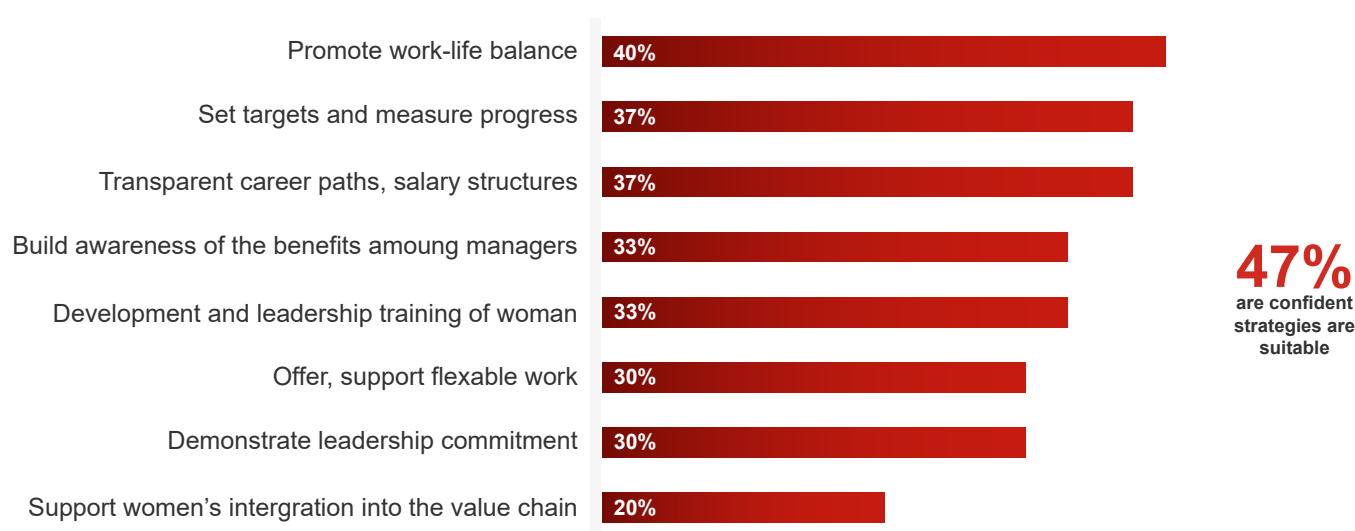


Diagram 4: Workforce Strategy Trends (2016 World Economic Forum Future of Skills Report)

2.3.3. Micro-credentials trends

The use of micro-credentials to build a package of skills aligned to 4IR technologies and ways of working has increased. In the last decade, there has been a proliferation of learning programmes and credentials positioned as “alternatives” to traditional formal education programmes. Rapidly advancing technology makes it essential for people to continuously upskill themselves by doing courses and keeping up to date with the latest technology in the market as well as the newest platforms and practices.

Micro-credentials are defined by the OECD as “credentials that are not recognised as stand-alone formal educational qualifications by relevant national education authorities “. These are used by individuals to improve a skill in a particular area and are short, low-cost, mostly online courses that provide learners with a digital certification or a ‘digital badge’ when complete” (Kato, Galán-Muros & Weko, 2020).

A lack of knowledge and common understanding about micro-credentials has been recognised as a central challenge to their coherent implementation across higher education systems (Orr, Pupinis & Kirdulytė, 2020).

MICT SETA has developed several certifications to address ICT skills gaps. They are in the final stages of developing ten 4IR qualifications in collaboration with the Quality Council for Trades and Occupations (QCTO). The QCTO was established in terms of the Skills Development Act, 1998 (Act No. 97 of 1998) (which offers guidance to skills development providers and assessment centres that must be accredited by them) and the process is now with the South African Qualifications Association (“SAQA”) for approval and registration. Industry experts were consulted to inform the development of these 4IR qualifications.

The 4IR qualifications that are being developed are as follows:

1. Artificial Intelligence;
2. Cybersecurity;
3. Cloud Computing;
4. Data Science;
5. Software Development;
6. Internet of Things;
7. Robotic Processing Automation;
8. Design Thinking;
9. Quality Engineering Automation; and
10. eWaste for ICT products nearing their end of life.

It is critical that once approved, there is increased collaboration across the ICT ecosystem (Government, Education, Industry and MICT SETA) to acknowledge, leverage and embed these micro-credential qualifications. It will also be critical for Government to incentivise stakeholders to build a package of skills through micro-credentials that embed the relevance and recognition of these in all relevant frameworks.



Examples of additional career focused (continuous learning) forums run by global ICT companies in South Africa are discussed below:

- Future technology skills and certification programmes initiated by Company A which provides students and educators with the curricula and certifications they need to succeed in a technology-driven economy such as coding skills based on the latest tools and technologies, IT administration and cloud platform solutions, an introduction to data science concepts and tools as well as productivity applications in demand in today's workplace;
- Programmes initiated by Company B which seeks to build cyber-security, IoT and networking skills online;
- Training and certification programme initiative by Company C which is designed to bridge the skills gap between the university and industry. Through the programme, students are able to access several different career offerings and select the one that supports their career goal most effectively (such as Big Data Engineer, Cloud Application Developer, IoT Cloud Developer, etc);
- Technology skills and certification programmes initiated by Company D in partnership with various Academies around the world. Through this partnership, the programmes deliver training on Company D's ICT technologies, encouraging students to get certifications and developing talent with the requisite practical skills for the ICT industry and the community; and
- Company E launched a digital learning platform designed to propel South African education into the digital future by providing free access to online educational content. Digital Innovation Awards are also driven by the organisation at a SME and large enterprise level on an annual basis.

In addition to this, several companies are running Innovation Labs to drive digital innovation. These organisations will need access to talent with the knowledge and practical skills required by the new technology.

2.4. Current ICT talent development challenges

There are several challenges facing the Post School Education and Training (PSET) system that must be addressed by the DHET who is responsible for skills development. These challenges emanate from the external environment (allocation decisions), factors internal to the way the institutions operate (efficiency and implementation challenges) and broader policy shifts that took place in government (for example, the function shift of TVET colleges from the provincial to the national sphere of government).

The key challenges are summarised from the DHET Revised Strategic Plan 2020/2025 are as follows:

General challenges

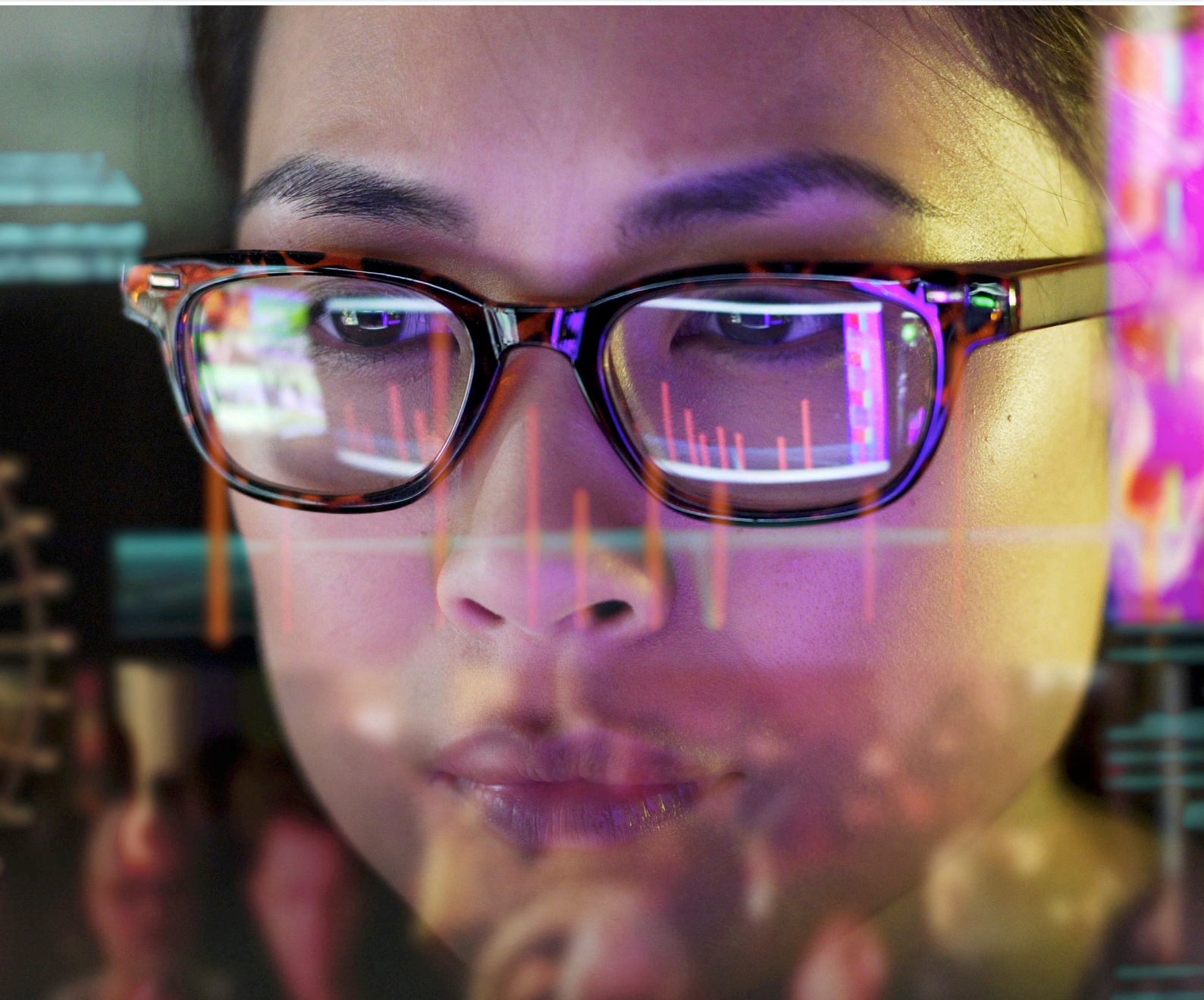
Availability of data for labour market intelligence: The (White Paper for Post-School Education and Training, 2013) observes that, although South Africa has put a range of ambitious measures in place to improve skills planning, “the system neither produced good information about skills needs, nor increased the quality of provision in areas needed in the economy”. The WPPSET concludes that the limited credibility and impact of the current sector skills planning system is the result of inadequate research capacity; a lack of economics, labour market, and industry expertise; poor data classification and management; and a lack of planning.

Infrastructure: Inadequate infrastructure and equipment which results in inefficiencies which are worsened by the increasing number of students, lack of appropriate maintenance and overcrowding of facilities (West & Meier, 2020). In terms of the Global Competitiveness Index 2019 edition, South Africa is ranked 89th out of 141 countries in terms of ICT adoption and is below the upper-middle-income group average (World Economic Forum, 2019). This ranking is influenced by the number of mobile-cellular telephone and broadband subscriptions, fixed-broadband internet and fiber subscriptions and internet users as a % of the adult population. South Africa is ranked low relative to other countries (104 out of 141) in terms of the number of broadband internet subscriptions per 100 people (World Economic Forum, 2019).

Financing: Funding for education in South Africa has increased but it is still not sufficient to meet demands. This ultimately curtails the successful implementation of the tools and skills required by the 4IR in education. Greater investment is required in new technological advancements and institutions need to prioritise what the funding should be used for. Further to this, technological infrastructure and appointment of highly skilled educators needs to be prioritised. There has been a steady decline in state funding for the university sector, including inadequate contributions by the National Student Financial Aid Scheme (NSFAS).

Completion rate: There is a relatively low graduation and success rate among University and TVET students. From insights received in interviews, Professors are reporting that 50% of the students who come into university never graduate and that more specifically, the Science and Engineering faculty has the highest fallout rate. Similarly, the completion at TVET colleges has decreased over the years.

Curriculum: As reflected in interviews, inadequate needs analyses are being conducted to understand the required skills in the ICT Sector. Interviewees indicated that higher education institutions are not keeping pace with updates to curricula. As a result, curricula are not always optimally aligned to needs and skills development processes are not keeping pace with the rate of adoption of emerging 4IR technologies. Inhibiting policies and bureaucracy associated with changes to curricula, further compounds this challenge. Additionally, interviewees indicated that Universities and TVETs are not consistently equipping graduates with the soft skills (such as problem solving, teamwork and self-management), which are essential in the work environment and are becoming as important as technical skills



Challenges pertaining to educational institutions

Universities: Universities face several challenges. These are:

- Perceived lack of value associated with university degrees given that so many people today hold degrees. The impact is that more organisations and individuals are looking to additional qualifications/certified programmes or experience as a to differentiate themselves from others;
- Universities are not leveraging collaboration opportunities. As per interview feedback, there is insufficient collaboration between universities and industry on research and innovation, curriculum design and work placement.
- Perceived lack of use of digital learning opportunities to meet student increasing expectation of universities to improve the use of technologies as part of the student experience. As reflected in interviews, many universities have yet to use basic digital elements, including integrating technologies, digitising of content and automating administration processes, etc.
- Increased recognition of the importance of lifelong learning. Due to evolving technology and future jobs, some university leaders estimate that around 40% of existing degrees will soon be obsolete (Singhal, 2018). This will require a review of the mandate and business models of Universities.

TVET Colleges: The 2019 White Paper for Science, Technology and Innovation and Post School Education and Training (WPPSET), highlights the following as key challenges:

- Deficits in programme quality;
- The professional capability of staff;
- The need to build a stronger Management Information System (MIS);
- Weak partnerships between TVET colleges and industry;
- The need to restore links between the colleges and the labour market by making programme offerings more responsive;
- Improving the placement of college graduates in jobs;
- Confusion around the branding and placement of TVET colleges in the PSET system.

Challenges pertaining to reskilling/upskilling for enterprise/sector

- **Lack of skills intelligence** (e.g., sector trends, labour market intelligence) and a clear skills framework that helps organisations to determine the desired skills they want to build, to access the current skills pool, identify the skills gap and enable a structured approach to reskilling/upskilling of employees;
- **Inconsistent and fragmented approach to addressing the skill gap:** There is no broader consensus on priority skills and coherent approach to identify skills supply and future demand. Without a structured approach to longer term strategic workforce planning, organisations are unable to appropriately leverage opportunities to build talent through the broader ICT ecosystem, rather than having to revert to building these internally;
- **Misaligned talent development programmes :** Given the evolving nature of technologies and demand on skills across industries, employees tend to need a combination of formal educational background (formal learning), on-demand micro-learning, experiential learning projects and practical courses to build the skills that could be used at different levels of the organisation;
- **Accelerated brain drain:** The continued and accelerated brain drain due to emigration is resulting in a loss of key ICT talent. South Africa is currently refilling the talent pool slower than the rate at which people are leaving;
- Further to this, there are limited opportunities for foreigners to apply for critical and scarce skills, with DHA's official Critical Skills List for immigration purposes being narrowed from an ICT perspective. This list has been narrowed due to Government's position being that there is ample access to ICT professionals in the local market and that the scope for foreigners to occupy these roles should be restricted. It is questionable whether there is sufficient supply of ICT talent locally to cater for future demand.



2.5. Case study

2.5.1. Background to case study

In 1997, a leading tech company approached the Government of Costa Rica with a proposal to set up operations in Costa Rica. The tech company's primary concern was the need to develop a labour pool sufficient in size and skills to support their needs. Although the educational level in Costa Rica was already above norm for developing nations, the country lacked sufficient infrastructure to meet all the company's human resource requirements. This case is a great example of how the government, ICT Sector and education collaborated to resolve the talent development gap in Costa Rica.

The role of government, education and the ICT sector in ICT Talent Development in Costa Rica is outlined below.

2.5.2. The role of government in ICT talent development in Costa Rica

The Costa Rican government played a pivotal role in the success of the project which ultimately advanced ICT talent development in Costa Rica.

Firstly, government created an attractive climate for foreign investment. Secondly, the government showed an unwavering commitment towards improving ICT education in the country. They dedicated substantial efforts to implementing policies in collaboration with non-profit organisations which enabled Costa Rican students to receive exposure to basic technology early on in their education. Additionally, they invested funds to improve ICT infrastructure to enable the provision of internet accessibility across Costa Rica.

2.5.3. The role of education in ICT talent development in Costa Rica

At the onset of the agreement between the Costa Rican government and the tech company, the parties agreed that they would develop mid-level technicians with the right skillsets to fill the current gap, using a partnership between government, the tech company, and the education sector. Education related infrastructure was critical for the company to achieve its commitment to the initiative and in the initial conditional agreement with the government, the tech company insisted on improvements to technical education. This resulted in continuous and close cooperation between government, the tech company and Costa Rica's universities and schools. The impact made by the tech company was visible in a series of programmes and relationships designed to increase both the number of graduates and their proficiency.

President Figueres, the Minister of Education and the Dean of Instituto Tecnológico de Costa Rica (ITCR), a prominent university in Costa Rica, responded to the requirement by modifying the curriculum of ITCR and creating specialised certification programmes to ensure the correct training of technicians (Spar, 1998).

As a result of the above, there was a notable surge in the number of students enrolled in engineering which grew from 577 in 1997 to 874 in 2000 (UNDP, 2001). Costa Rica also implemented a broad range of programmes not only for higher education, but also for teachers and students in Costa Rica's elementary and secondary schools in support of this initiative.

Investments were made by the tech company to continuously upskill employees and place employees on mobility assignments abroad where they worked within the company's operational areas to gain skills and get exposure to additional training. Exposure to the company's competitive environment, knowledge and world-class practices helped raise performance standards of the ICT industry's workforce and suppliers in Costa Rica.

2.5.4. The role of industry in ICT talent development in Costa Rica

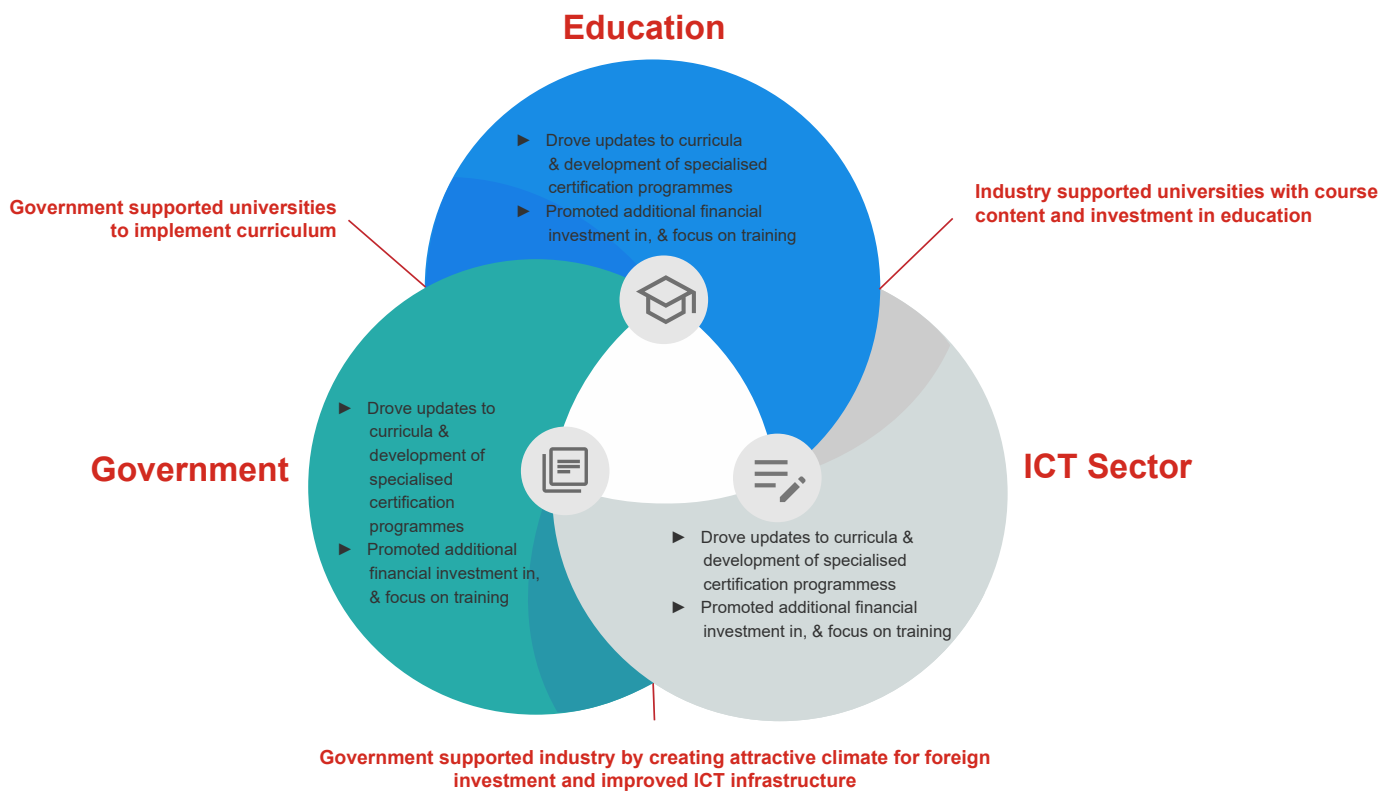
The tech company's contribution included:

- Investment in technical education programmes in collaboration with major educational institutions and vocational schools;
- Leading and supporting a range of programmes for teachers and students; and
- Sharing knowledge and creating awareness of supportive business cultures and standards which can be used to enable initiatives of this nature.

President Carlos Alvarado Quesada remarked that the collaboration between the various stakeholders has opened significant employment opportunities for people of different educational and skill levels. The increased ICT talent pool in Costa Rica, which can be attributed to this initiative has attracted many other companies to set up their production facilities in Costa Rica (The Central American Group). Costa Rica now has a flourishing electronics cluster which is the largest among its export sectors, incorporating 55 companies of which 42 are foreign. It employs 12,000 workers and exports billions in products a year, the largest being the microprocessors, led by the tech company (Frederick & Gereffi, 2013).

2.5.5. Interaction between the various stakeholders involved in the case study

The diagram below summarises the various role players and how they collaborated.



2.5.6. Conclusion and key learnings from above

The investment and presence of the tech company had a positive impact on Costa Rica's economy, industry, educational institutions, and business culture and enabling the upskilling of individuals.

There is much that South Africa can learn from the case study. There are many opportunities for the government, education, and ICT Sector, to improve and to strengthen proactive collaboration to resolve the talent development challenge in the ICT Sector. Through collaboration stakeholders will be able to ensure that sufficient 4IR skills are built for the ICT Sector to be able to respond to future technology trends.



2.6. How a global ICT organisation is contributing to ICT skills development globally

Company D, a global ICT player, with foreign investment in South Africa is committed to playing a significant role in driving talent development globally and locally. To enable this, Company D developed and implemented a talent development framework aimed at reducing the talent deficiency in the ICT sector. Additionally, the framework aims to develop standards for ICT talent development, build alliances, and create understanding of the value that can be derived from talent and sound talent development practices.

This initiative named the Company D Digital Inclusion Initiative leverages the power of an established ecosystem (underpinned by cooperation agreements with industry partners, higher learning institutions at enterprises aimed at promoting the ICT sector) to offer opportunities for students to complete company certified certifications in ICT and obtain workplace experience and practical on-the-job skills.

**All participants benefit from the eco-system collaboration.
Most notably:**

Academies

- Have access to industry players across the ICT value chain to gain insights into new technology trends;
- Have access to latest technologies and online learning resources;
- Have access to Master industry standard simulation lab tools;
- Have access to extensive Industry standard training;
- Receive teacher enablement and certification;
- Get support directly from Company D;
- Are supported to develop a customised curriculum and unique cutting-edge courses;
- Can enhance student career competitiveness and increase the employment rate;

Students

- Obtain exposure to industry and advanced technologies;
- Obtain latest technologies and online learning resources provided by Company D;
- Have access to master industry standard simulation lab tools;
- Receive industry standard ICT training and obtain career certification;
- Have opportunities to join master classes, seminars, industry trips and ICT competitions;
- Have access to job opportunities and opportunities to broaden their career paths; and
- Receive discounted rates on Company D's certification exam.

By the end of 2020, Company D had deployed Academies in China, Southeast Asia, the Middle East, Africa, Europe, Latin America, and the Southern Pacific, covering 82 countries. 1,800+ ICT Academies have been established, 3,000+ instructors have been certified and 100+ job fairs have been held. It has hosted 5 annual ICT Competitions in which 2,000+ universities and 200,000+ students participated.



3. Way forward and recommendations

As indicated from the analysis of findings from interviews and desktop research, the ICT ecosystem, with all its predominant stakeholders (education, industry and government) is currently behind in the task of providing a thriving and sustainable ICT economy, that is sufficiently responsive to the ICT skills demands of our country. Despite an aggressive effort by government in the last few years to empower South Africa's economy by investing considerable funds in capacitating ICT initiatives, more needs to be done collectively to stay ahead in the dynamically changing ICT landscape. Although the directive from government for all ICT stakeholders to increase efforts in 4IR advancement is clear, the "how" seems to be very elusive.

A coordinated programme driven by key stakeholders that consolidates all ICT initiatives which are working towards the upliftment of the ICT industry and enablement of government's 4IR ambition is recommended to address the ICT skills challenge

3.1. Analysis of findings

Our analysis from interviews and desktop research has revealed the following as summarised below:

3.1.1. There is a need to speed up the process of moving South Africa to a digital economy

- Government's response to the 4IR and need to build a digital economy is still in early days. As the indicators from various organisations outlined in section two, Government recognises that 4IR is a key imperative to enable South Africa to respond positively to build a digital economy. In a recent interview, the higher education, science, and innovation minister further states that rapidly evolving technologies have the potential to spur industrial development, attract investment, as well as create the conditions for inclusive growth (ITWeb, April 2022). While acceleration efforts are underway through various commissions and initiatives in support of the 4IR agenda, there is much that can still be done to propel South Africa's digital economy forward.

If South Africa is to realise and reap the inherent benefits of being a regional hub for ICT services and software in the digital economy, there is a need for Government to speed up the adoption of a digital economy. To enable this and meet the associated increasing demand South Africa requires both an effective ICT infrastructure and the requisite future ICT skills supply to meet the growing demand.

3.1.2. There is substantial demand for ICT talent

- **The demand for the number of ICT skills (i.e., quantity) will increase as the ICT industry grows.** As the South African economy continues to transition and organisations expedite digitisation of their operations as well as through the emergence of small/niche ICT companies as well as through the FinTech, etc., we can expect that the ICT sector will continue to grow at the same pace (at a minimum) as it has to date. This will increase existing demand (which is already constrained) for traditional technology skills in South Africa. Current noteworthy ICT skills gaps include information security, data analysis and processing, cloud computing, IoT and connected devices, artificial intelligence, and machine learning. As per Harambee research, which seeks to map out digital and ICT roles and demand in South Africa, there is a forecasted demand for approximately 66 000 people in digital and ICT roles during the period 2021, some of which is latent demand. Approximately 44 000 of these jobs are suitable for youth.
- **New technologies and ICT trends will require different kinds of jobs and ICT talent, (i.e., quality of ICT skills will differ).** As it currently stands, ICT skills gaps present significant barriers to the adoption of new technologies (World Economic Forum Report 2020). Emerging ICT trends such as Fifth-Generation Mobile Networks and Edge computing, etc. together with the drive for green technologies will result in an increasing demand for new infrastructure and services. This is resulting in the emergence of new jobs and/or roles of which the requisite skills to deliver on the ICT skills demand are not yet clearly understood. The MICT SETA Skills Plan 2022/23 further outlines the top 10 sectoral priority occupations with Software Developer representing 28.4%, Computer Network and Systems Engineers representing 28.9%, ICT Systems Analyst representing 18.4% and Developer Programmers representing 7% of the total occupations being high in demand.
- **There are implications for the skills requirements of existing employees.** According to the World Economic Forum Future of Jobs Report (2020), organisations are cognisant of the fact that by 2025, 44% of the skills that employees will need to perform their roles effectively will change. 73% of organisations are looking to provide reskilling and upskilling opportunities to their existing employees to meet the emerging skills demand and changing job requirements. Employers also recognise that the digital economy requires new sets of skills and knowledge, in which many countries, including South Africa, have deficiencies, such as technological savviness, agile, design thinking, entrepreneurship, collaboration and business acumen.

3.1.3. There is a need to increase the supply of ICT talent to cater for future demand

- **The education system is still not yielding sufficient ICT graduates and the curricula is not aligned to market needs.** Although progress has been made to drive ICT readiness at education level, greater focus is required to ensure adequately skilled ICT educators, alignment of curricula to industry requirements and available connectivity to drive adoption. Completion rates remain low relative to demand, even though the number of ICT graduates at University and TVET levels are growing. Although there has been a continuous increase in students enrolling in HEI Science, Engineering and Technology (SET) programmes with a total of over 323,000 enrolling in 2019, only 65 211 students (29.1%) graduated (MICT SETA Sector Skills Plan, 2021). At a TVET level, the number of students in TVET colleges who registered versus completed the L4: Information Technology and Computer Science qualification is recorded at 32.4% (301 completed out of 1 074 registered) in 2019 (DHET Statistics on Post-School Education and Training in South Africa, 2019).
- As confirmed in the interviews conducted in November 2021 the curricula does not appear to be aligned to the needs of the market and there is still a disconnect between academia and the industry on the whole and requires enhanced involvement of the industry players in curriculum through a well-coordinated academician-industry collaboration. Greater agility in policies and procedures regulating formulation of curricula will enable universities and TVETs to respond to the rapidly changing skills demands because of emerging ICT trends and increase probability of graduates securing employment.
- **Government, organisations and employees will need to find a way to expedite integration of traditional and new ICT skills required by emerging technologies.** As the exponential pace of change increases, all stakeholders will need to explore alternative ways to expedite integration and development of traditional and emerging ICT skills (both in terms of theory and practical application). The reason is twofold. The first being attributed to insufficient talent supply through the educational system and the second due to rapid technological changes requiring employees to learn different skills. As indicated in the World Economic Forum Report (2020) all organisations surveyed indicated that some form of reskilling was required. The value of micro-credentials should be given greater recognition. These could be positioned as alternatives to traditional qualifications and enable employees to build a package of skills as ICT skills evolve. This will require a change to the way qualifications are assessed and the way in which competencies are measured when hiring individuals.

- **South Africa needs to do more to nurture ICT talent and keep it in the country.** Recent reports have shown that the momentum of South Africans seeking opportunities abroad has increased significantly over the past 5 - 10 years due to the concern of economic growth in South Africa. South Africa's tax regime and incentives are not set up currently to address talent shortages arising due to globalisation and the great resignation and limit available retention strategies. It is worthwhile keeping in mind that skills that are globally sourced are for the economic benefit of those countries, resulting in South Africa having to compete for scarce skills. The 2019/20 Critical Skills Survey indicated that ICT Specialists continue to be one of the most sought-after skills which is indicative of the ICT talent shortage. 19% of respondents in this survey indicated that ICT Specialists are the most difficult areas to recruit for from abroad. This is up from 17% in 2018 and 15% in 2017 and indicates that the skills shortage, even from abroad is becoming more pervasive. This is according to a survey run by Xpatweb (2019-20 Critical Skills Survey Results (xpatweb.com)).



3.2. Conclusion

The following can be summarised from the analysis of interviews and desktop research.

Although there is a great demand for technology skills in South Africa, supply falls short for both existing and newly skilled talent. This presents a risk to South African economy to meet the demands of the digital economy and 4IR progress. Additionally, there is a potential opportunity cost given the rising demand for IT goods and services, and South Africa's unique placement as a regional hub.

Skills gaps for existing skills continue to grow as skilled labour continue to emigrate. There is significant forecasted demand in digital and ICT roles with the rise and adoption of emerging technologies within the South African ICT sector.

The research, in-depth interviews held with stakeholders in the ICT ecosystem, and the Costa Rica case study have provided great insights and afforded the translation of the core responsibilities that stakeholders need to take on, pivotal to the advancement of the Talent Development agenda in the ICT Sector in South Africa, of which the ICT Sector is a key enabler.

3.3. A metaphoric talent development model for the ICT ecosystem

The model that follows illustrates a suggested structured approach to build ICT skills to address the outcomes of our research. If implemented with the necessary mandate and gravitas this situation requires, it will enhance and expedite the ability of learners and organisations to become digitally future fit.

The talent development model highlights three key stakeholders in the ICT talent development ecosystem that can fundamentally shift the prosperity of the ICT economy, namely government, the Education Sector, and ICT Sector. Each stakeholder has a role to play and a destination to reach to achieve this objective. These destinations are **1: ICT Talent Development**, **2: ICT Sector Career** and **3: Sustained Economic Development**.

Having studied the reported data, analyzed the primary research from surveys and interviews held with key stakeholders and understood the gross imbalance in demand and supply of ICT skills in South Africa, it makes sense that increased efforts need to be injected into solving the ICT skill crisis. The Costa Rica case study presented in the report, exemplifies many meaningful and beneficial learning points that can be adopted and applied in the South African context.

As an analogy, the stakeholders of the ICT ecosystem can be represented by various components of a typical flight service where the absence of any one component, could bring the ecosystem into disarray as depicted in diagram 4.

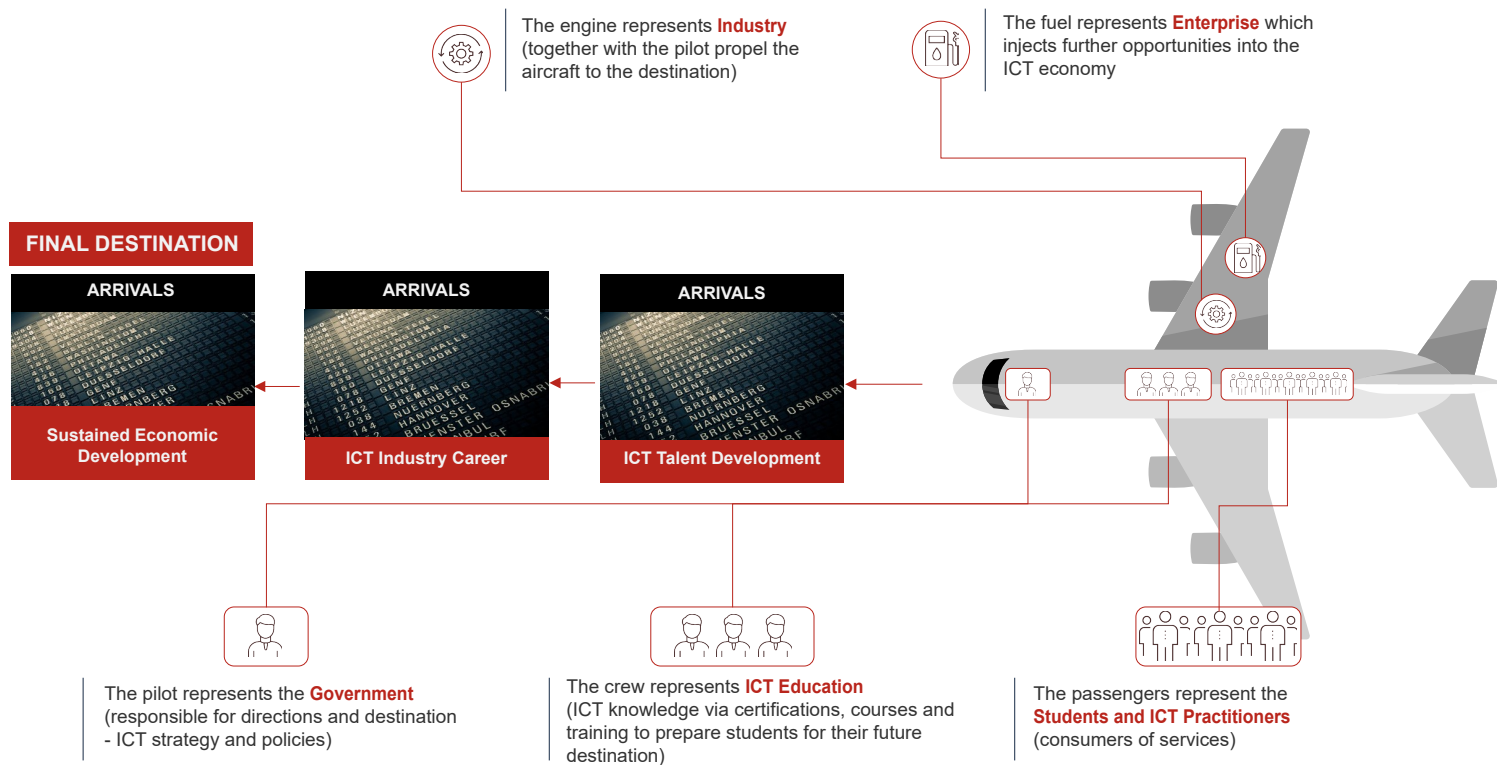


Diagram 4: ICT Talent Development Model

The key stakeholders and their roles in the ICT ecosystem are depicted below:

Stakeholder	Role
Passenger (Students and ICT Practitioners)	Consumers of services whose goal is to reach their destination of having the appropriate skills to meet the demands of the ICT industry in terms of 4IR tech and new ways of working.
Pilot (Government)	Sets direction to the destination, specifically in terms of the following: <ul style="list-style-type: none"> Setting ICT skills development strategies, policies and legislation; Providing infrastructure to the ICT Sector; Establishing private and public growth initiatives in affiliation with MICT SETA; and Creating a social-political environment and financial incentives and contributions that attract support.
Engine (ICT Industry)	Together with the pilot propel the aircraft to the destination and keep the ICT ecosystem in motion by providing a pivotal platform for the application of skills and experiential learning on the job through direct employment, internships and employee acceleration programmes.
Crew (ICT Education)	Equips passengers with necessary information and training to arrive at the destination, specifically in terms of the following: <ul style="list-style-type: none"> Understanding skills demand from industry; Providing the ICT training curricula and certifications and keeping the curricula up to date; and Ensuring accreditation of service providers within the remits of the ICT Sector policies.
Fuel (Enterprise)	Injects further opportunities into the ICT economy to certify those in the unemployed talent pool which makes South Africa more attractive to foreign investors, which only elevates the entire aircraft (ecosystem) to higher altitudes.

The destinations in the above model are a three-part journey as depicted below:

FIRST DESTINATION	SECOND DESTINATION	FINAL DESTINATION
Sustained Economic Development	ICT Industry Career	ICT Talent Development
Attainment of an ICT education validated by certification and micro-credentials to build a package of skills aligned to 4IR tech and new ways of working.	Provides employment opportunities, while matching skills sets to fulfil demands.	Representation of a thriving economy in the country as a direct result of the contributions of all the players in service.

3.4. Stakeholder's role and action suggestions (quick wins)

From the three destinations outlined below, key stakeholder roles and suggestions are only provided in terms of the first destination (ICT Talent Development).

As it stands, the current approach of the SA ICT Skills Development Ecosystem is in the process of addressing the ICT talent gap in South Africa, which is supported by the research conducted in this paper. It is the recommendation of this paper that true progress in the ICT Talent Development can only take place when government, education and the ICT sector collaborate as a unit to contribute to talent development, supporting graduates in securing industry careers and attaining sustained economic development.

Although each stakeholder has a role to play within the ICT Talent Development destination, the ongoing collaboration between government, ICT sector and the education sector in terms of talent development is critical to ensure a sustainable talent development solution. It is suggested that each stakeholder play the following roles individually, while simultaneously working together to ensure that quick wins are implemented which have immediate benefits and can be delivered quickly. A quick win has a narrow and focused scope which can be fully implemented within three months with focused attention and increased collaboration.

3.4.1. Government

- **Aligning policy to deliver results by placing greater focus on measuring and monitoring progress.** This includes making sure skills development policies are reviewed, outcomes are measured, and targets are set to improve ICT talent development in South Africa and structured processes are in place to monitor progress and implement proactive remediation measures;
- **Providing more flexibility to the higher learning institutions** to update the curriculum in terms of 4IR emerging technologies and associated experiences;
- **Making education training accessible and future-proof:** providing access to digital technologies and relevant ICT education for talent development purposes at a school and post-school level, including transversal skills (soft skills) to ensure that a pipeline of ICT talent is maintained going forward and working in close partnership with employers to enhance employability of graduates as well as challenging the mindset when individuals are being educated on the importance of acquiring a basket of skills to support ICT skills of the future and recognising the certification system to shrink the skills gaps, facilitating a smoother and efficient labor market consideration; and
- **Fostering cooperation between stakeholders in the ecosystem is a key factor of successful implementation of policies and initiative, and digital skills are no exception:** regulatory pressures and administrative complexities result in national level collaborations often choosing familiar partner organisations with whom they have worked previously when considering new proposals. With the fast-moving nature of technology and ICT, industry calls for a more responsive educational approach. A collaboration between ICT industry and education can be structured differently to promote a natural convergence and administration, monitoring and evaluation could be positioned as an agent to promote collaboration between all the parties involved.





3.4.2. Education institutions

- **ICT/digital education content and exchange framework and pilot:** conducting a feasibility study to develop an ICT/digital education content framework, and exchange platform and initiating pilot collaboration projects between enterprises and educational institutions to encourage digitalisation of all types of education institutions;
- **Supporting educators/teachers in understanding cutting-edge digital technologies:**
 - Helping to include digital skills as part of competencies at every education level and to expand the availability of digital skills through the education and training system within the ICT sector;
 - Educating teachers with the necessary business and ICT acumen so that students can be exposed to ICT leading practices and emerging technologies; and
 - Regularly providing students with information on ICT skills and jobs of the future.
- **Launching a dialogue with SA's relevant authority** for a proposal/recommendation on how enterprise can contribute towards successful digital education. In conjunction with relevant authority enterprise to define a long-term strategic vision for digital education as well as key priorities and actions.

3.4.3. ICT sector

- **Conducting regular training events, providing training sources and creating job opportunities for students:** various forums to be used to help students keep up to date with emerging technologies and trends, and how technologies may be leveraged to support and improve business performance. Creating job opportunities for individuals in the ICT sector to reduce unemployment through career fairs, internships, and ICT talent exchange programmes;
- **Providing universities and TVETs with information on current and emerging skills:** this could include newsletters sent to the universities on a quarterly basis as well as how the curricula may be changed to meet these trends;
- **Providing continuous lifelong learning for their employees:** providing employees with the latest learnings to help develop their skills and advance themselves with the new emerging technologies to ensure overall retention and transferrable skills through reskilling plans (i.e., via academies, online learning platforms, seminars, professional bodies considering certification as a different mechanism in reskilling initiatives; and
- **Ensuring the transfer of imported skills:** identifying recipients among the local workforce of knowledge transfer by foreigners hired to plug the skills gap. Continual and proactive monitoring of knowledge transfer by way of skills transfer plans entered between the foreign and local employee.





4. Conclusion

The Zulu term “simunye” directly translates to “together we are one” – a term that has profound relevance to an ecosystem that is working in silos in its current state. Now is the time to unite and collaborate on the future of ICT talent development.

Increased efforts in collaborating across the ICT ecosystem, increased transparency around commitments and an increased level of accountability will go a long way in shifting the ICT playing field. The art of the possible, has been illustrated in the case of Costa Rica, who with the aid of industry investment, cooperative commitment, engagement with all parties and accountability, were able to turn their ICT economy into a thriving one. Unemployment rates declined and foreign investment flourished. Our rainbow nation comprises of a diverse people sincerely interested in the common good.

Appendix A: National Qualifications Framework (NQF) Act No 67 of 2008

Level		Sub-Framework and Qualification Types		
10	HEQFS	Doctoral Degree (Professional)		
9		Master's Degree (Professional)		
8		Bachelor Honours Degree <ul style="list-style-type: none"> Postgraduate Diploma Bachelor's Degree (480 credits) 	Occupational Certificate (Level 8)	OQSF
7		<ul style="list-style-type: none"> Bachelor's Degree (360 credits) Advanced Diploma 	Occupational Certificate (Level 7)	
6		<ul style="list-style-type: none"> Diploma Advanced Certificate 	Occupational Certificate (Level 6)	
5		Higher Certificate	Occupational Certificate (Level 5)	
4	GENFETQSF	National Certificate	Occupational Certificate (Level 4)	
3		Intermediate Certificate	Occupational Certificate (Level 3)	
2		Elementary Certificate	Occupational Certificate (Level 2)	
1		General Certificate	Occupational Certificate (Level 1)	

Appendix B: ICT Curricula

	University of Cape Town	University of the Witwatersrand	Ekurhuleni East TVET College	False Bay College (TVET)
First Year	Computer Science 1010 Computer Science 1011 Computer Science 1015 Computer Science 1016 Foundations of Computer Programming for Engineers	Computer Science I: Basic Computer Organisation Discrete Computational Structures Introduction to Algorithms and Programming Introduction to Data Structures and Algorithms AND Mathematics I (Major): Algebra I Calculus I AND Computational and Applied Mathematics I	Electronics Introduction to Information Systems Introduction to Systems Development Electronic Control and Digital Electronics or Basic Multimedia	Introduction to Information Systems Electronics Multimedia Basics
Second Year	Computer Science 2001 Computer Science 2002 Programming Assessment Independent Research in Computer Science	Computer Science II: Analysis of Algorithms Computer Networks Database Fundamentals Mobile Computing AND Mathematics II: Abstract Mathematics Basic Analysis Introduction to Mathematical Statistics Linear Algebra Multivariable Calculus Transition to Abstract Mathematics AND Computational and Applied Mathematics II	Systems Analysis and Design Computer Hardware and Software Principles of Computer Programming Electronic Control and Digital Electronics (Optional) Multimedia Content (Optional)	Systems Analysis and Design Computer Hardware and Software Principles of Computer Programming Multimedia Content

	University of Cape Town	University of the Witwatersrand	Ekurhuleni East TVET College	False Bay College (TVET)
Third Year	Computer Science 3002 Computer Science 3003 C++ and machine learning Computer Science 3023	Computer Science III: Analysis of Advanced Algorithms Formal Languages and Automata Operating Systems and System Programming III Software Design III OR Software Engineering III AND Computational Applications III: Computer Graphics and Visualization III Machine Learning III Parallel Computing III Software Design Project III	Systems Analysis and Design Computer Hardware and Software Principles of Computer Programming Electronic Control and Digital Electronics (Optional) Multimedia Content (Optional)	Data Communication and Networking Computer Programming Multimedia Service Systems Analysis and Design

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