



Capacity Building Programme for Employment Promotion

To-Be Report: Digital Skills for the Future

WESTERN CAPE DIGITAL SKILLS SHARED AGENDA FOR ACTION

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1 Introduction

The fast pace of technological change, and the ubiquity of digital technologies in all aspects of work and life, place new demands on everyone. In recognition of the accelerating technological advances and the requirement to remain responsive to the needs, challenges and opportunities of a hyper-connected global economy, the Western Cape Government has identified the positioning of the Western Cape as a leading global digital hub as one of its goals.

The As-Is report provided a descriptive overview of the current awareness of the potentially-disruptive impact of technological advances on skills requirements and digital skills demand-and-supply patterns (e.g., shortages, duplications of efforts, gaps) as they relate to the top three stacks of the Digital Skills Framework as presented in the Inception Report. Primary emphasis was on the sectors identified by the WCG as strategic growth sectors that are ICT intensive.

The Demand Analysis section of the As-is report considered the current demand for digital skills in the Western Cape. Preparing the Western Cape to meet the digital skills requirements of the Fourth Industrial Revolution (4IR) requires that the Province has an understanding of the skills and capabilities that businesses will need.

An online survey of business and industry role-players was conducted to ascertain views and perspectives about the technologies and skills likely to shape the Western Cape economy in the near future.

The purpose of this report is to: “Gauge the (future) digital skills requirements to achieve the objective of positioning the Western Cape as a leading global digital economy hub. This requires some work on “forecasting” what digital skills are likely to be needed for a “global digital hub” within the context of the likely impact of the 4th Industrial Revolution (4IR)”.

The new digital technologies that have risen to prominence during the last few years hold the possibility of drastically changing both the way businesses and other organisations function and individuals go about living their lives. Some technologies, such as Artificial Intelligence, Robotics or Cloud Computing, were mere experimental or visions of idealistic visionaries a few decades ago, but have now become part of day to day life. Many of these technologies were seen only a decade ago as “to be” projections, whereas they have now become reality.

When it comes to shaping the Western Cape’s digital future, it is therefore important to identify the impact these technologies, digital transformations and innovations will have on world of work and the province’s skills base. Accordingly, it is essential to understand the systemic changes that are likely to arise (*the technologies, digital transformation in business, changes to the supply of skills, and new skills requirements*) that will be required to become a successful digital hub of global standing.

Once these systemic changes have been identified and understood, then it will be possible to propose a skills agenda that the stakeholders can agree upon.

2 Context for the To-Be report

2.1 Terminology

In this study, the term “transformative digital technologies” (TDTs) is used, instead of “4IR technologies”. Not all “4IR technologies” are digital. A wide variety of designations are used for these technologies, including:

- “game changing technologies”¹
- “transformative technologies”²
- “emerging technologies”³
- “new technologies” – found in many publications of the WEF⁴.
- “digital exponential technologies”⁵.

Similarly, the term “Fourth Industrial Revolution”, used as a designation of the “era” that is characterised by certain megatrends⁶ and disruptive technologies is only used sparingly.

We caution also over the use of terms like “disruptive” and “new technologies” that portray hockey stick effect innovations. Many of these technologies have been in existence for years, with new relevance arising from convergence, hyper-connectivity and mobility.

2.2 Broad Objective

Digital disruption is both a threat and an opportunity to individual businesses, to Citys, and regions. This report looks to the future, what digital transformation may mean for industry, and the skills that will be required to achieve the WCG vision of a global digital hub.

2.3 The Digital Skills Ecosystem

Digital skills for a global digital hub are developed within an ecosystem with multiple layers of influence (not just transformative digital technologies). The ecosystem for skills development (for the creation of a global digital hub), is represented in Figure 1. The ecosystem is contextualised by:

- Technological changes
- National Macroeconomic conditions
 - Demographics
 - Employment patterns
 - Rapid urbanisation
 - Educational challenges
- The Local business ecosystem
 - Digital business start-ups
 - Relationships between businesses and local universities and other places of research and learning
 - Adoption of digital technologies by established businesses
 - Funding - the availability of capital
 - Underlying digital infrastructure and services: network, exchanges, data centres, etc.
- Regional conditions

- Demographics
- E-readiness of Provinces (infrastructure)
- Economic activities
- Regional networks
- Education and training institutions
- Global shifts
 - Internet penetration
 - Climate change
 - Capital Markets

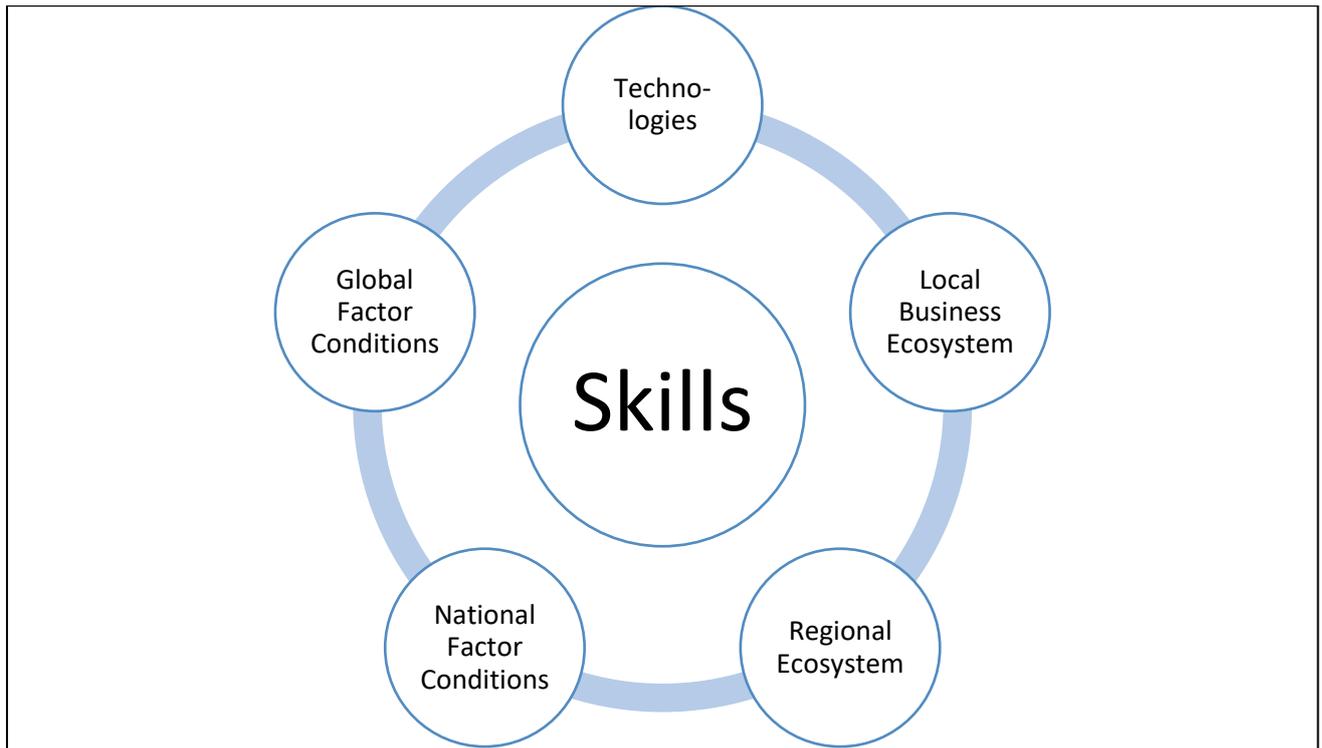


Figure 1: The Digital Skills Ecosystem

2.4 Policy, Economic and Social dimensions

The *national vision of the future of the country* has embraced the need to respond to the 4IR⁷, with an understanding of the skills imperatives for responding positively to it.

National government line departments are increasingly strategising responses that align their business functions with the possibility of a new reality.

Education institutions are also embracing the need for change, with Higher Education Institutions (HEIs) and government education departments looking at curriculum, qualification and certification issues.

Business associations, labour groups and social activist groups are heavily engaged in debate on the positive and negative impacts of an increasingly digital world.

2.5 Foresight approach

Futuristic views of the positive and negative impact of digital technologies are commonplace in the media. A formal foresight approach can enable stakeholders to identify real trends, and to envisage the futures that may realistically be created. Such a formal foresight process cannot be followed by this study; at best these are *informed decisions* of how the region (and business sectors) may be shaped by digital technologies. In other words, this study takes *foresight positions* based on informed choices.

2.6 Digital Transformation and Transformative Digital Technologies

Digital disruption of the Western Cape economy is already occurring as businesses are challenged to reconsider/reinvent their business models due to the impact of digital technologies, new (digital) entrants, platform businesses and out-the-box business innovations. Digital transformation is the response to the new business reality.

Digital transformation is the process of shifting an organisation from a legacy approach (i.e. a decrease in the application of old technology) to new ways of working and thinking using digital, social, mobile and emerging technologies (i.e. the implementation of new technologies, such as platforms, Blockchain, and design thinking). It involves a change in leadership, different thinking, the encouragement of innovation and new business models, incorporating digitisation of assets and an increased use of technology to improve the experience of your organisation's employees, customers, suppliers, partners and stakeholders⁸.

A wide range of terminology is used in describing disruptive, transformative and enabling digital technologies, including reference to "Fourth Industrial Revolution Technologies", or "4IR technologies"⁵. This Report will refer to technologies that enable digital transformation as Transformative Digital Technologies (TDTs). Some of the TDTs that are expected to impact various sectors in the Western Cape are listed below:

1. Data analytics (and related) (user-/client- and entity-related):
 - a. Data analytics proper
 - b. Data modelling and predictive analytics
 - c. Data visualisation
2. Hyper-connectivity of devices amongst themselves and with human users:
 - a. Internet of things (IoT)
 - b. Industrial Internet of things (IIOT)
 - c. Mobility: increasing broadband speeds and mobile applications drive consumer interactions
3. Cognitive technologies⁹:
 - a. Artificial intelligence in general, including
 - i. Machine Learning
 - ii. Deep learning
 - b. Robotic process automation (RPA)

- c. Digital twins
 - d. Image recognition (including personal identification and authentication)
 - e. Human language recognition, understanding and production/generation (incl. “chatbots”, “virtual assistants”, both of which make use of AI)
4. Robotics
 - a. Advanced industrial robotics
 - b. Cobots (collaborative robots)¹⁰
 - c. Humanoid and non-humanoid land robots (for various purposes)
 5. Sensor technologies
 6. Location technologies
 7. Cloud computing
 8. Immersive technologies:
 - a. Augmented Reality (AR)
 - b. Virtual Reality (VR)
 - c. Mixed Reality (MR)
 9. Blockchain / distributed ledger
 10. Digital ecosystems and platform technologies
 11. App- and web-enabled markets
 12. Social media
 13. Cybersecurity / digital security
 14. 5G networks
 15. Wearable electronics
 16. Additive manufacturing (in certain contexts also called 3D printing).
 17. Drones (actually, remotely piloted flying devices, or in advanced instances, aerial robots)
 18. Digitally-supported learning environments (amongst others, “micro learning” and “learning in the flow of work”)¹¹
 19. Programming/coding/digital system development, in all its different manifestations, as well as the various related skills and competencies required to create, implement and maintain computers and other digital devices – a range of digital skills and competencies that are best expressed in the Skills Framework for the Information Age.¹²
 20. Technologies for human talent management (identification, optimisation, personal development pathways, etc.) – in progressive and sustainable ways.¹³

2.7 Key Characteristics of Transformative Digital Technologies

The key characteristics of the TDTs that are driving digital socio-economic transformation are:

- Pervasiveness: TDTs are part of the background fabric of a socio-economic system. Their absence or failure has wide impacts
- Convergence: TDTs rarely occur as single technologies – it is the overlap of functionality of many systems and technologies that deliver the value; e.g. Cloud computing is a combination of high-speed broadband networks, cheap digital storage and processing power and an outsourcing business model.

- Innovation: TDTs underpin or drive new business and technical models; e.g. mobile based location tracking, combined with digital payment systems, enable the *Uber* ride hailing service
- Intelligence: TDTs increasingly have built in intelligence (algorithms, AI, etc.) that track, learn and predict user behaviour, e.g. Facebook Marketplace

2.8 Adoption rates in various sectors of industry

The adoption rates of the various TDTs are different in various sectors of industry and even within industry sectors (i.e. individual business enterprises), depending on the maturity level of the industry or the company, and on the level of human talent and openness to innovation (see Annexure B).

In 2018, the WEF surveyed companies across a wide range of industrial sectors in various countries, asking a number of questions relating to the prospects for adopting new technologies in 2018 and again in 2022, the impact of the adoption of these technologies on the workforce, on upskilling and re-skilling, etc.⁴. The results indicated the interest displayed in adopting various technologies in the different sectors – and the probability of new technologies being adopted. The wide-ranging interest in Data Analytics, Internet of Things, AI and Cloud is significant across all industries, next to the expected “App- and web-enabled markets”. This was further corroborated by the “*Digital outlook*” survey, discussed in detail in a later chapter. The *Digital outlook* survey analysis identified Data Analytics, Big Data, Cloud Computing, Cyber Security and Internet of Things, as the high priority TDTs that business is considering.

3 Manifestations of a “to be” scenario

3.1 Digital Skills for the Future

What they are and why they are important?

The basic skills needed to find, evaluate, utilise, share and create content using information and communication technologies are already a mainstream requirement for effective functioning in the economy.

Digital technologies are transforming businesses at a rapid pace; consequently, digital skills that enable, support and facilitate digital transformation are already highly valued. The speed at which business and industry are adopting digital technologies, innovations and business models means the demand for people with advanced digital skills is growing as well.

The social benefits of a digital transition are not part of this study. The creation of a global digital hub does however, allude to the economic benefits that may manifest for industries and businesses that embrace TDTs.

In attempting to understand what skills (and their quantities) may be required in the future, it is first necessary to paint a picture of that likely future.

Once we envisage that future, then we can then consider what skills will be needed for that future to transpire. Firstly, this requires setting a timeframe: A 5 year future timeframe is used as the basis for the to-be analysis, as any longer timeframe period is highly speculative and very likely to be off the mark. Secondly, determining future skills requirements depends largely on what business will look like in that future period (not exclusively but primarily); thirdly, business demand and the nature of

work in the To-Be future drives the nature and number of skills that business will require to survive and compete. Government is the other major employer, but tends to follow business in skills and work trends. When considering the To-Be future, we will therefore not separate “future government” from the concept of “future business” for the purpose of this study.

Logically, one should also consider the broad trends that will influence the “business of the future”. These broad trends include technology issues, but also new business models, political, social and economic factors. The DEDAT objective of a “Global Digital Hub” implies an ecosystem underpinned by formal businesses. Since the formal business environment is largely aware of global trends in technology and business models and tends to follow them, then global trends for technology and business models are good proxy indicators for what may happen locally.

Political, social and economic factors provide an additional, localised view into what may happen (scenarios) in the future.

Given this, then the focus of the report is on digital transformation of business, as it is the key factor driving future digital skills requirements.

Digital transformation of business is underpinned by:

- Transformative Digital Technologies (TDTs);
- New business models;
- Mindset changes and organisational cultures that foster innovation;
- New Skills
- Entrepreneurship
- Other digital innovations.

The broad effect (or intent) of digital transformation in business is:

- Efficiency to reduce costs;
- Growth through innovation, new business models or new market entry; and,
- Staying competitive or survival.

Digital skills requirements are driven by these business intentions. Individual businesses and whole sectors of business will be affected differently by digital transformation; however, we can assess the role of transformative digital technologies, new business models, and other digital innovations on sectors in terms of:

- Business Impact;
- Timeline for Impact;
- Maturity of the Model/Innovation/TDT.

3.2 Challenges around human talent

3.2.1 Benchmarking readiness for the Fourth Industrial Revolution

The WEF report “Readiness for the Future of Production” specifically addressed: “The Fourth Industrial Revolution and emerging technologies”¹⁴. Of 100 countries considered, South Africa holds the 45th position for the “Structure of Production” and the 49th position for the “Drivers of Production”. (No combined ranking value is presented; only a ranking in these two separate divisions).

Within the “Drivers of Production”, South Africa is placed at the 67th position in terms of Human Capital. Within “Human Capital” category, and relating to the “Current Labour Force”, South Africa is at position 94 in the sub-component “Digital skills among population”¹⁵. Based on the WEF report, South Africa is classified in the group of “Nascent countries”, which are “***least ready for the future of production***” (p. vii). (See Annexure B.)

In the recent Automation Readiness Index by the EIU, South Africa ranked 22nd out of 25 countries included in the index¹⁶. The sub-title of this publication of this index “Who is ready for the coming wave of automation?” is significant. Although South Africa fares better in the component “Innovation Environment” (position 18), it fares in the lowest position in relation to the components “Education Policies” and “Labour Market Policies”.

3.3 World of work changes and challenges

A bleak future awaits workers who cannot learn new skills, adapt to new technologies, or for whom whole job functions will disappear.

“The digitalisation of industry is dramatically transforming the skill sets required by employees of manufacturing companies. Changes in manufacturing technology and the growing use of ICT mean that the required skills are changing more frequently. Whereas in the past there was a high demand for specialists with a lot of in-depth knowledge, in the future there will be a growing call for “multi-versatilists”. These are employees who have an interdisciplinary understanding of interrelated processes and are capable of acquiring the necessary specialist know-how in a short space of time. Such employees understand that some of the skills and knowledge they have acquired in the past will only remain useful for a limited time. They are characterised by a desire to keep learning throughout their lives.”¹⁷, i.e. they are life-long learners.

The objective of creating a “Global Digital Hub” pertains not only to cutting edge or leading industries, or highly technical entrants that can leverage new digital technologies. Industry also depends on a broader workforce that are not directly associated with the “in vogue” technologies and innovations that make the current headlines. The level of expertise of those workers may not be at the cutting edge of TDTs, but digital skills for more mundane processes are equally important. Upskilling, re-skilling and “right skilling” of the existing workforce is therefore of key importance.

Changes to the world of work have many facets:

- Many jobs (close to 50% in OECD countries) will be significantly affected by automation, with a high possibility of significant changes in the way the jobs are being performed in the presence of some level of automation. This has implications for the skills requirements for these jobs.
- The variance in regard to the possibility of job losses across countries is large; several factors influence this variance, such as sectoral structure and composition of the economy, and the organisation of jobs in a particular sector.

- The risk of automation is not uniform for workers within a sector; it is much larger for the mid-level and lower-level jobs that can be more easily automated.
- Upskilling and re-skilling of workers is critical, not only because of the possibility of job losses, but as the precursor for increasing productivity, cost reductions and greater competitiveness.

In the near future, the challenge is that, job functions and skills requirements will have little resemblance to the current status quo. A recent OECD study¹⁸ highlighted some concerning findings:

- The risk of automation is the highest for older workers. In countries where young people are better skilled than older workers, the younger persons might find it easier to adapt to new jobs created as a result of the new technologies. Where this is not the case, the risk of retrenchments is high.
- Evidence from this OECD study suggests that the odds of participating in upskilling and re-skilling are significantly lower among workers who are in jobs with the highest risk of automation. Individual workers either do not understand the implications or do not have access to upskilling programmes. It is also uncertain if companies are making judgements of labour vs. automation instead of investing in upskilling.
- Phelps¹⁹ emphasises skills in terms of “how employees do” rather than “what employees do”, or above and below the line competencies

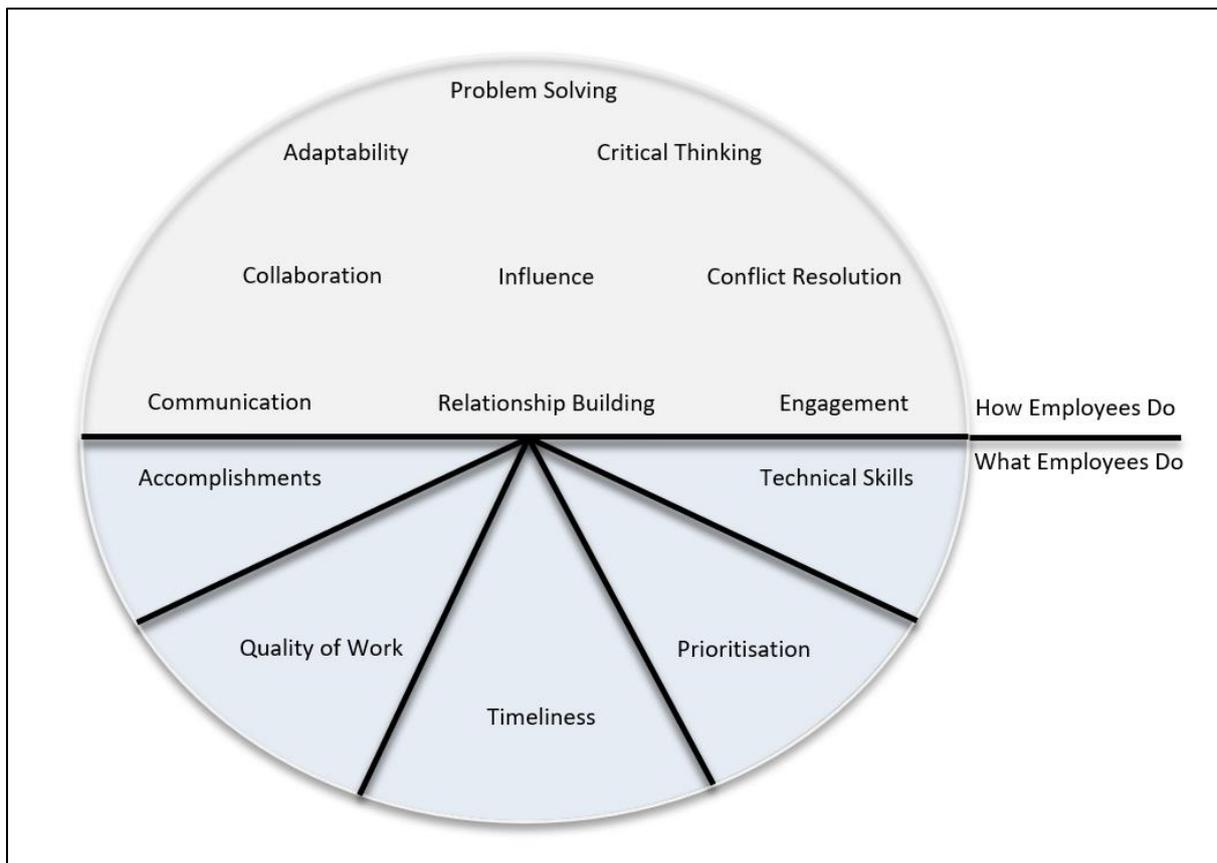


Figure 2: Above-the-line and Below-the-line job competencies

4 The Future of Supply

4.1 The challenges of supply

This study focussed on current and future digital skills demand. The future of supply is less obvious:

- Higher education institutions are facing an array of challenges, from admissions policy, fee payments, student housing, the provision of bridging programmes and changes to the curricula. Even with a good understanding of the future requirements of digital skills in the marketplace, it is unlikely that HEIs will be agile enough to respond sufficiently to rapid market changes, or be able to scale their outputs to meet the future demands enough.
- The growth of online platforms (i.e. Massive Open Online Courses, or “MOOC”) for learning is expected to continue. Several online learning platforms have partnered with HEIs (locally and globally). Recognition by industry of online learning and self-learning can help to improve the supply of skills.
- Private sector skills development organisations are seen to be an important component of future supply. Fragmentation and disruption of the skills supply pipeline will occur as private universities and ICT focussed training institutes emerge.
- In-house skills development for industry will be driven by digital transformation requirements. The importance of digital leadership in matching skills development programmes with digital transformation will be critical.
- Affordability and accessibility of digital skills development programmes will remain problematic for a large portion of school leavers.
- The role of sector bodies, industry associations and business forums will be critical in driving the agenda for digital transformation, digital leadership and digital skills development.

The provider scene regarding digital skills training is crowded; aside from conventional post-school educational institutions (state-supported or private), there are ever more online educational providers; providing MOOC programmes, micro-courses, different forms of credentialing, etc. Online courses may become the dominant basis of learning in the future.

In South Africa, a number of issues restrict the production of students with skills in TDTs. Intake numbers by universities for formal multi-year study programmes are limited by the Programme Qualification Mix (PQM) that drives universities funding. Changes to university programmes to accommodate evolving needs have long timeframes. There are, of course, exceptions to such programmes, such as postgraduate diplomas that lead to students qualifying in shorter periods of time.

Short courses at universities are intended for responding to the rapidly changing needs of industry/business and society. Universities are mandated to develop and accredit such short courses that can have the status of accredited programmes. The quality of such courses can differ between universities. Business schools often offer a range of programmes that are relevant to business and organisations, but in this context affordability remains a concern. This is a highly competitive and contested space for universities, and it is unlikely that local universities will collaborate in this space.

Ideally, a wide range of short courses on topics relevant to the changing digital technologies should be available for businesses, for both upskilling and re-skilling, as and when required. In specialist areas, it may be difficult to develop and present appropriate courses, in view of the scarcity of specialists in the university academic departments, as many academics view this as an addition to their standard tasks of teaching and research.

Businesses and users in South Africa are increasingly using local and international online learning platforms. Given the aforementioned variation in quality of the offerings of online providers, informed guidance is required.

The need for a more agile approach towards programmes in conjunction with industry/ business is formally recognised by higher education.²⁰ To some extent, provision is already made for such courses/programmes at HEIs. The question is “how it should be expanded to scale for the anticipated demand brought about by the TDTs?”

4.2 Rethinking Specialist skill pathways

The pathway to specialist ICT jobs (e.g. cybersecurity experts) is not easily characterised; students often enrol for learning programmes (e.g. computer science) that can lead to a variety of ICT jobs. However, many ICT experts originate in other areas of study (e.g. physics) and develop in-depth business ICT skills through course branching, self-learning or career deviations. The pathways to expertise are therefore rarely through a single “line of study”, but through a process of learning and pivoting. The opportunity to re-direct highly trained graduates (e.g. engineers) to areas of high demand for specialist skills (e.g. data scientists) - either through short courses, online and self-learning, or other methods - must be fully explored, as this represents shorter pathways to specialist ICT skills rather than increasing the base intake of entry level students. Examples of such pathways are shown below.

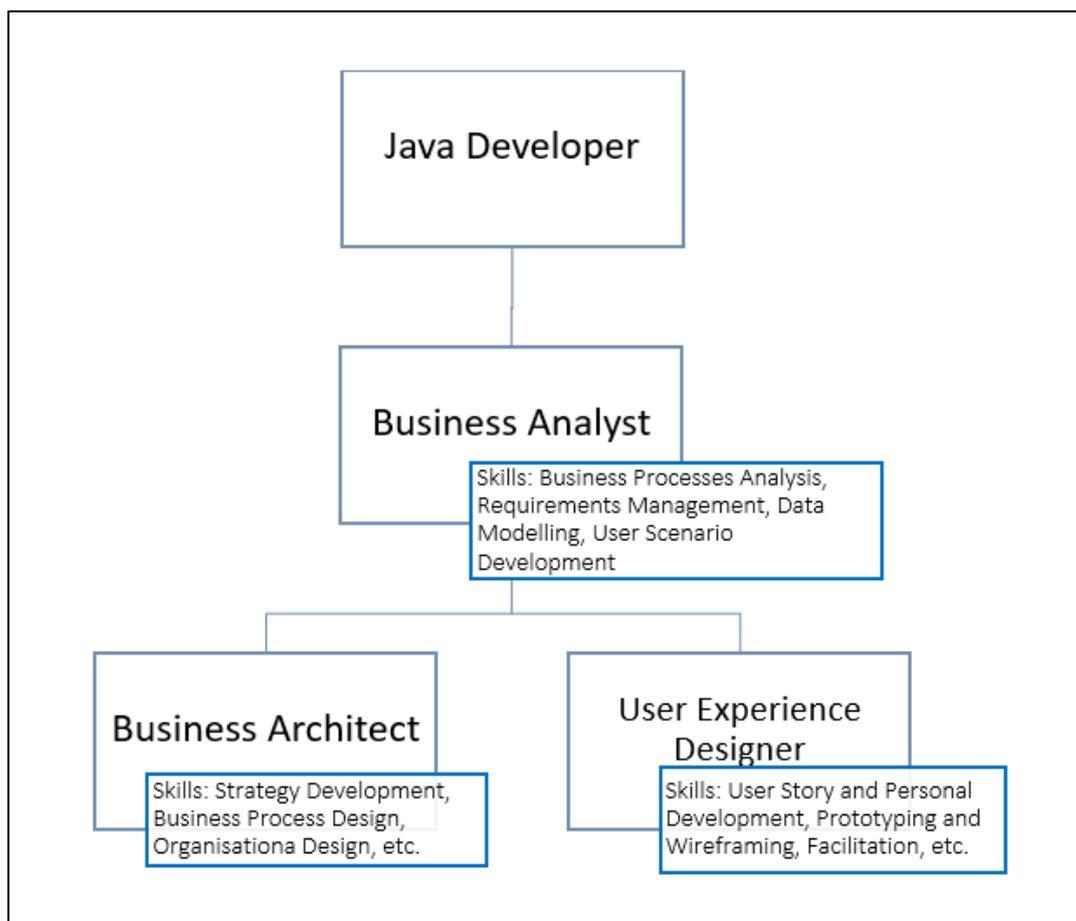


Figure 3: Java Developer Skill pathway¹⁹

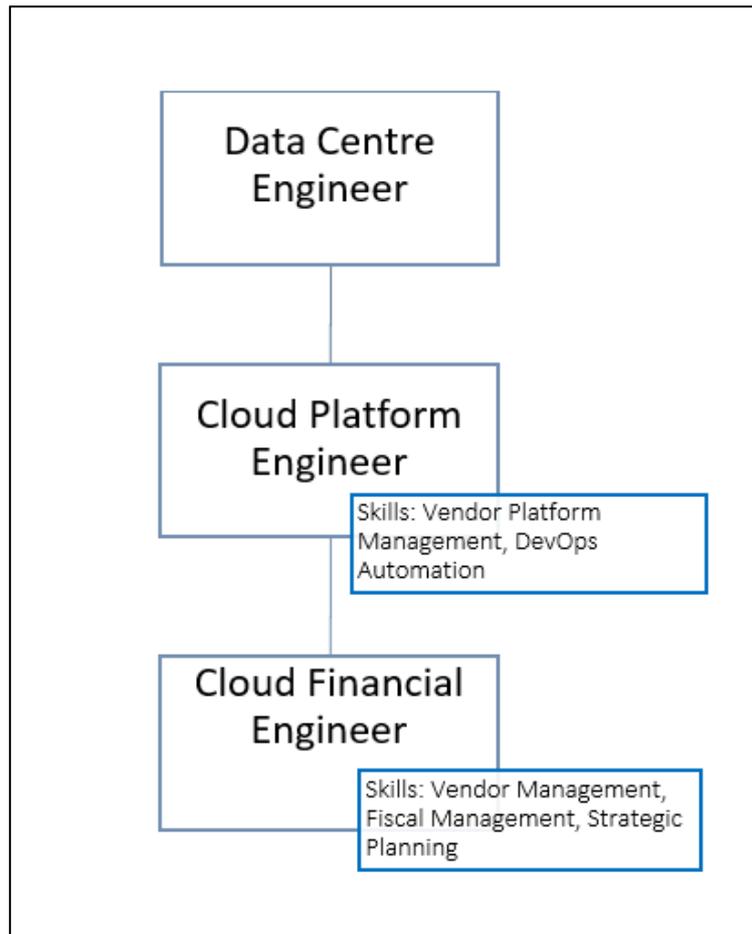


Figure 4: Data Centre Engineer Skill Pathway¹⁹

4.3 The reskilling imperative

The importance of workers upskilling and re-skilling has already been emphasised. If the Western Cape wishes to excel in the digital space, it needs to devise ways to stimulate industry, business organisations and labour, and find ways of facilitating collaboration amongst sectors and businesses to address shared skills requirements, in order to make upskilling and re-skilling accessible and affordable.

5 Determining future digital skills needs

5.1 Digital Skills Survey

This section of the To-Be Report describes the findings of a survey conducted to give an insight into the views of business representatives about the digital technologies and skills considered important to the Western Cape economy.

The survey, conducted by using the *SurveyMonkey*²¹ tool, had eleven (11) multiple choice and two (2) open ended questions (see Annexure A). The survey was distributed by Accelerate Cape Town, the Cape IT Initiative (CapeCiTi), and the DEDAT, to their respective database of stakeholders.

The survey was designed to enable field driven analysis e.g. response data could be analysed based on the job profile or industry sector of the respondents. These sectors were ICT and Technology, Financial Services, Retail, Tourism, and Media.

The survey provided 703 responses, 385 of which (i.e. 54.8%) were full responses. Only full responses were analysed. This analysis of these 385 responses form the basis of this section of the report.

The survey was trust-based (i.e. anonymous and non-verifiable) meaning that the data and responses cannot be independently confirmed. Furthermore, since the profile of respondents is predominantly in the ICT/tech sector, the results cannot be generalised to the entire business population in the Western Cape. Respondents were asked to provide their views on future technology priorities, anticipated digital skills requirements, skills gaps, and possible interventions to fill such gaps.

5.2 Profile of Respondents: Sector and Job function breakdown

The number of respondents from respective business sectors is shown in Figure 5. The role of each respondent in his or her company is shown in Figure 6.

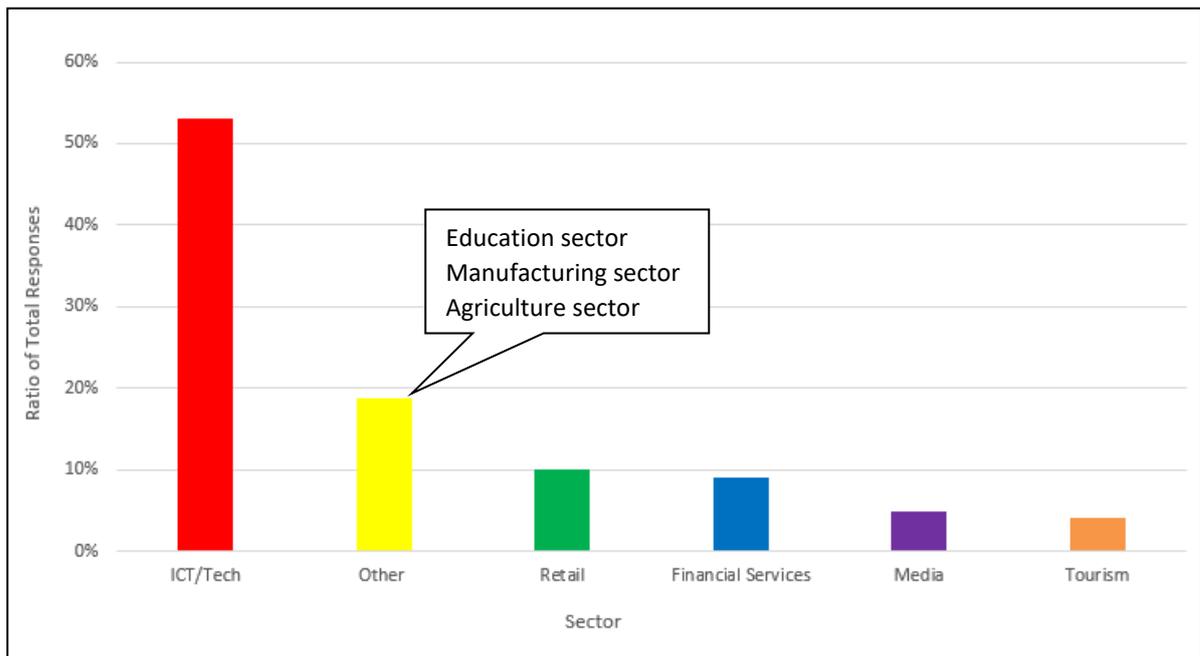


Figure 5: Number of respondents in each sector [N=385]

Overall, the majority of respondents (**204 or ≈53%**) were from the **ICT/Tech** sector, followed by the **Retail, Financial Services, Media, and Tourism** sectors. Respondents who did not fall into the designated sectors were provided the option of listing their sector, which is collectively listed as “other”; these included respondents from Education, Manufacturing, and Agriculture sectors (see Figure 5).The majority of respondents was either from **Senior Management**, or responsible for **IT**. Given the background focus on digital technologies, digital skills and the envisioned global digital hub, this response was to be expected (see Figure 6).

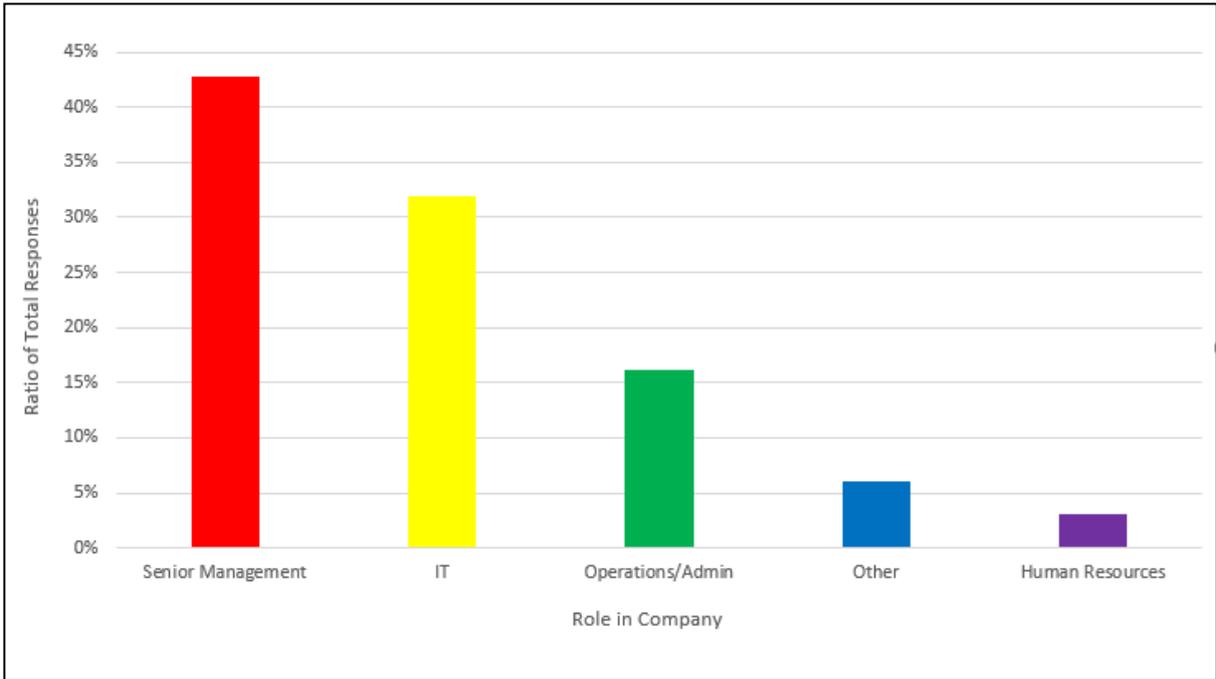


Figure 6: Respondents' role in their company [N=385]

5.3 Responses: Digital transformation

From Figure 7, we see that more than **80% (308 out of 385)** of respondents plan to **up skill/re-skill** their staff with digital skills within the next year, and more than **80% (308 out of 385)** of respondents also plan to **expand ICT operations** within the next two (2) years by either increasing their ICT budgets, implementing major technological changes, or adding more ICT practitioners.

It can be argued that these responses are potentially the respondents' understanding of the imperatives for digital transformation, either by investing in ICT, preparing their staff, or otherwise augmenting their workforce capability.

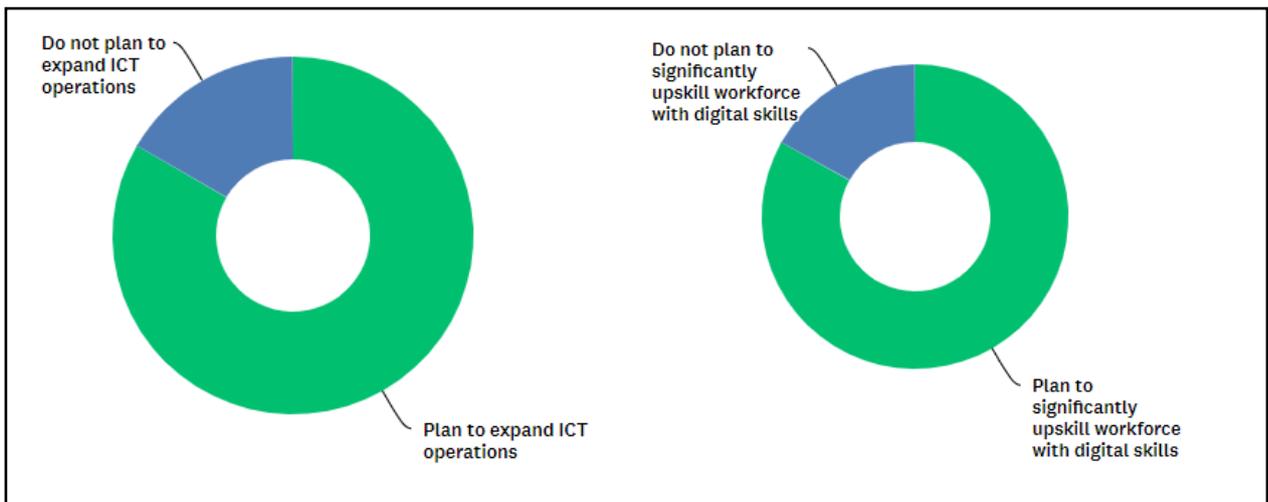


Figure 7: Plan to expand ICT operations, and significantly up skill workforce with digital skills [N=385]

5.4 Responses: Technology futures

The survey asked respondents' views of the technologies most likely to impact companies in the Western Cape in the near future (see Figure 8). The options provided correspond with the responses captured in the As-Is report.

Over a five-year time horizon, the technical/technology areas most likely to impact the respondents' companies are **Data Analytics, Cloud Computing, and Cyber Security.**

These were followed by operational technologies **Internet of Things, Artificial Intelligence, and Big Data.** Machine Learning – (which is closely related to Artificial Intelligence) - was seventh; taken together, these three technologies would have been in the top three.

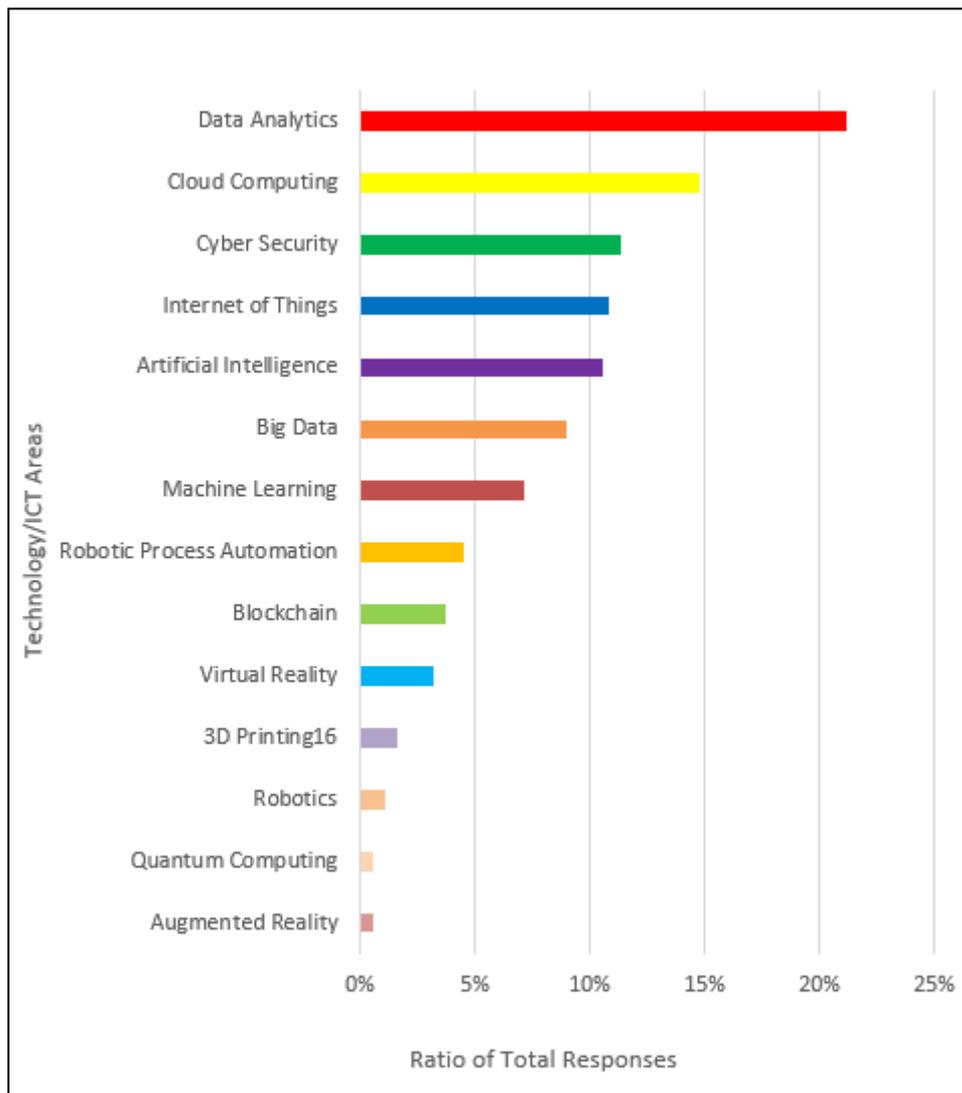


Figure 8: Technology futures: technology/ICT areas that will have an impact in the next five years [N=385]

5.5 Responses: Technology skills

Respondents were asked which skills were most likely to be required by companies in the Western Cape in the near future, as presented in Figure 9. No options were provided and respondents could list any skill that they considered relevant. Furthermore, respondents could list more than one but no more than three. Similar skill types were grouped together.

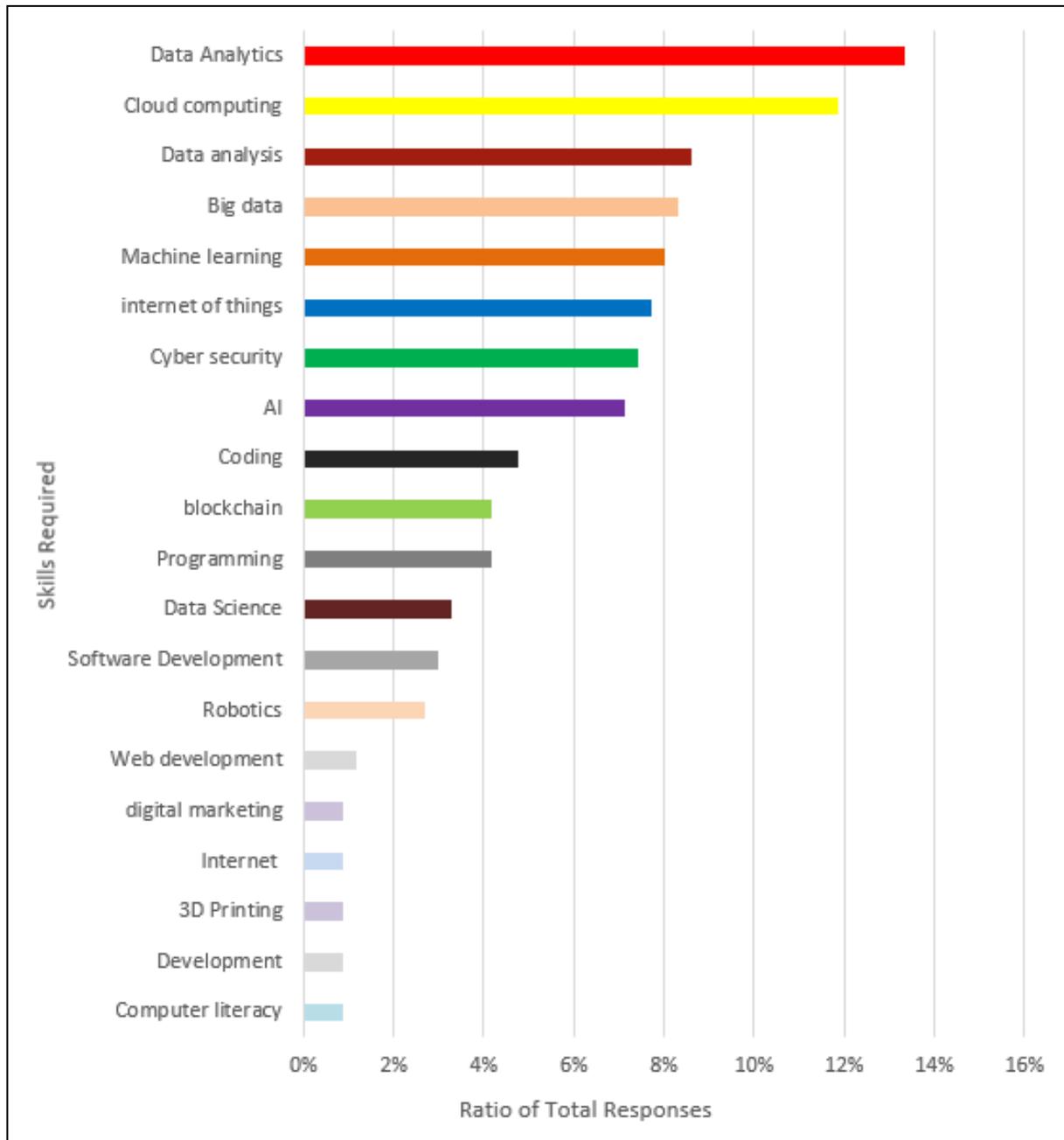


Figure 9: Technology skills: technology skills that will be most needed in the next five years [N=385]

The skill sets anticipated to be required in the next five years with the most mentions are, **data analytics** (13.4%), **cloud computing** (11.9%), and **data analysis** (8.6%). **Data analysis** is a broader term that refers to the process of compiling and analysing data in order to present findings to management to help inform business decision-making. **Data analytics** is a sub-component of data

analysis that involves the use of technical tools and data analysis techniques. Taken together, data analytics (13.35%) and data analysis (8.6%) are the skills most in demand by a large margin (21.95% of all responses). Further, the next tranche of anticipated skills requirement includes **big data** (8.3%), which is also related to data analytics and analysis.

When taken together, anticipated skills requirement in the related fields of **machine learning** (8.0%) and **artificial intelligence** (7.12%) form the next largest skill requirement type, exceeding the second-ranked mention of cloud computing skills (11.9%).

Coding skills (4.7%), programming skills (4.2%), and software development skills (3.0%) total up to 11.9% - clearly another important skill expected to be a requirement for Western Cape businesses.

5.6 Analysis: Technologies and skills ranked by respondent role and respondent sector

Given the above responses, it is possible to analyse the data to determine which skills are seen as most important by different role payers within companies, and by role players within sectors.

Method: In order to achieve this, the responses regarding technologies and skills were categorised into three groups – high priority, medium priority, and low priority, dependant on which third the aggregate response fell into, as described in Table 1 below:

Priority (rank)	Description
High priority	These technologies, skills or issues are considered very important by a significant number of respondents
Medium priority	These technologies, skills or issues are considered important by respondents, but not as high a priority
Low priority	These technologies, skills or issues are considered less important by respondents

Table 1 Ranking of technology and skills issues into three categories

The overall categorisation in terms of technology areas is therefore:

Technologies

Rank	Technologies in each category
High priority	Data analytics, cloud computing, cyber security
Medium priority	Internet of things, artificial intelligence, big data
Low priority	Machine learning, robotic process automation, block chain, virtual reality, 3D printing, robotics, quantum computing, augmented reality

Table 2 Ranked technologies in each category

Skills

Rank	Skills in each category
------	-------------------------

High priority	Data analytics, cloud computing, data analysis
Medium priority	Big data, machine learning, internet of things
Low priority	Cyber security, artificial intelligence, coding, block chain, programming, data science, software development, robotics, web development, digital marketing, internet, 3D printing, development, computer literacy

Table 3 Ranked skills in each category

5.7 Analysis: the importance of new technologies for different role players

Filtering results by job function showed differing priorities between Senior Management and IT; IT personnel consider **Cyber Security, Cloud Computing, and Artificial Intelligence** to be the priority, whereas Senior Management considered **Data Analytics, Internet of Things, and Cloud Computing** as the top ICT areas to impact in the future (see Table 4). Differing priorities between management and IT personnel are commonplace: IT departments are sometimes focussed on the technology and technical issues (with less regard for costs and business imperatives); management's focus sometimes disregards the importance of IT and only consider investments in IT as asset management and defensive investment. Cyber security is a case in point; investing in cyber security has little direct returns – (it is in effect like buying insurance) – and viewed as a cost incurred, based on the probability of a negative event occurring. The occurrence of a cyber security incident places responsibility squarely on the shoulders of IT whereas management often views IT as overreacting and only being interested in the technology- due to the usual non-occurrence of incidents.

Ranking	All Roles	IT	Senior Management
High	Data Analytics	Cyber Security	Data Analytics
	Cloud Computing	Cloud Computing	Internet of Things
	Cyber Security	Artificial Intelligence	Cloud Computing
Medium	Internet of Things	Data Analytics	Machine Learning
	Artificial Intelligence	Internet of Things	Artificial Intelligence
	Big Data	Big Data	Cyber Security
Low	Machine Learning	Machine Learning	Big Data
	Robotic Process Automation	Block chain	Block chain
	Block chain	Robotic Process Automation	Robotic Process Automation
	Virtual Reality	3D Printing	Virtual Reality
	3D Printing	Robotics	3D Printing
	Robotics	Augmented Reality	Robotics
	Augmented Reality	Virtual Reality	Augmented Reality

	Quantum Computing	Quantum Computing	Quantum Computing
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Table 4: Top Technology/ICT area that will have an impact in the next five (5) years compared by role

5.8 Analysis: the importance of new technologies by sector

The same approach was used to determine the priority technology areas for the respective sectors.

The ICT/tech industry respondents rated **Cloud Computing**, **Cyber Security**, and **Data Analytics** as the most important technical/technology areas that will have an impact in the next five years (see Table 5).

Data Analytics is the anticipated priority area for respondents in the Financial, Retail and Tourism sectors, while **Big Data** was the number one anticipated priority of respondents in the Media sector.

Ranking	Sectors				
	ICT/Tech	Financial	Retail	Media	Tourism
High	Cloud Computing	Data Analytics	Data Analytics	Big Data	Data Analytics
	Cyber Security	Big Data	Internet of Things	Data Analytics	Cloud Computing
	Data Analytics	Machine Learning	Cloud Computing	Artificial Intelligence	Internet of Things
Medium	Internet of Things	Robotic Process Automation	Big Data	Virtual Reality	Cyber Security
	Artificial Intelligence	Cloud Computing	Artificial Intelligence	Cloud Computing	Machine Learning
	Machine Learning	Artificial Intelligence	Cyber Security	Robotic Process Automation	Big Data
Low	Big Data	Robotics	Machine Learning	Internet of Things	Virtual Reality
	Block chain	Internet of Things	Virtual Reality	Machine Learning	Robotic Process Automation
	Robotics Process Automation	3D Printing	Robotic Process Automation	Cyber Security	Artificial Intelligence
	Virtual Reality	Cyber Security	Augmented Reality	Augmented Reality	Augmented Reality
	3D Printing	Virtual Reality	Block chain	Block chain	Block chain

	Robotics	Augmented Reality	3D Printing	3D Printing	3D Printing
	Augmented Reality	Block chain	Robotics	Robotics	Robotics
	Quantum Computing				

Table 5: Top 5 technology/ICT areas that will have an impact in the next five years compared by Sector

5.9 Analysis: the importance of technology skills for different role players

When asked which ICT skills are expected to be the most important to meet the future needs of the company, respondents rated **Data Analytics, Cloud Computing and Data Analysis** as high priority, followed by **Big Data, Machine Learning** and **Internet of Things** as Medium priority (see Table 6).

"[There is a] High demand and limited supply of general programming and electrical engineering skills."

~ Senior Management Respondent

Although Management and IT respondents disagreed on the priority technologies for the future, there was general consensus on the anticipated skills requirement, with respondents in both roles listing **data related skills** such as Data Analytics, Data Analysis and Big Data as the most important skills for the future (Table 6). These responses are in agreement with the demand analysis section of the As-Is report, which also showed that skills such as data analytics and big data were the top "in-demand" skills in Cape Town.

Ranking	All Roles	IT	Senior Management
High	Data Analytics	Cloud Computing	Data Analytics
	Cloud Computing	Big Data	Cloud Computing
	Data Analysis	Cyber Security	Data Analysis
Medium	Big Data	Machine Learning	Block chain
	Machine Learning	Internet of Things	Cyber Security
	Internet of Things	Data Analytics	Machine Learning
Low	Cyber security	Data Analysis	Internet of Things
	AI	Programming	Coding
	Coding	Artificial Intelligence	Programming
	Programming	Software Development	AI

Table 6: Top three (3) skills that are anticipated to be the most important in the next five (5) years

5.10 Analysis: the importance of technology skills by sector

The priority skills anticipated to be required by different sectors going forward (as presented in Table 7) confirm that **data related skills** are the top priority skills across all sectors. Interestingly, the ICT/Tech sector again responded with a requirement for cyber security skills (see earlier discussion on cyber security).

Ranking	Sectors				
	ICT/Tech	Financial	Retail	Media	Tourism
High	Cloud Computing	Data Analytics	Data Analytics	Data Analytics	Cloud Computing
	Machine learning	Data Analysis	Cloud Computing	Data Analysis	Data Analytics
	Cyber security	Data Science	Digital Marketing	Coding	Internet of Things
Medium	Internet of Things	Business Intelligence	Big Data	Digital Marketing	AI
	Data Analytics	Block chain	Data Analysis	AI	Cyber Security
	Data Analysis	Cyber security	Artificial intelligence	ICT Skills	Block chain
Low	AI	Machine Learning	Cyber Security	Big Data	Data Analysis
	Programming	Big Data	Machine Learning	Block chain	Business Intelligence
	Big Data	Coding	Block chain	Animation	Industry Experience
	Software Development	Data Integration	Programming	Communication	Marketing

Table 7: Top three (3) skills that are anticipated to be the most important in the next five (5) years, by sector

The emerging consensus view by respondents across sectors and job functions is that data related skills (i.e. analysis and data science) is the single most important skills area likely to impact companies in the Western Cape in the immediate future.

It is interesting to note that IT practitioners and the ICT sector shows a strong concern for **Cyber Security** skills, which is a highly technical, complex, and hard-to-find skill set. Cyber security requirements are normally fulfilled by a small number of people (meaning low job numbers) with highly specialised and scarce skills. Whilst this is a very niche focal area, the impact of becoming a region known as a “global leader” in Cyber security skills must not be underestimated - data breaches cost South African companies alone more than R30 million²² per incident and affected millions of users in 2018 across all sectors²³.

High-end Cyber Security personnel can work remotely, meaning that global work can be easily generated if the region becomes known as a “global leader” in Cyber security skills. It can be argued

that specialist technical skills in other areas, such as Data Analysis afford the region the opportunity of being a “global leader” in these areas as well. Whether specialist technical skills drive growth isn’t a focus of this study; however, a combination of entrepreneurial and specialist skills is a potent mix for nurturing new business development and start-ups.

These results match the demand analysis study conducted for the As-Is report, which showed that Data Analytics, Big Data, Cloud Computing and Cyber Security were part of the top five ICT skills required in Cape Town (See Section 2.1.4 of the Demand Side Analysis report).

5.11 Responses: Source of skills

To understand where companies were sourcing the skills required, respondents were asked about the main supply for the employees with the talent that they need. Respondents thought that companies are more likely to train candidates “in-house” than source them from **universities or TVET colleges** (see Figure 10). This trend was seen across all sectors (see Figure 11).

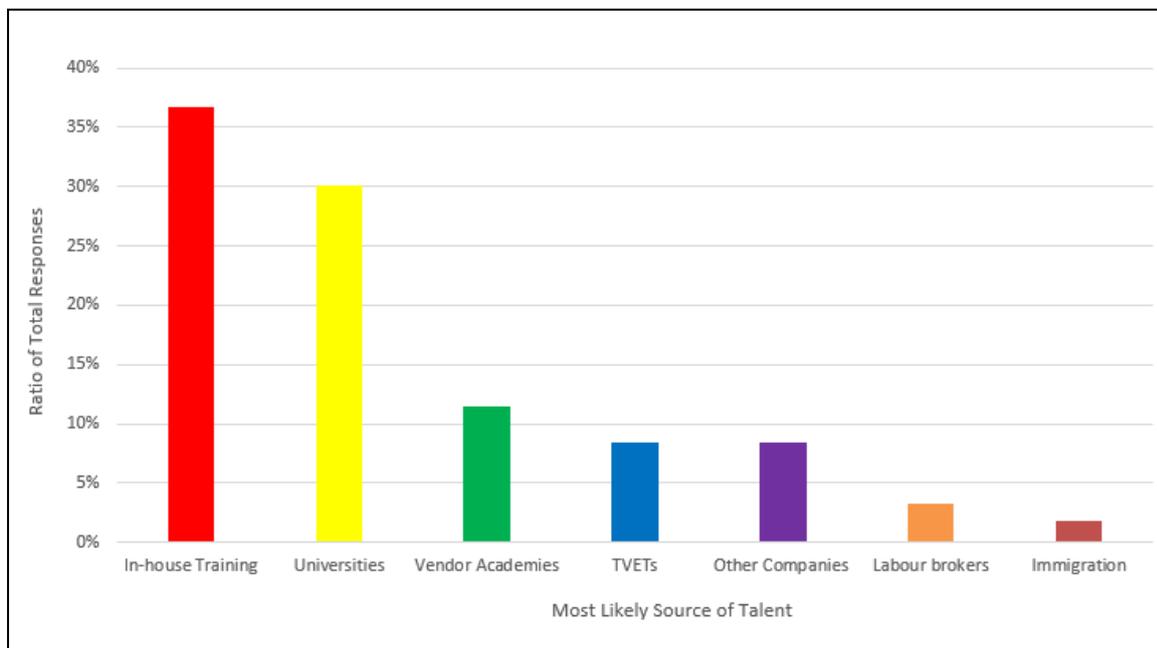


Figure 10: Most likely source of talent of Technology/ICT/Digital Skills [N=385]

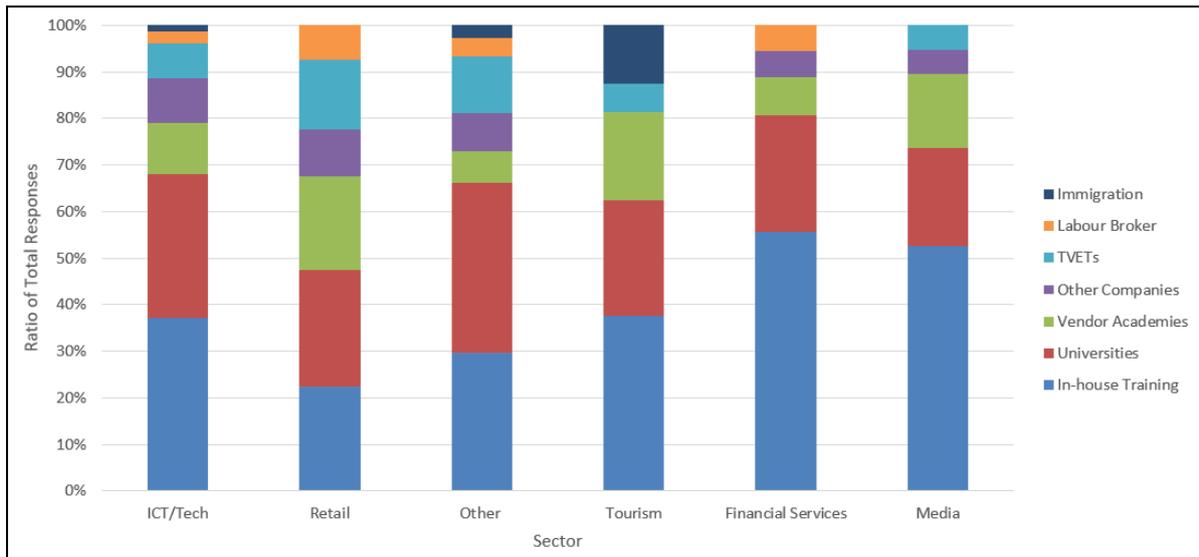


Figure 11: Most likely source of talent of Technology/ICT/Digital Skills, compared by sector [N=385]

In attempting to understand what was most important to companies when looking for potential candidates, respondents unequivocally favoured the **ability/appetite for continuous learning** as the most important attribute, and more than double the preference for a formal University qualification (see Figure 12). This of course requires some disaggregation, as that may apply to low and mid-level jobs, but may not be the case for high-end vacancies. This level of detail was unfortunately not tested in this survey.

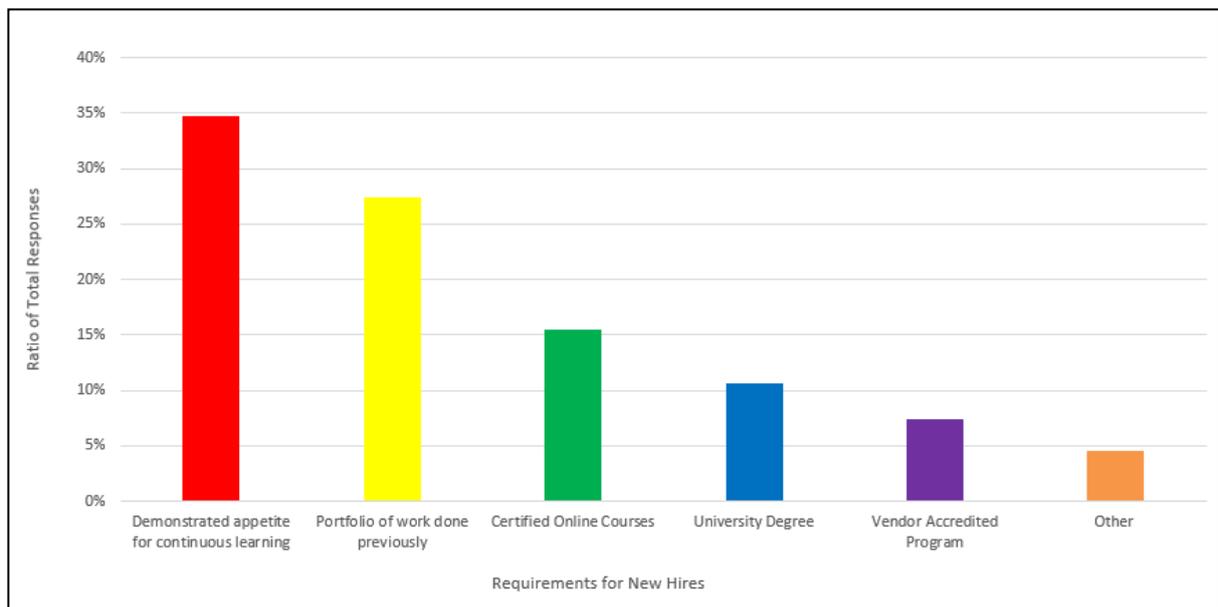


Figure 12: Most important requirement for new hires [N=385]

This preference (appetite to learn) may be explained in the follow-up response that asked about the major challenges companies encountered when acquiring or keeping appropriate technology/ICT/digital staff.

“Applicants having qualifications but that do not possess the appropriate skills-set required by the company” came out as the key factor. This concern was echoed by members of industry at the As-Is workshop - raising concerns that the university curriculum is not meeting the requirements of industry for work-ready candidates.

“The universities and TVET should not only provide students with theoretical aspects, but also should make sure that all final year undergraduates are provided with the opportunity of internships before they graduate”

~ ICT Sector Respondent

The **limited pool of skilled applicants**, which is an indication of a skills gap in the Western Cape, i.e. demand exceeding supply of technology/ICT/digital skills, is also a major concern (see Figure 13).

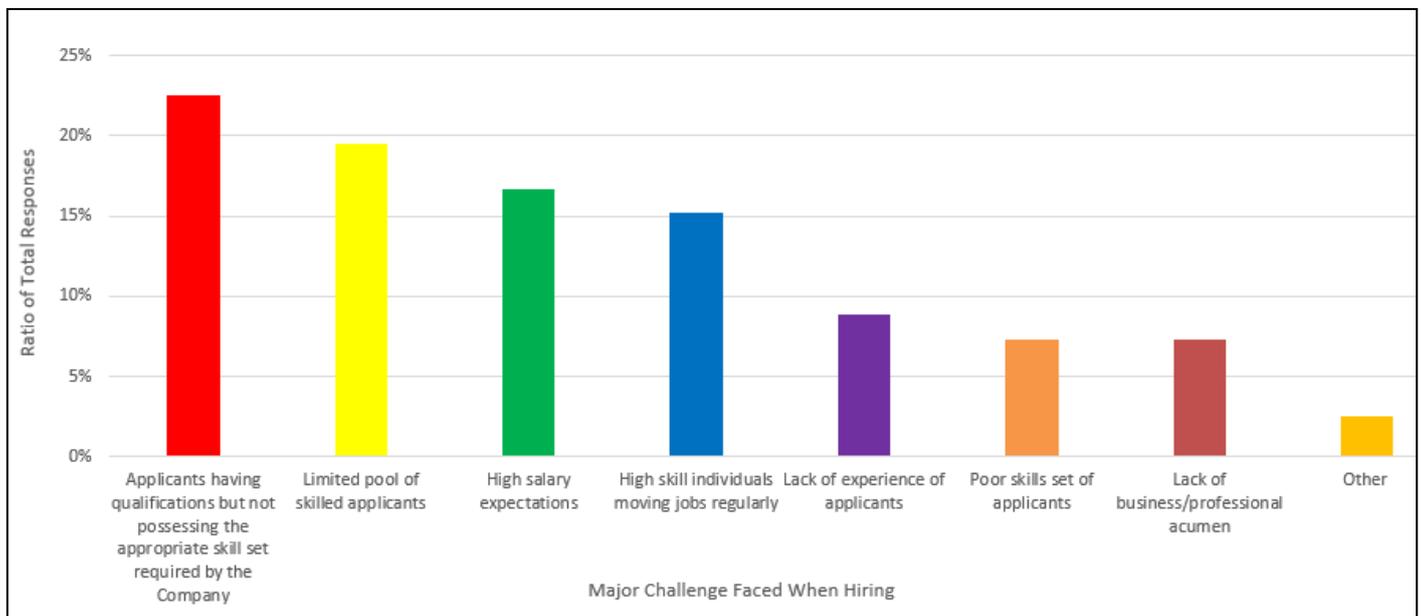


Figure 13: Major challenge faced when acquiring and keeping appropriate Technology/ICT/Digital practitioner [N=385]

Respondents indicated that the most valuable intervention by both Government and the Private sectors to address the skills shortage is to **“Support internship or job-shadowing programmes to provide job experience”** (see Figure 14 and Figure 15).

This view seems to contradict the actual demand for interns, as reported by the demand analysis study in the As-is report, which showed that out of all the ICT related vacancies in Cape Town in September 2018, there were only **1%** internship opportunities available (see section 2.1.2 of the demand analysis Report). Even when organisations are investing in training work-ready students/interns, there is generally a poor uptake of interns after the training is complete²⁴, pointing to other factors that may have to be considered when enabling market entry for job seekers.

This may imply that the private sector in the Western Cape is expecting to hire experienced individuals as interns without putting in the effort to develop skills at the internship level; alternately it may imply that the programmes currently generating the interns are not producing the right skills, that interns are very poorly skilled, or find it hard to acquire the expected skills on the job, or some combination of all of the above.

What is of concern is the lower ranking or emphasis placed on the need to support reskilling or upskilling. We think this aspect is crucial to job retention going forward. Industry collaboration across a sector will be needed to grow a pool of talent, rather than competing for a small talent pool (poaching). Such collaboration requires behaviour change from industry.

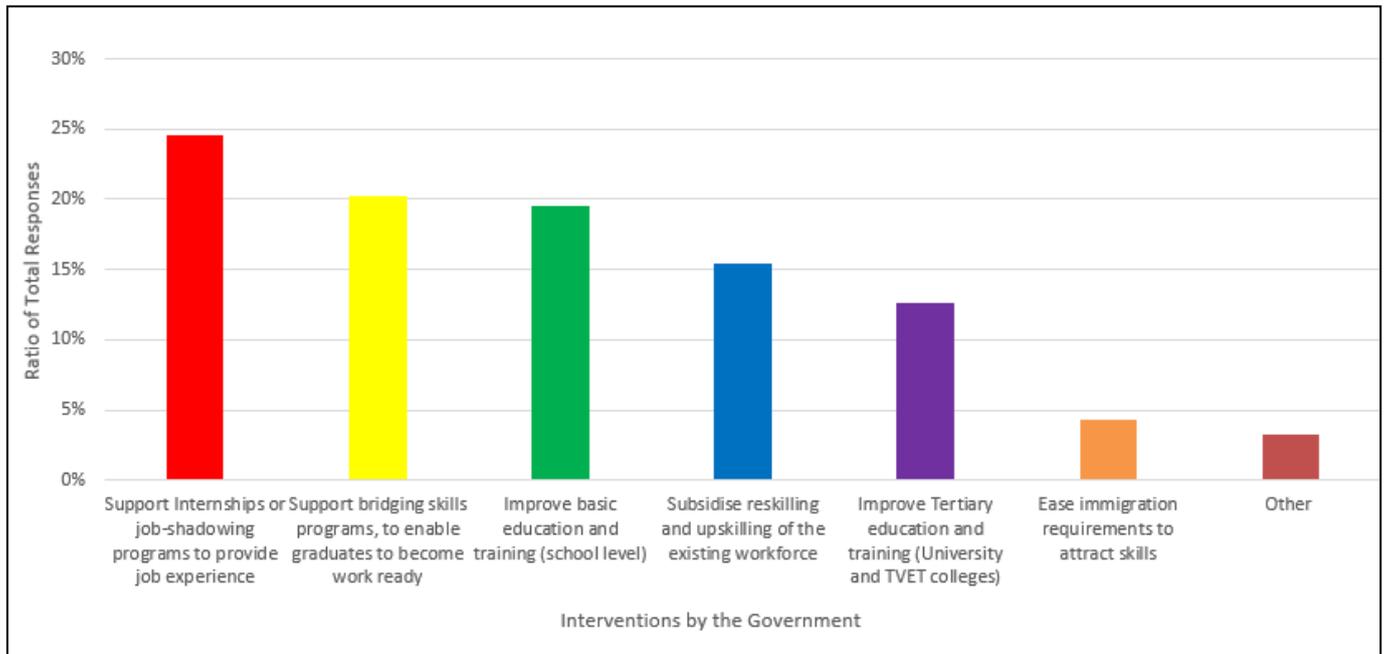


Figure 14: Intervention by the Government to support the growth of digital skills [N=385]

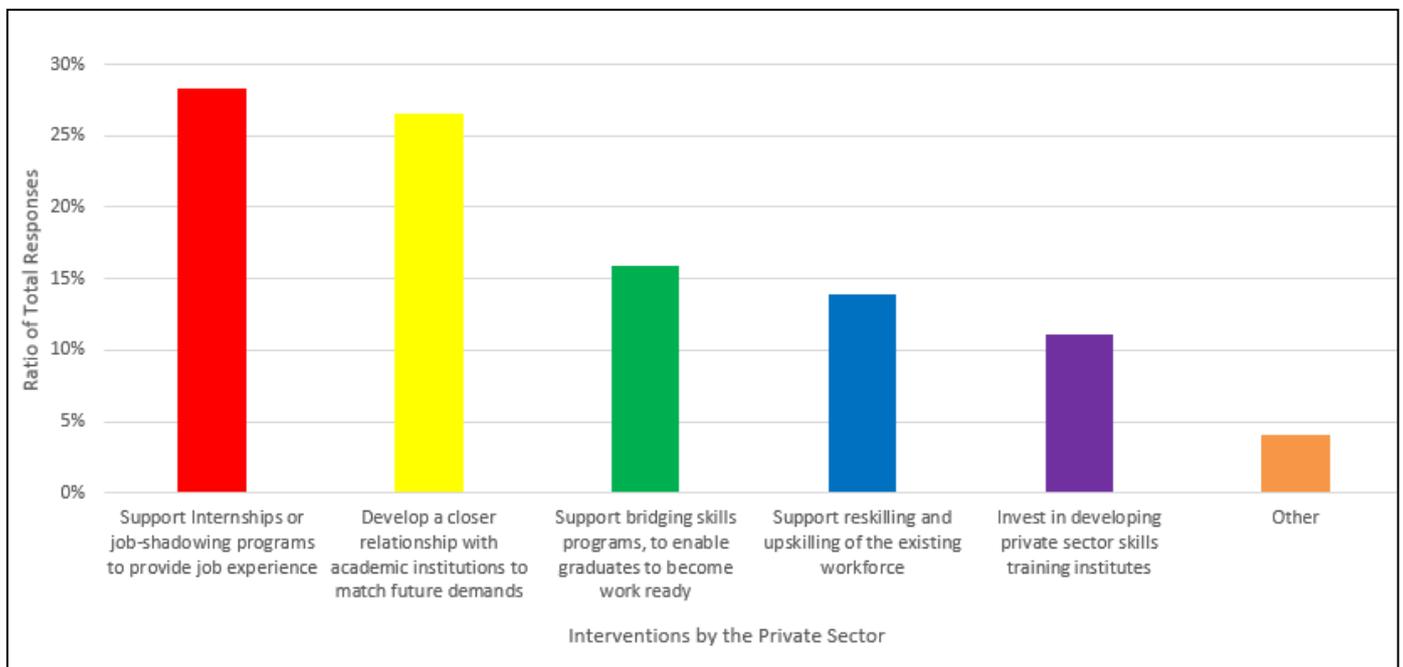


Figure 15: Intervention by the Private Sector to support the growth of digital skills [N=385]

5.12 Skills requirements by sector

This section disaggregates the responses of the respective sectors:

1. ICT/Tech
2. Financial Services
3. Tourism
4. Retail
5. Media

The top responses to technology, skills and intervention questions are mapped in Table 8 and analysed in the sub-sections below.

5.12.1 ICT/Tech Sector

The ICT/Tech sector showed a clear preference for training and up skilling talent in-house, and will also tend to choose candidates with experience over qualifications (see Figure 16). This industry in particular is changing rapidly, due to new technological innovations being implemented by ICT practitioners, before being adopted elsewhere.

A challenge that this sector is facing is that academic institutions are lagging behind on

equipping graduates with work-ready skills, as seen in Figure 17. The reasons for this are either that the academic curriculum is updated at a slower pace than industrial adoption of new technologies, or that candidates are not being appropriately trained in soft skills (such as problem solving, teamwork and self-management), which are essential in the work environment and equally important as technical

“Closer relationship between government and the private sector in developing school leavers and graduates could go a long way to growing skills and making the city and province more attractive to global entrepreneurs.”

~ ICT Sector Respondent

skills. Another challenge faced by this sector is that there is a very insignificant number of candidates graduating from the four Universities, and the TVETS in the Western Cape. This issue was flagged in the As-Is report, which showed that, in 2016, only 1183 candidates graduated with ICT related skills, from Universities and TVETs in the Western Cape (see table 10.4 of the As-is report). Career accelerators such as CapaCiti are already tackling this issue by training students in both, technical and with a high emphasis on soft skills²⁵. Respondents from the ICT industry have indicated that they are willing to develop a closer relationship with academic institutions to ensure graduates are work-ready (see Figure 19) in order to meet the future demands. However, as mentioned earlier, the take-up of fully trained interns is poor. Therefore, the most important intervention by the Government, as viewed by the ICT industry, is that of providing internships and job-shadowing programmes, see Figure 18.

Some ICT companies such as BCX have invested in large internal technology career accelerators. Industry organisations such as the Cape IT Initiative (CiTi) also train students/interns in digital skills such as Java, Python, .Net, SQL etc²⁶.

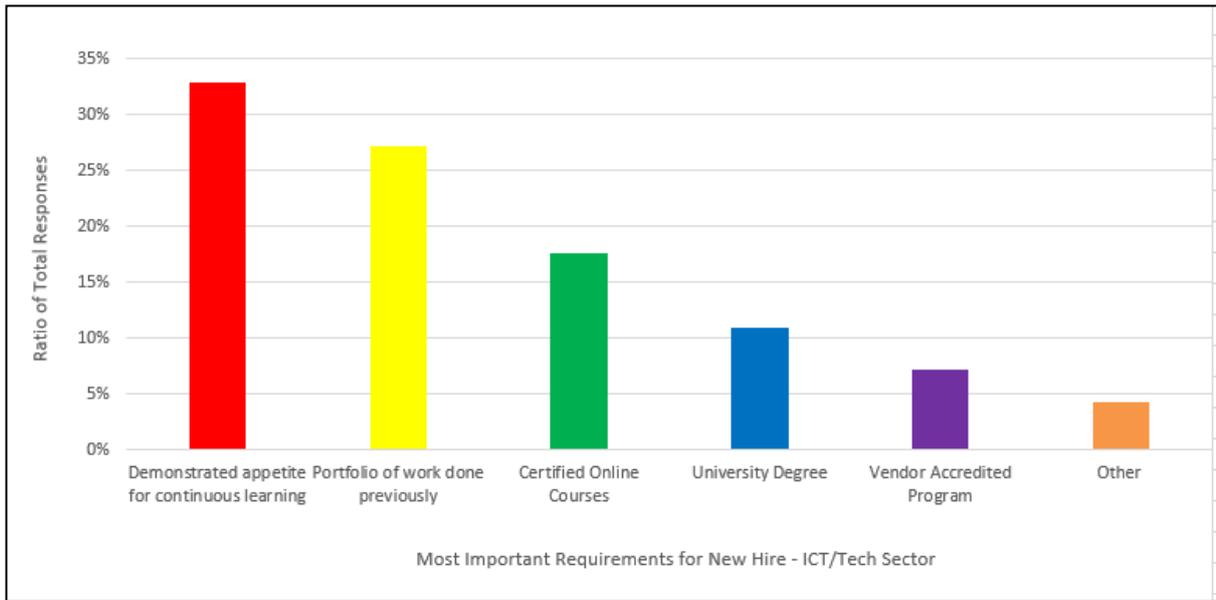


Figure 16: Most important requirement for new hires in the ICT/Tech Sector [N_{ICT}=205]

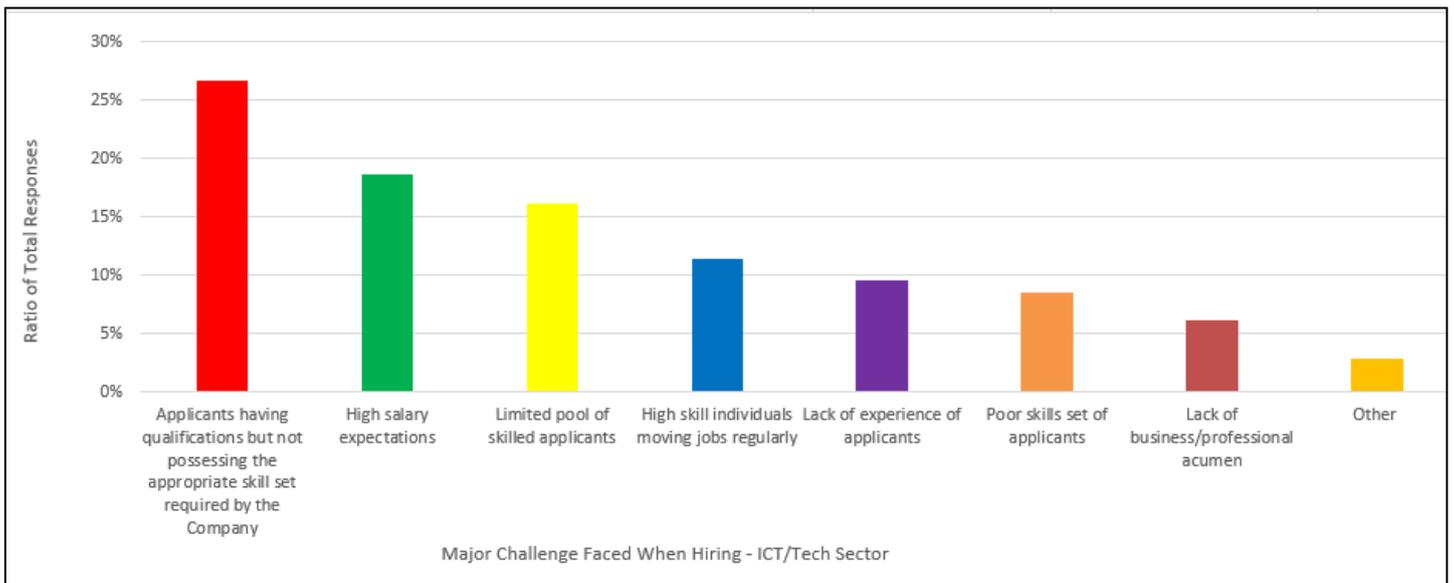


Figure 17: Major challenge faced when acquiring and keeping appropriate Technology/ICT/Digital practitioner in the ICT/Tech sector [N_{ICT}=205]

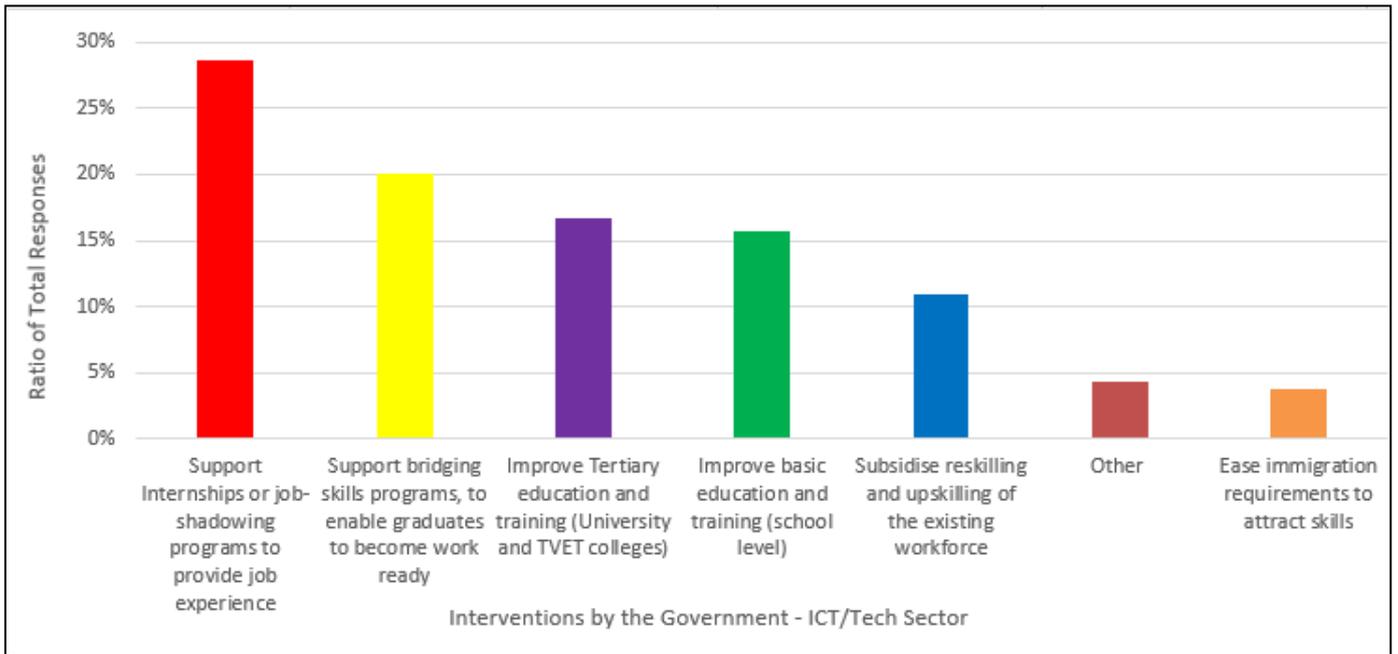


Figure 18: Intervention by the Government to support the growth of digital skills in the ICT/Tech Sector [N_{ICT}=205]

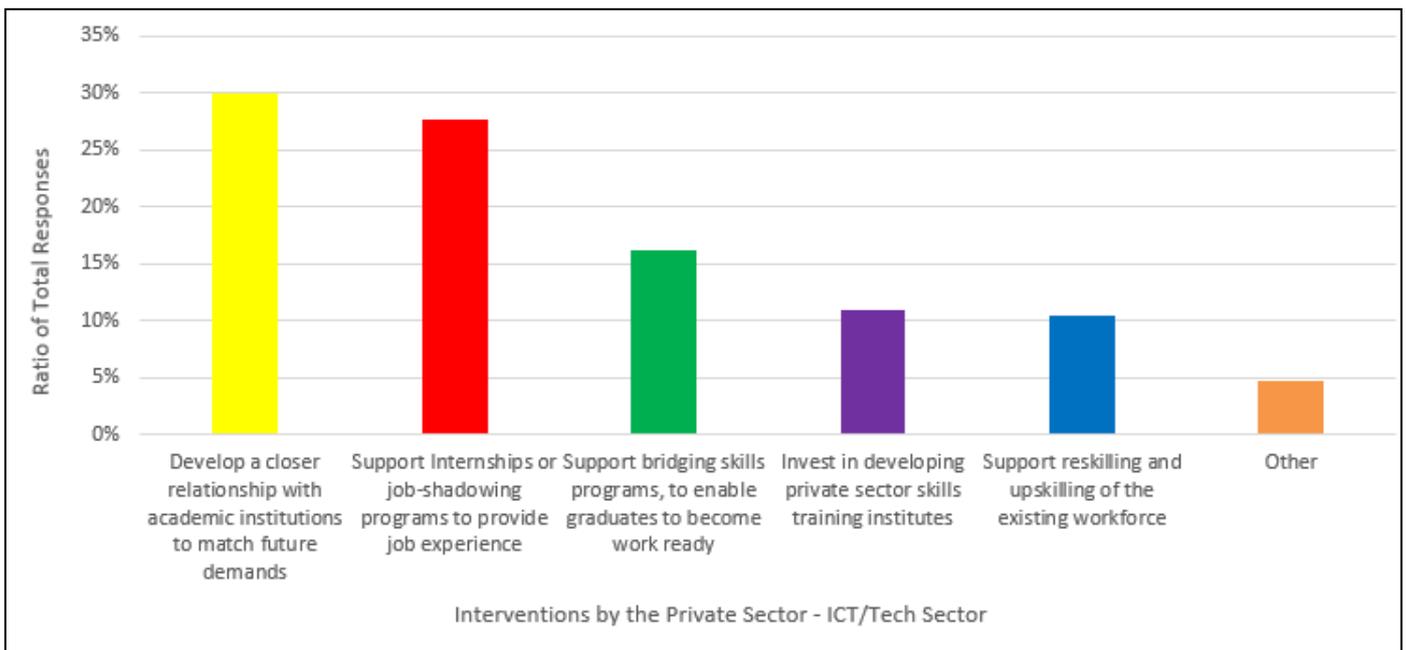


Figure 19: Intervention by the Private sector to support the growth of digital skills in the ICT/Tech Sector [N_{ICT}=205]

5.12.2 Financial Services Sector

The local financial services sector faces a number of technology driven challenges. Modern financial products and services are primarily digital in nature, technical innovation is rapid, and consequently digital transformation is imperative. The rise of new ‘fintech’ services means that this sector is also facing disruption to its business models.

A lack of skilled staff is therefore a debilitating feature of the financial sector. This sector has a strong presence in the Western Cape, and the growth of financial technology (fintech) start-ups such as *Luno*, *Snapscan* and *Yoco* is changing the local landscape. Key skills required in this industry (such as data science) are highly specialised; however, the available skills pool is limited.

An industry-wide skills development and continuous learning platform like Degreed can be of great help here in SA.”

~ Financial Services Sector Respondent

Attempts to tackle this shortage, such as the BCX Data Science Academy and the University of Cape Town’s Master’s degree in Data Science (with a specialisation in Financial Technology, and a focus on machine learning and block chain²⁷) are at an early stage. However, training graduates with appropriate skills by the University has a timeframe of a minimum of three to four years. Consequently, firms in this sector evidently prefer candidates with the aptitude to be up-skilled through on-the-job training and continuous learning (Figure 21). Respondents from this industry indicated that they are willing to support internship or job shadowing programmes to increase the pool of skilled labour (Figure 23), and expect to receive assistance from the Government in the form of subsidies for re-skilling and up-skilling of their existing workforce (Figure 22).

The importance of staff with aptitude for up-skilling is emphasised by a large bank that recently retrenched a significant number of staff on the basis that they did not meet the requirements for the business going forward²⁸.

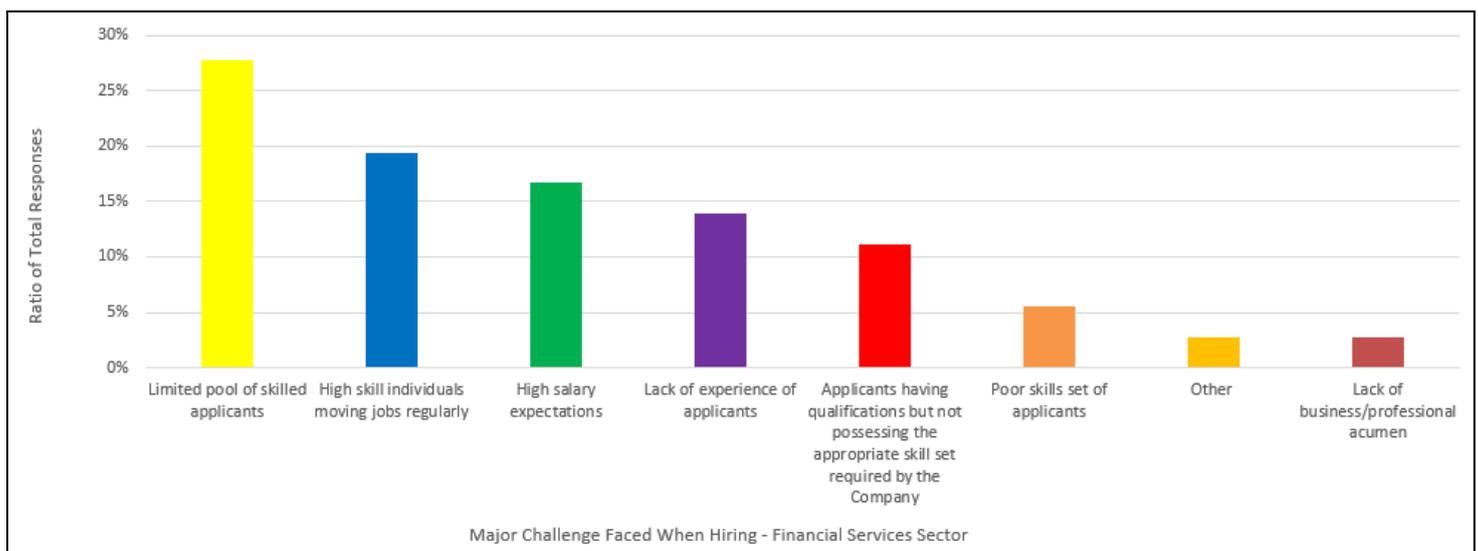


Figure 20: Major challenge faced when acquiring and keeping appropriate Technology/ICT/Digital practitioner in the Financial Services sector [N_{Fin}=35]

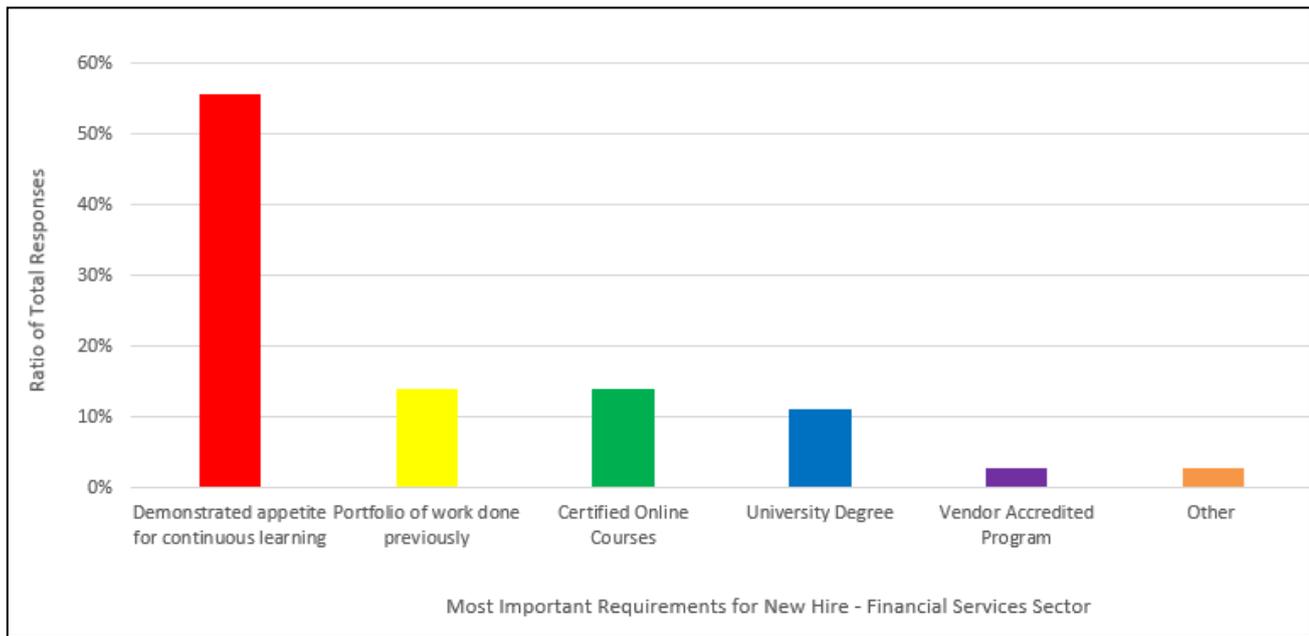


Figure 21: Most important requirement for new hires in the Financial Services sector [$N_{Fin}=35$]

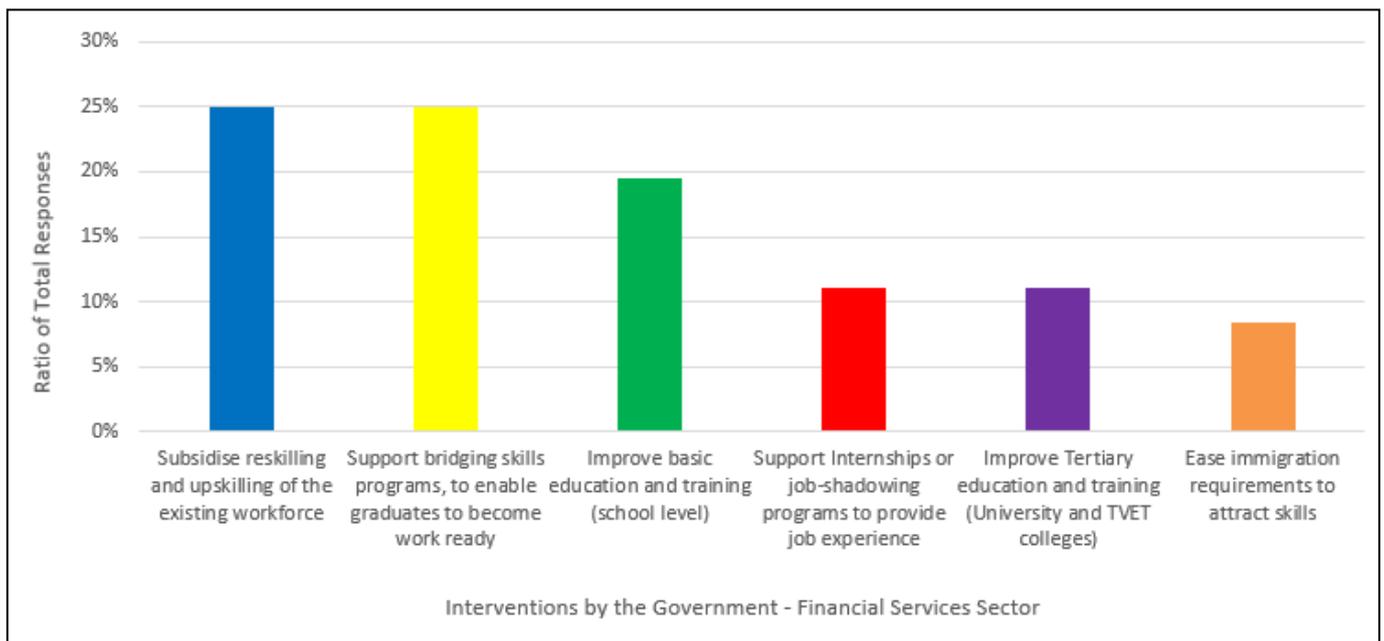


Figure 22: Intervention by the Government to support the growth of digital skills in the Financial Services Sector [$N_{Fin}=35$]

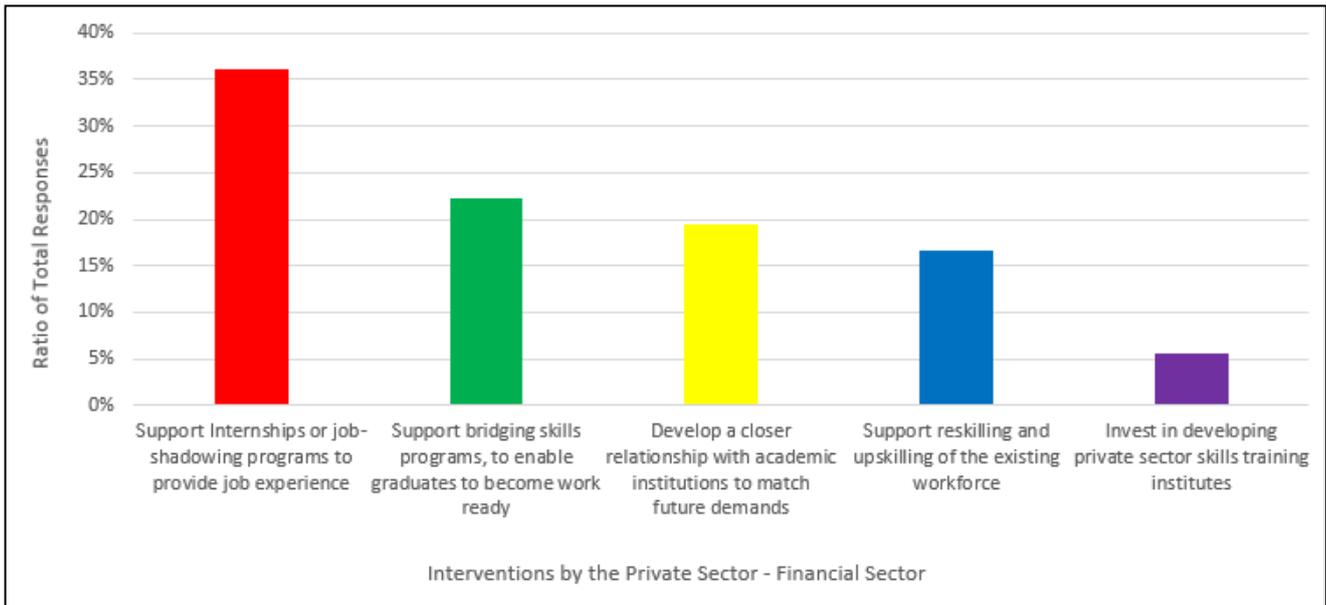


Figure 23: Intervention by the Private sector to support the growth of digital skills in the Financial Services Sector [N_{Fin}=35]

5.12.3 Retail Sector

The formal retail sector in the Western Cape has been transformed by digital technologies transformation over the last decade. The rise of online only retailers such as *Takealot*, *Zando* and *Superbalist* follows global trends in retail and e-commerce. Traditional bricks-and-mortar stores such as *Pick n Pay* and *Woolworths* have been providing digital services such as self-check-out and online shopping for a while.

The number of survey responses from this sector was relatively low and so the following analysis should therefore be treated cautiously.

The priority skills requirement for the future in this industry is data analytics, as seen in Table 7. However, since this industry is competing for the same pool of individuals with sectors such as ICT and Financial services, it is seemingly experiencing high turnover of skilled individuals, having identified “**High skill individuals moving jobs regularly**” as a major challenge. This is possibly due to sectors such as ICT and financial services being able to afford higher salaries for skilled talent.

In order to meet their future skills demands, respondents from this sector indicated that they are willing to develop a closer relationship with academic institutions to ensure graduates are work-ready (see Figure 27). The most important intervention by the Government, as viewed by the Retail sector, is that of providing internships and job-shadowing programmes (see Figure 26).

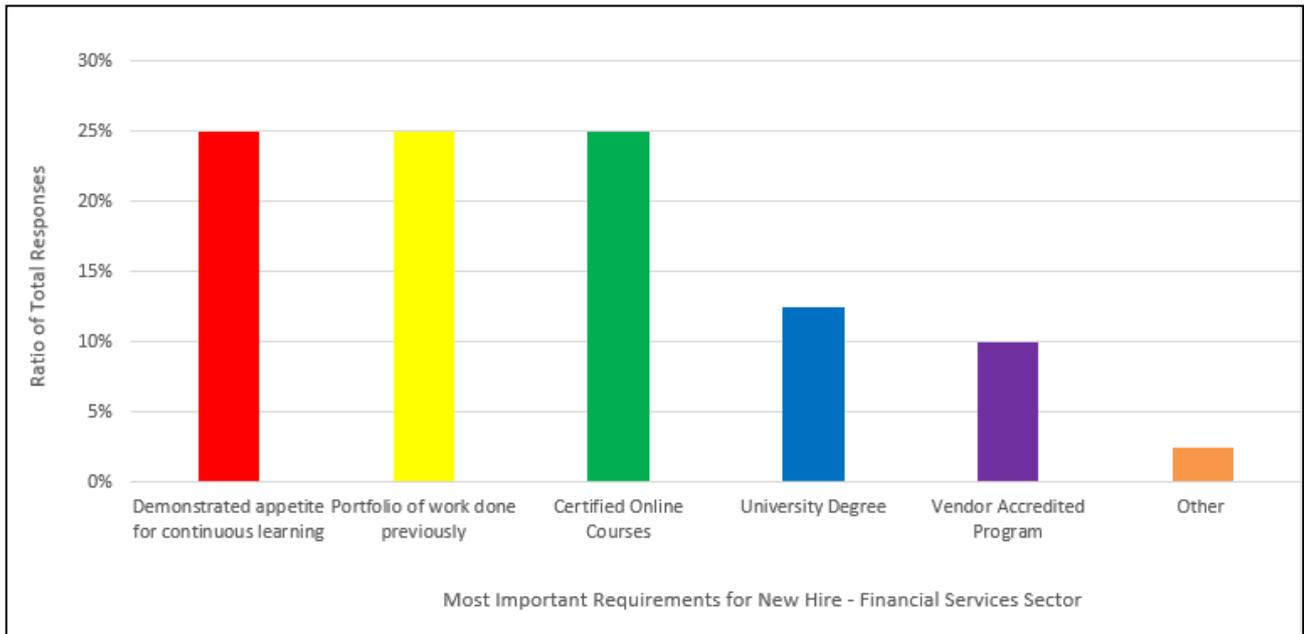


Figure 24: Most important requirement for new hires in the Retail sector [$N_{Ret}=39$]

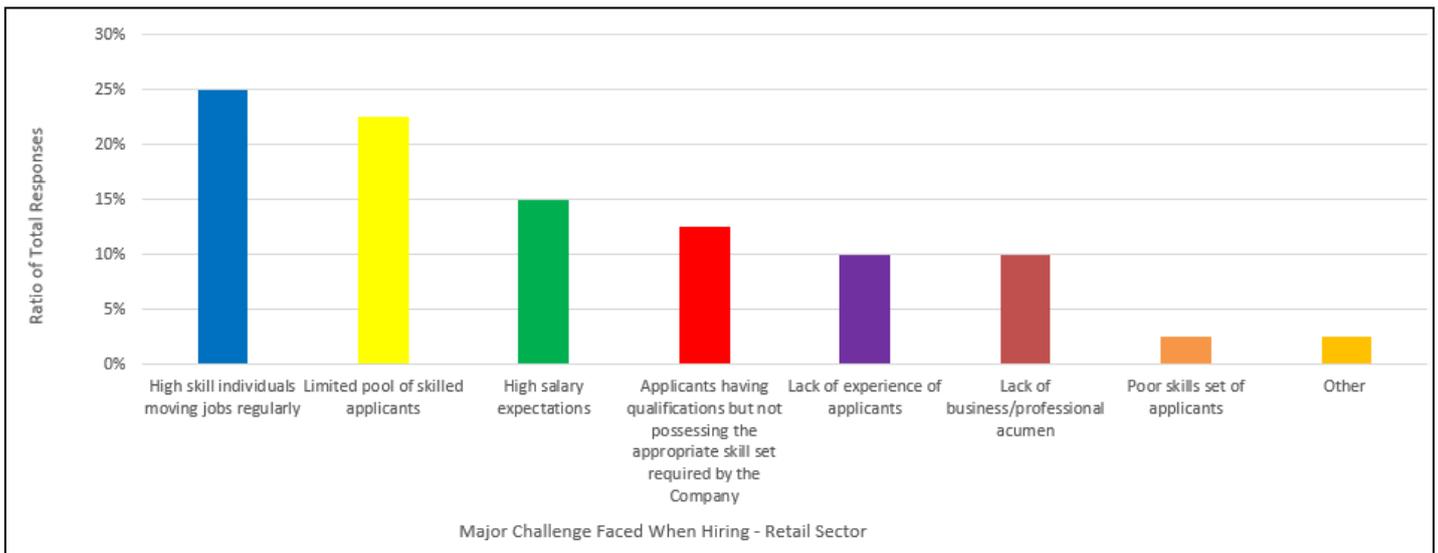


Figure 25: Major challenge faced when acquiring and keeping appropriate Technology/ICT/Digital practitioner in the Retail sector [$N_{Ret}=39$]

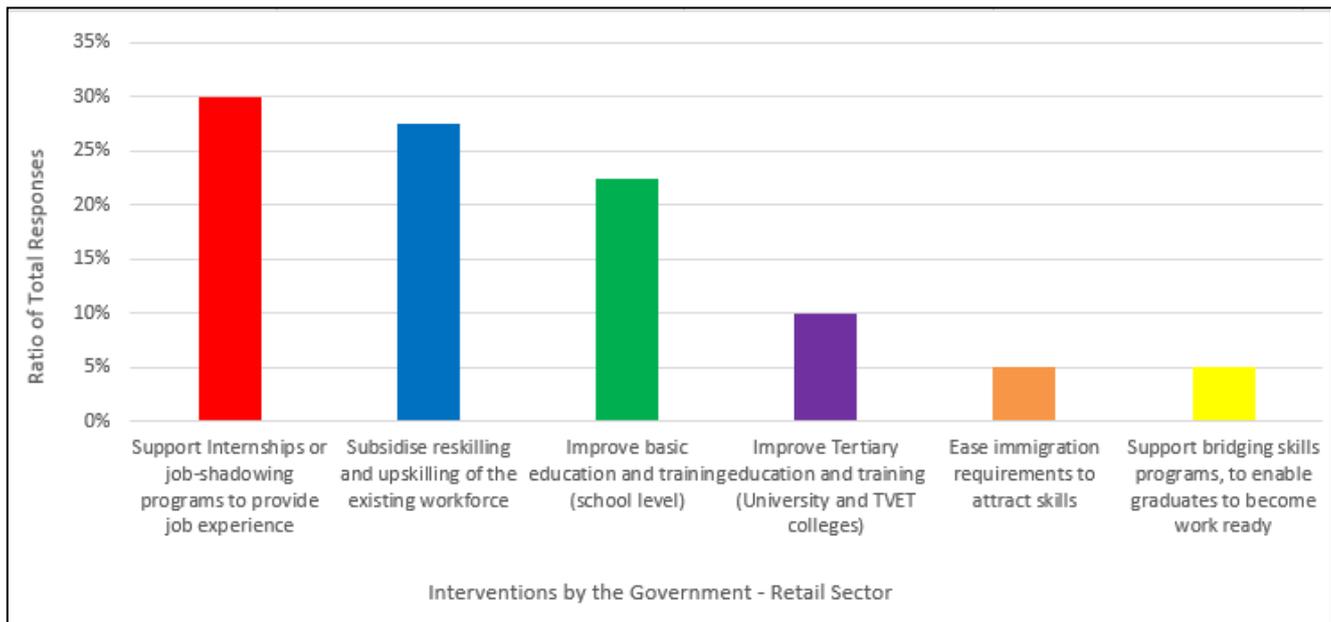


Figure 26: Intervention by the Government to support the growth of digital skills in the Retail Sector [N_{Ret}=39]

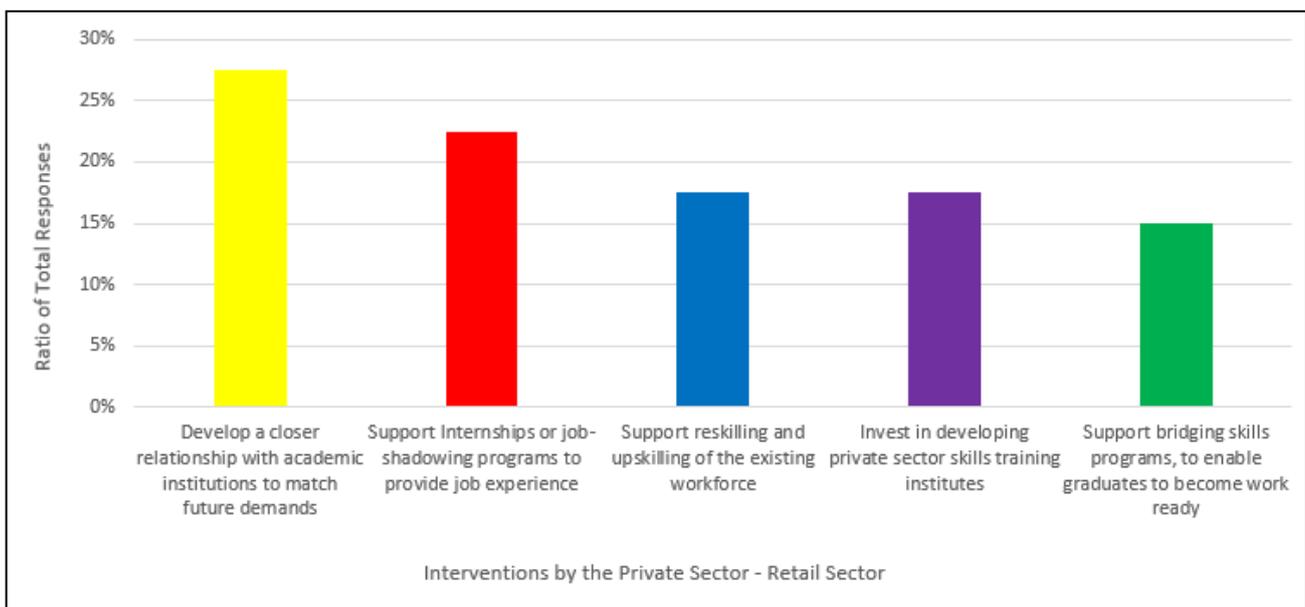


Figure 27: Intervention by the Private sector to support the growth of digital skills in the Retail Sector [N_{Ret}=39]

5.12.4 Media Sector

The media sector has been using various forms of digital technology for decades (think Internet radio, online publications and video streaming). The boom in new digital media (social media, online news and web streaming services) and the slow death of traditional media has dramatically changed the nature of work in this sector. Over the last decade, the advent of affordable computers, online software, and ‘broadband’ internet access has pushed the sector into a “gig economy” mode, in which pieces of work are often contracted out to a pool of individual professionals or small specialised firms.

Contract workers with varying abilities and digital skills compete for these pieces of work. This industry is highly competitive, but there is high demand for quality by clients²⁹.

The media sector identified a limited pool of skilled applicants as its primary skills-related issue. In the context of the sector this implies that there is a shortage of individuals that can produce high quality work. This is corroborated in that the sector considers experience and a portfolio of work done previously as the most important requirement for new hires (Figure 28).

Respondents from this sector noted that the private sector can support internship and job shadowing programmes to provide job experience, whereas the Government could support bridging skills programmes to enable graduates to become work-ready.

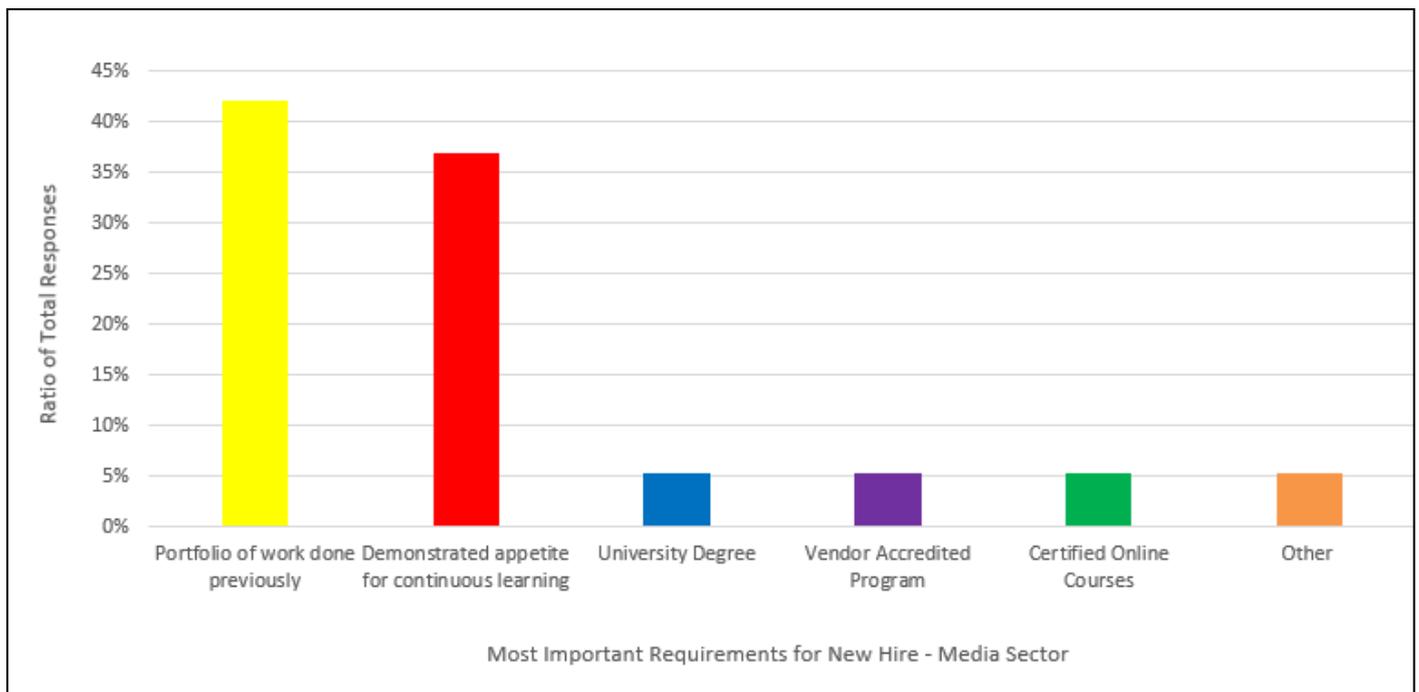


Figure 28: Most important requirement for new hires in the Media sector [$N_{Med}=19$]

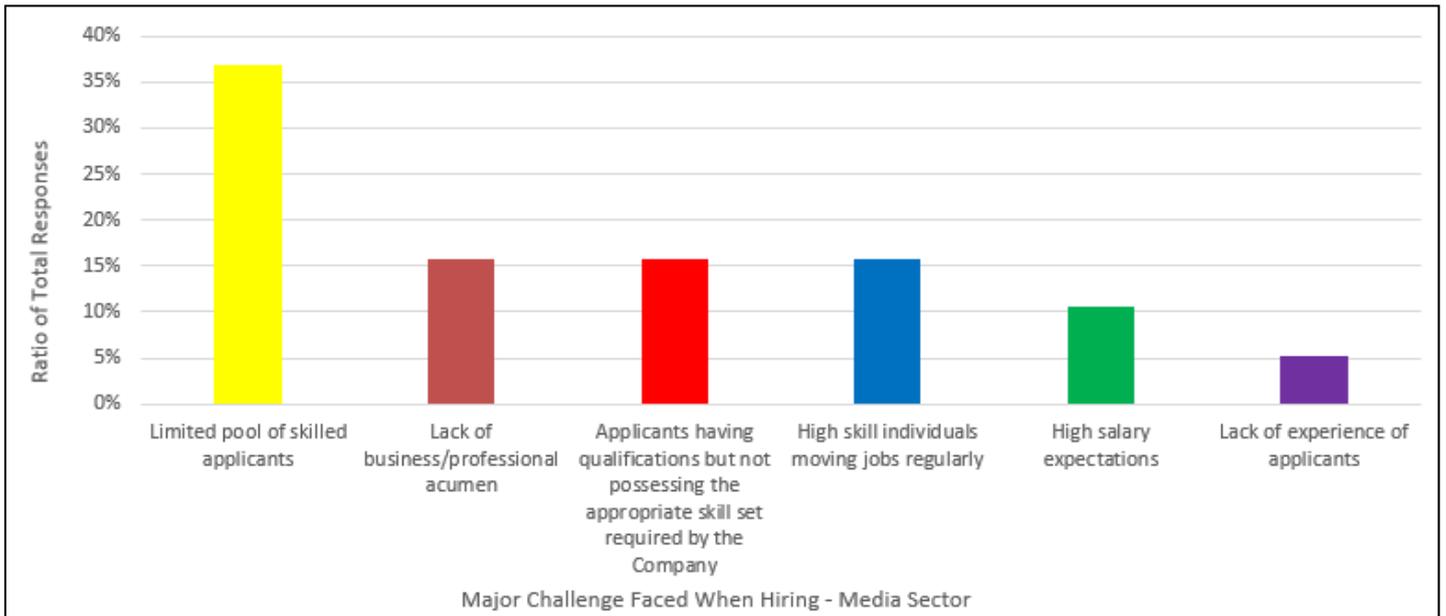


Figure 29: Major challenge faced when acquiring and keeping appropriate Technology/ICT/Digital practitioner in the Media sector [N_{Med}=19]

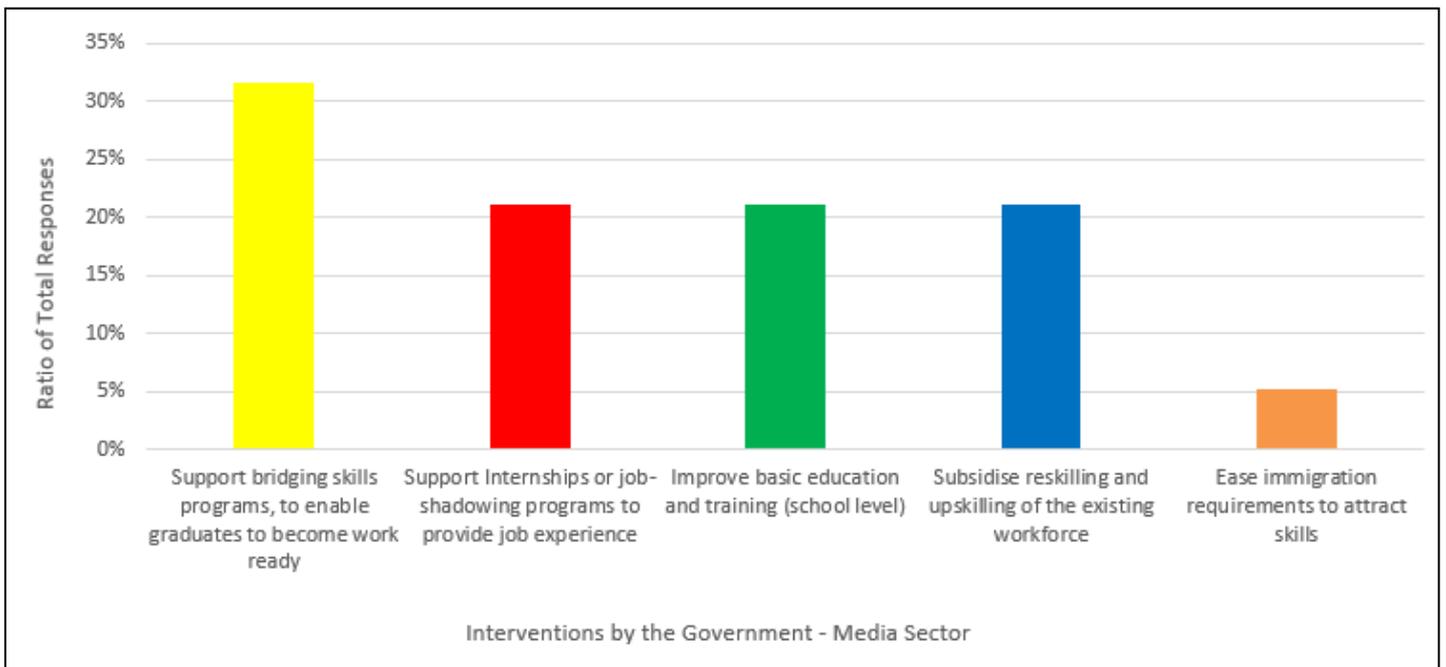


Figure 30: Intervention by the Government to support the growth of digital skills in the Media Sector [N_{Med}=19]

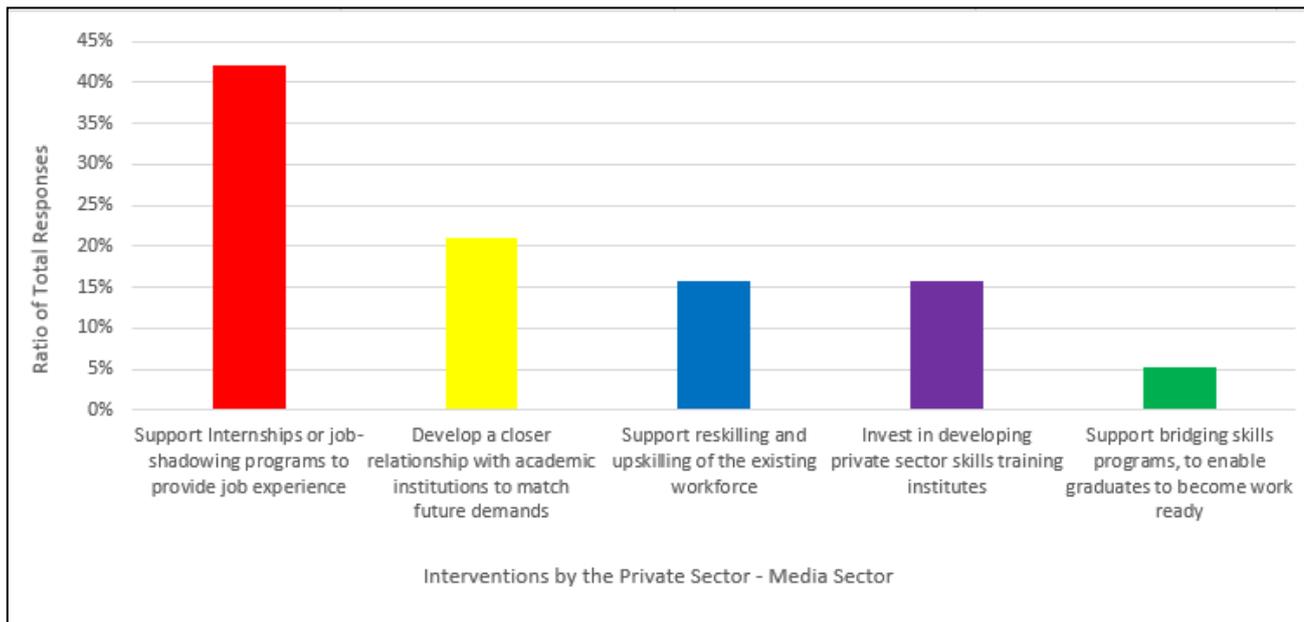


Figure 31: Intervention by the Private sector to support the growth of digital skills in the Media Sector [N_{Med}=19]

5.12.5 Tourism Sector

The tourism sector in the Western Cape is composed of the accommodation industry which piggy-backs on international digital agencies such as *booking.com* and *Airbnb*; the travel industry with the most popular local digital travel platform being *Travelstart*; and attractions some of which are run by the public sector (e.g. parks, monuments, beaches). Online guides such as *EatOut* and *insideguide* are important sources of information and bookings.

The biggest challenge and problem starts with basic education - Unless the building blocks are firmly in place at pre-primary and primary school to achieve good all round levels of maths and reading and writing skills - learners will always struggle with the quantitative subjects like maths and science throughout their education years.."

~ Tourism Services Sector Respondent

As was mentioned in the As-is report (see section 6.4 of the As-is report), there is little formal education led training for digital skills in the tourism sector. The industry in general has a low level of computer literacy. According to respondents of the survey, even when applicants have qualifications, they do not necessarily have an appropriate skills-set required by the company.

In order to improve the basic computer literacy of the work force in the tourism industry, respondents noted that the Government should improve basic education and training at school level, whereas the private sector sees its role as being to provide job experience through internship and job-shadowing programmes.

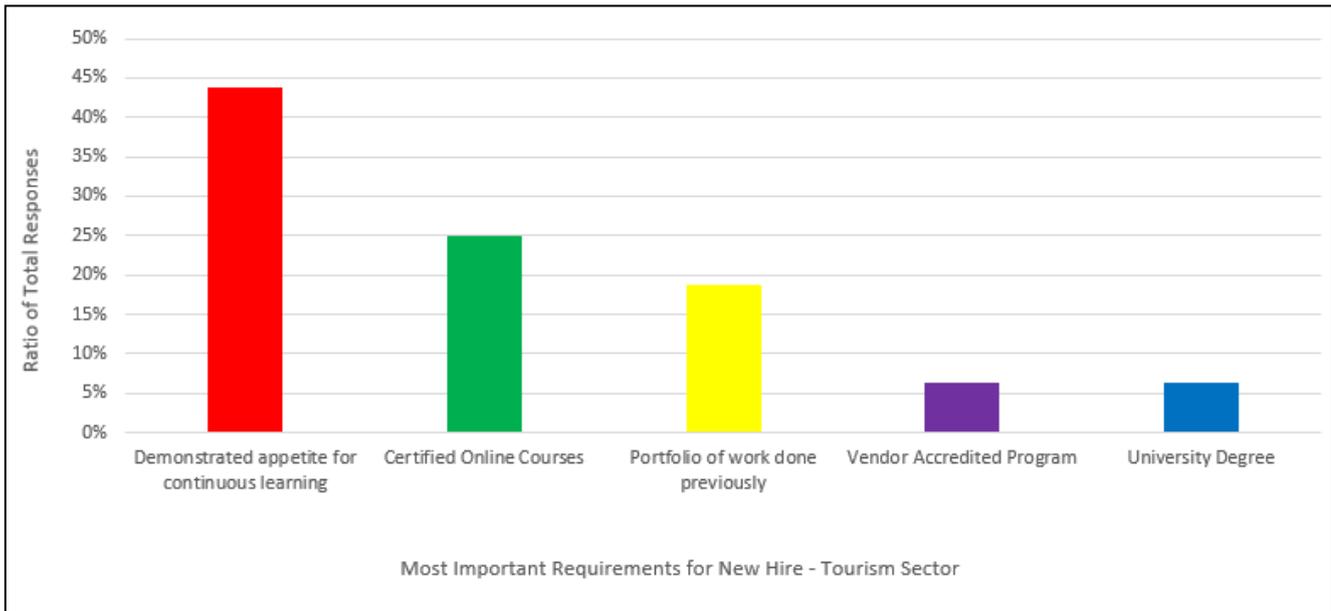


Figure 32: Most important requirement for new hires in the Tourism sector [$N_{\text{Tour}}=16$]

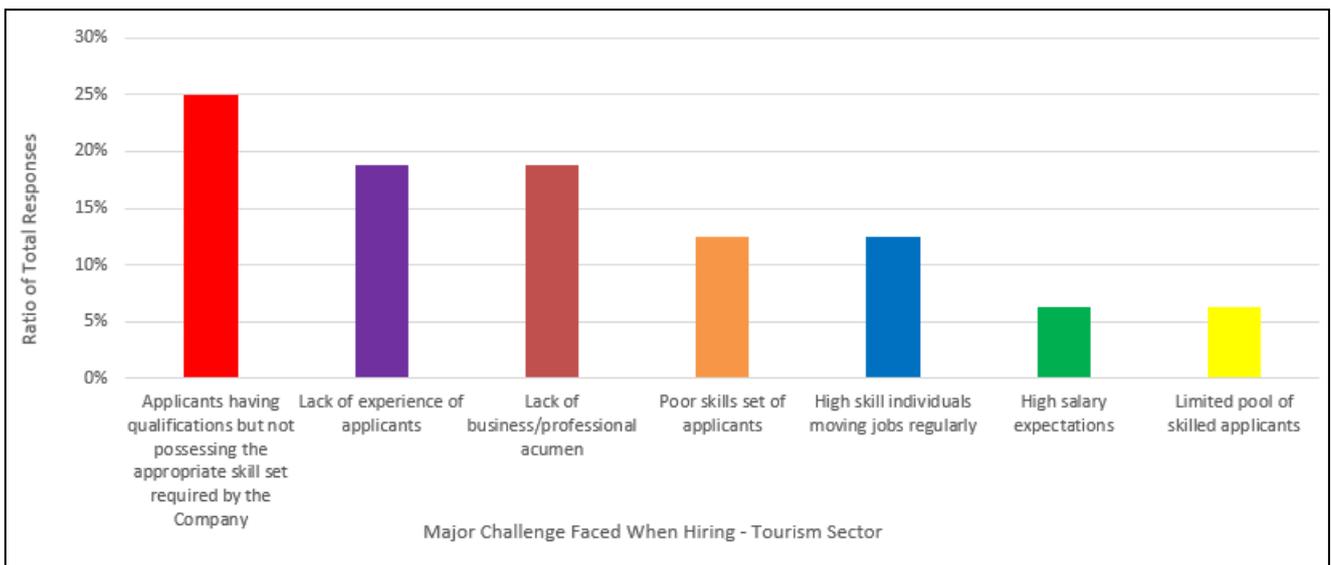


Figure 33: Major challenge faced when acquiring and keeping appropriate Technology/ICT/Digital practitioner in the Tourism sector [$N_{\text{Tour}}=16$]

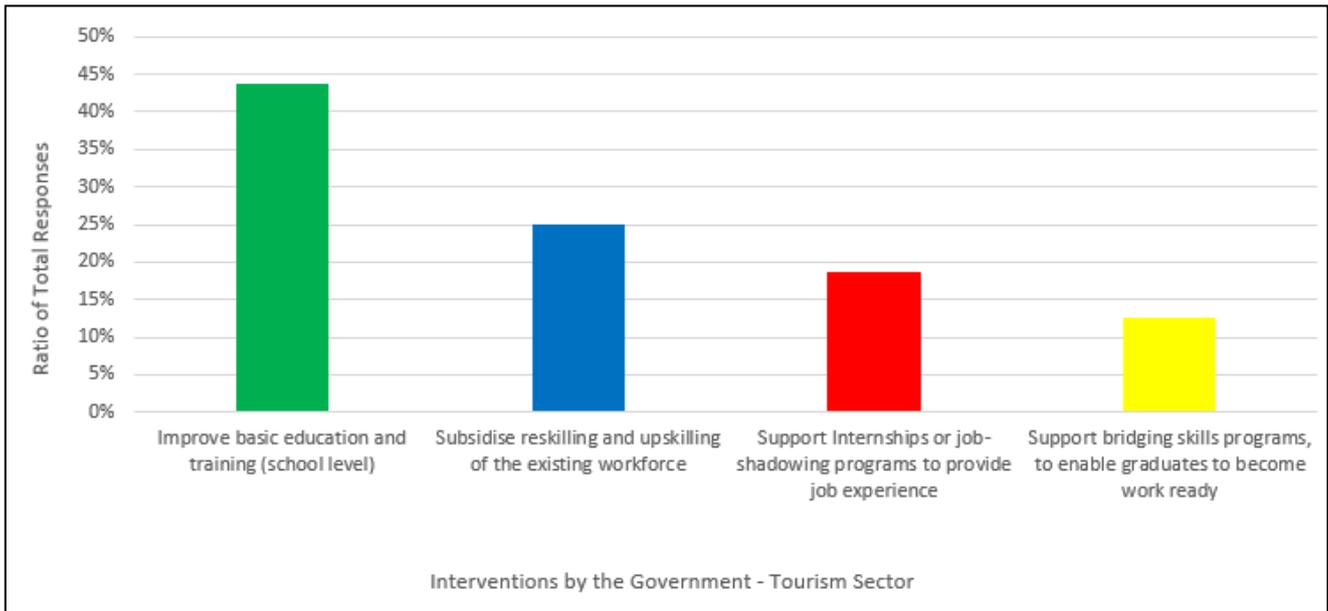


Figure 34: Intervention by the Government to support the growth of digital skills in the Tourism Sector [$N_{\text{Tour}}=16$]

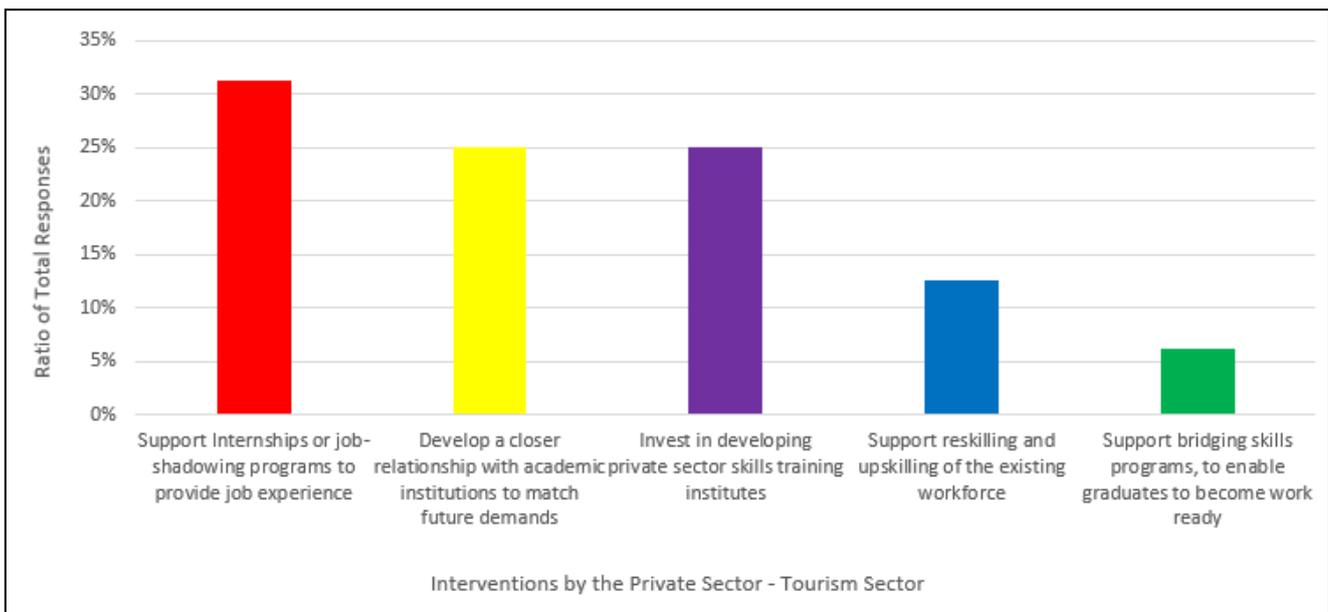


Figure 35: Intervention by the Private sector to support the growth of digital skills in the Tourism Sector [$N_{\text{Tour}}=16$]

	Top Technology Area	Top Skills Required	Most Likely Source of Talent	Most Important Requirement for Talent	Major Challenge Faced in Acquiring and Keeping Talent	Government Intervention to Support Digital Skills Growth	Private Sector Intervention to Support Digital Skills Growth
ICT/Tech	Cloud Computing	Data related skills such as data analytics, data science, big data	In-house training	Demonstrated appetite for continuous learning	Applicants having qualifications but do not possess the appropriate skills-set required by the company	Support internships or job-shadowing programmes to provide job experience	Develop a closer relationship with academic institutions to match future demands
Financial Services	Data Analytics	Data science	In-house training	Demonstrated appetite for continuous learning	Limited pool of skilled applicants	Subsidise re-skilling and up skilling of the existing workforce	Support internships or job shadowing programmes to provide job experience
Retail	Data Analytics	Data Analytics	In-house training	Portfolio of work done previously	High skill individuals moving jobs regularly	Support internships or job-shadowing programmes to provide job experience	Develop a closer relationship with academic institutions to match future demands

Media	Big Data	Data science, data analytics, big data	In-house training	Portfolio of work done previously	Limited pool of skilled applicants	Support bridging skills programmes to enable graduates to become work-ready	Support internships or job shadowing programmes to provide job experience
Tourism	Data Analytics	Data analytics, data visualisation, big data	In-house training	Demonstrated appetite for continuous learning	Applicants having qualifications but do not possess the appropriate skills-set required by the company	Improve basic education and training (school level)	Support internships or job shadowing programmes to provide job experience

Table 8: Responses mapped by Sector

5.13 Comments from the Digital Skills Survey

The Survey allowed participants to comment freely on issues of concern. The following is a selection of these comments:

“Digital skills are available in a disproportionate and disparate manner in South Africa because Basic Education, and from there, tertiary are failing. The few that receive decent BE go on to succeed at tertiary and in industry while the bulk are left behind to purchase lottery tickets, gamble at casinos and turn to crime and dead-end jobs. The problem to address is systemic basic education. That's the only long-term solution. Anything else is stop-gap.”

“Automation and working from home are the next big things in the industry as companies look for ways to cut operational costs. Newbies in the industry should focus on what their passionate about and not be directed by salary scales then they will succeed and be able to turn their ideas into new businesses.”

“The challenge we hear much about is not just the lack of skilled applications but the lack of mentorship and training for newly trained eg developers. Senior experienced developers are in such short supply, and considered 'expensive' by employers that they don't get to dedicate enough time to mentoring and growing junior developers within their teams. “

“Provide Coding training that will enhance South African Youth to be innovative and learn new digital trends, programming languages in order to get ready for new career in technology.”

“Closer relationship between government and the private sector in developing school leavers and graduates could go a long way to growing skills and making the city and province more attractive to global entrepreneurs. Legislation and programs that support entrepreneurs and startups will also enhance the city and province's attractiveness. Finally, government needs to address immigration so entrepreneurs and skilled ICT professionals are attracted to the country and city. “

“support startups with resources, infrastructure as well funding “

“The universities and TVET should not only provide students with theoretical aspects, but also should make sure that all final year undergraduates are provided with the opportunity of internships before they graduate, because it does not help to know everything about the theory of what you going to do, but when it comes to practicality of it, you lack or fail dismally. From second year, students need to have close ties with the organizations that they will likely in future to work for, gaining fist hand exposure to what they do and what they will be doing. Most of the poor rural South Africans do not access to adequate information, and when they come to universities they are open to all sort of possibilities but because the university afford you little time they do not have time to take on majors that they are not familiar with for fear of not knowing what the career prospects are, therefore, if internships start on the second year level, by the time they live the university they will be confident enough to pursuit the postgraduate in the ICT sector. “

“Create and incentivise major cross-cutting skills development initiative with links to public and private suppliers linked to a kind of “apprenticeship” scheme “

“We wouldn’t have a skills shortage if we weren’t limited to only 50% of the potential population. Need programs that bring girls into tech as young as possible, and general improvements from school level. “

“Entry level skills need to compliment and be linked to life skills. Management development skills and trading needs to part of joint programmes linked to specific industry skills. “

“For industry growth in the region, I believe the starting point is upping basic education at school level, but for the existing workforce, my major challenge is that digital courses to up-skill are extremely expensive. “

“Practical experience solving real problems is key. “

“better interaction and networking between business and academia would ensure supply and demand for skills is matched and grown in the digital world “

“Government's role should be to focus on increasing the quality of primary education and the private sector and universities partnership should resolve the rest. “

“Single nationwide portal for upskilling opportunities “

“Support Private Providers of education in all IT skills and recognition of international qualifications as part of local curriculums. “

“Tertiary institutions must be assisted in developing a curriculum that is aligned with the needs of the ICT Sector “

“An industry-wide skills development and continuous learning platform like Degreed can be of great help here in SA. “

“The process/application systems for all stakeholders are far too complicated, cumbersome and time consuming. Their caretakers are either uninformed or disempowered. There is no shortage of companies willing to play their part - enough to meet the demand. Sadly, the redtape journey from point A to point B for all stakeholders is far too arduous to be worth the effort. “

“I think government and private sector should work together to improve and introduce skills new and technology in our institutions “

"I think Government, including Dept of Basic Education, together with Private Sector should establish a bridge-institution for matriculants who can neither afford to study or obtain employment immediately after they complete matric, in order to provide some form of skill to join the workforce. Ideally a year's worth of training, but absolute minimum of six months. This should cover ALL areas of employment - from babysitting, cleaning and construction to basic IT skills. "ICT is changing rapidly, education should also follow the change. "

"Sector skills growth like any other will take place if opportunity is understood. There is history of ICT skills growth in response to needs that have been shared. Whether you look at the ERP systems of the 90's, the Web in the early 2000's. Improved access to business data, opportunities from public and private sector and the understanding of the business models of TECH will drive the adoption of ICT as careers. The sincerity of industry to grow a sector is based on information sharing not the donation of scorecard funds for points. "

"Significant attention should be paid to the digital skills requirements associated with major government-led initiatives in the WC, such as SKA and Cape Town's Smart City programmes "

"Software development coaches shadowed in their work environments by learners. "

"The problem is the quality of STEM education. If you have an advanced degree, or even an undergrad, in Maths/Physics, you can do the rest. Don't treat the symptoms, treat the cause. "

"There are always a funding / financial aspect when furthering studies or upskilling. Not everyone is able to do so without financial support. Scholarship for employees would be nice to have. "

"We need end to end Development and Placement programs that involves private and public organisations to work together. Government needs to be the catalyst to bring it all together. "

"Work ethic is a problem in SA. Salary expectations out of line with productivity. LABOUR INFLEXIBILITY, i.e. draconian labour laws. "

"National Education Syllabus and format needs to be addressed urgently. We can leapfrog to create the workforce required to fulfil the ever-growing technology world. Examples can be taken from countries like Finland, however these adoptions must be prioritised by government. "

"Need to get young people working on practical projects. Government can help with that, as it has many challenges. Need to put funding to internship like programmes and partner with smaller companies to help build skills while solving real problems. Win-win. "

6 Summary and Conclusions

6.1 Mind the Gap

Is there a digital skills shortage?

The recent OECD report, *Getting Skills Right: South Africa (2017)*³⁰, is one in a series of country studies aimed at identifying skills imbalances. The study found significant imbalances between supply and demand where cognitive skills are in short supply while manual and physical skills are in surplus. This report also makes reference to the OECD's Skills for Jobs Database (published in 2017) and provides information on occupations and skills shortages or surpluses in Europe and South Africa.

The Global Talent Shortage Survey³¹ showed that about 34% of employers in South Africa were experiencing challenges in filling positions, with skilled-trade vacancies reportedly the hardest to fill.

The Labour Market Intelligence partnership has also recently produced a technical report on "Occupations in High Demand in South Africa"³² that provides a mechanism for the validation of scarce skills in the country.

From a socio-economic perspective, a skills shortage can slow economic growth; as business must pay a premium for scarce skills, they may delay investment in productive innovations and business models, or may consider other investment locations as more attractive due to the availability of suitable digital skills.

A reliable pipeline for the supply of high-quality digital skills within the region could therefore be a catalyst for improved growth and enhanced socio-economic development.

The As-Is data analysis points to a real, current skills shortage in the region. This is corroborated by the survey conducted with business into their future requirements. It is conceivable, given the trend for businesses to increasingly adopt digital technologies, innovations and business models, that this gap with WIDEN in the next few years, unless Government, business, labour and civil society engage in positive actions to address the skills shortage.

Is there a skills mismatch?

The skills shortage has two dimensions: Quantity and Quality: . Quantity is the easier metric to measure; the number of vacancies on LinkedIn and the number of job searches on Google provide quantitative indicators (see details in the As-Is report). The quantitative gap or shortage is of course dynamically affected by a variety of factors and long-term data analysis is required to understand these factors (which is not part of this study).

Qualitative gaps are harder to measure, but are indicated by employers' opinions of the skills of newly qualified persons (generally poor); the inabilities of newly qualified persons to quickly and easily find appropriate employment (the time lag to get a job), the ability for continuous learning, and the mismatch between employee requirements and skills supply. The responsibility for the qualitative gap is a bone of contention between skills suppliers and employers.

Closing the gap requires both quantity and quality issues to be addressed. Very few countries (India and China are notable exceptions) produce high quantity and high-quality skills simultaneously.

Gap analysis hides the challenges that businesses are going to face if their current workforce is not appropriately skilled (or up-skilled) to meet the demands of a digital future. The gap, therefore, may be far wider than anticipated.

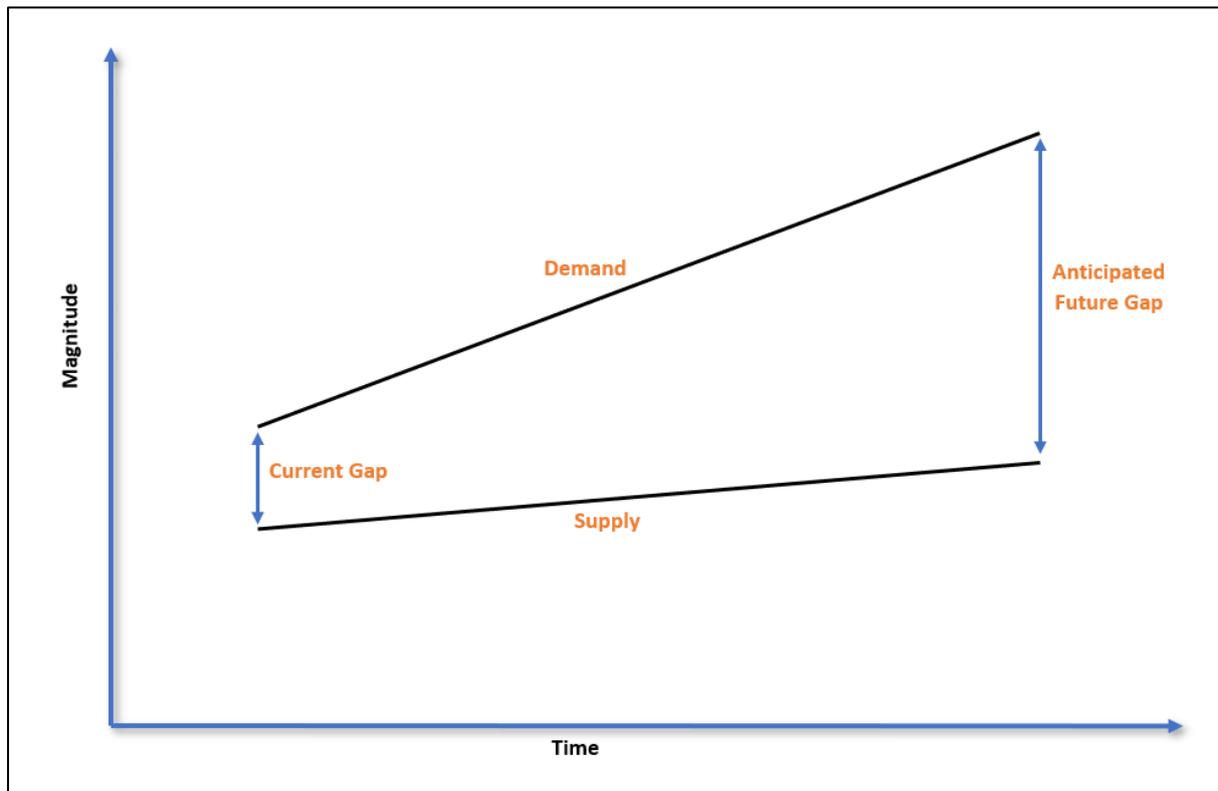


Figure 36: The Gap Scenario

6.2 Driving Transformative change in Digital Skills

The status quo will not deliver the digital skills required for the future and will in all probability under deliver on both the quantity and quality of skills required, and the change management required to up-skill the existing workforce.

Transformative change is required to deliver the skills needed for the global digital hub. Future scenario planning should occur at a sector and individual business level. For the WCG, the force field analysis showing the driving and restraining forces for the digital skills agenda is shown below.

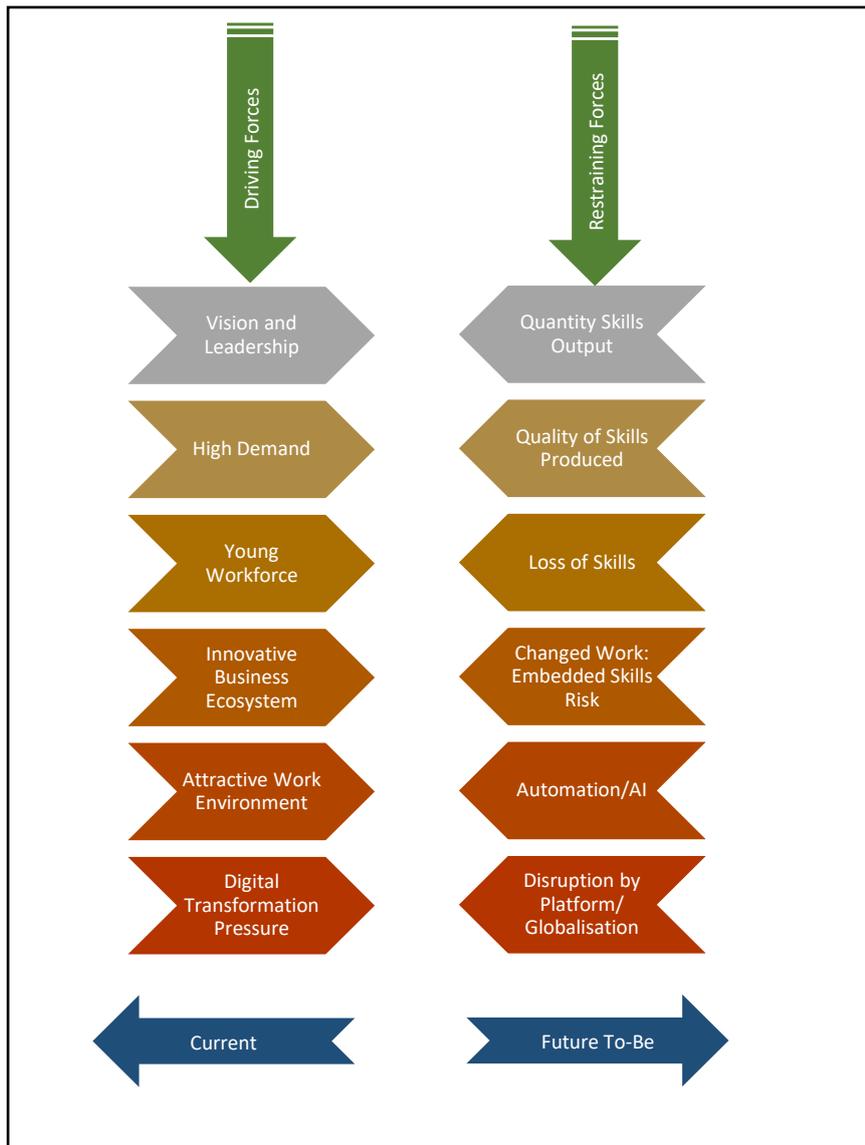


Figure 37: Force Field Analysis of Driving and Restraining Forces for a Digital Skills Agenda

6.3 Critical attention is needed from Business and Government

The As-is report and the survey found that both private and public sector organisations need to pay urgent attention to addressing the digital skills shortage. The survey did not specifically deal with in-house (staff) development of digital skills, but the private sector did indicate its preference for in-house skills development. Whether that only pertains to critical skills or deals with the range of skills necessary for digital transformation is unclear. Re-skilling and up-skilling current staff (as a defensive strategy against digital disruption) is going to be as important as producing newly qualified personnel.

The PWC report “Workforce of the future: The competing forces shaping 2030”³³ provides the following advisory for business and government leaders:

Act now	This isn't about some 'far future' of work – change is already happening, and accelerating.
Informed decisions	The future isn't a fixed destination. Plan for a dynamic rather than a static future. You'll need to recognise multiple and evolving scenarios.
Make a big leap	Don't be constrained by your starting point. You might need a more radical change than just a small step away from where you are today.
Own the debate	Digital transformation will affect every level of the business (and society), and cannot be left to only one party to address
People not jobs	It will be very difficult to protect jobs which are made redundant by technology – but they do have a responsibility to their people. Protect people not jobs. Nurture agility, adaptability and re-skilling.
Build a clear narrative	A vision for the actions needed should be widely supported

6.4 Improving the pipeline for skills

Developing a pipeline for skills has primarily been achieved, in the past, through the education system. This study did not touch on the schooling environment and only briefly looked at the higher education sector (Universities and TVET colleges). Ideally, digital skills development needs to start at the school level.

It is easy to propose better alignment of HEI courses with the demands of Industry. The reality is that the demand side will shift continuously into the future; HEIs have a difficult act of balancing immediate industry needs with that of producing capable, thinking and adaptable graduates.

There are however, areas of consensus between industry and the public sector that may yield quick and effective results. Insights from this study and longitudinal studies may assist the HEIs in making decisions on current and future skills demands. The primary suggestion for intervention by both government and the private sector centred around the development of interns and internships; however – recognition of the need is not translating into reality at the moment - interns produced by government supported programmes are not being hired as easily as expected ²⁴ and the transition from intern to employee isn't as easily achievable. This will be a focus of the discussion of the Roadmap.

Lastly, there is an opportunity for the region to benefit from the large number of highly skilled students that study at local HEIs, but are from other parts of the world. A focus on other African students presents an opportunity to make the region a continental hub for African digital skills. High-end migrant workers are the basis of many regions' competitiveness – the WCG should seek to capitalise on this potential opportunity.

6.5 Other points of entry

The survey highlighted the importance of other pathways to jobs requiring digital skills. Tertiary and other formal qualifications is the most obvious pathway, but vendor certification and private training institution certification are valid entry pathways. Sadly, TVET colleges seem to be lagging in dealing with this area of skills development.

6.6 The Leaky Bucket problem

The Digital Skills shortage is not unique to the Western Cape and the region “competes” on a global scale for scarce (high end) skills. The region therefore faces a known dilemma: how does one invest in developing skills that can migrate quickly and regularly to any other region (or competitor in the case of companies)? Unfortunately, this is a real and on-going concern: large multinational tech companies that are investing in the region - such as Amazon, Microsoft, Facebook and Google - are seen by young graduates as gateways to international opportunities for emigration.

In development terms, this is considered a leaky bucket: irrespective of how much water is poured into the bucket, it cannot retain maximum capacity due to the holes that allow the water to drain.

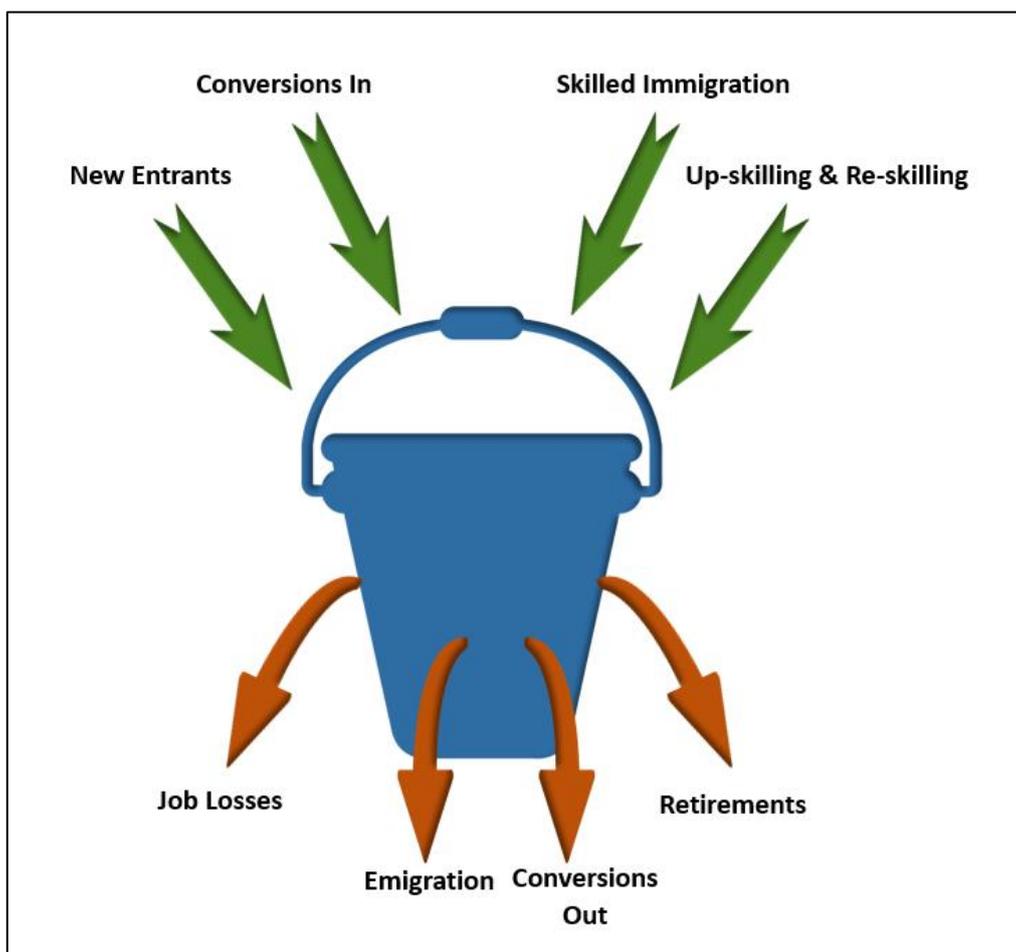


Figure 38: The leaky bucket model in the context of digital skills in the Western Cape

Companies manage the leaky bucket skills problem through contractual golden handcuffs: bursaries with strings attached, share options that only vest far into the future, and bonus rewards for loyalty. Community service for medical students and professional registration commitments for certain

professions are also used in a similar manner – no such mechanisms exist for public sector sponsored digital skills.

6.7 Employment Equity, Youth and Gender Transformation

This study did not touch on the issues of youth, gender and employment equity in the current skills profile, although the need to deal with them is obvious.

7 Sector snapshots

Sector snapshots were based on data gathered in the As-Is phase, including interviews with sector players and research on sector trends.

7.1 Financial and Business services sector

Items	Digital Transformation Influencers (DTI)	Time of impact	Business Impact	Maturity of DTI	Skills Impact
Description	Digital Transformation Influencers (DTI) are technologies, innovations or paradigms that will (or already do) impact businesses and every-day life	Short term: 1-2 years; Medium term: 2-5 years; Long term: 5-10 years	Transformational: likely to require major changes within organisations; High: will have a high impact on the organisation; Medium: will impact organisation processes and services	Mainstream: well developed and main organisations are already implementing; Early adopter: some organisations are using already; Adolescent: discussed widely very few implementations; Emerging: academic and research and development only	Effect on existing workforce, skills needed: High: major shift in skills/jobs requiring urgent attention sector under threat; Medium: impact on skills/jobs but with changes sector can cope; Low: sector can cope
1	Agile Organisations	Short	Transformational: these organisations are able to collaborate with or buy start-ups, attract and retain millennial talent (quote) and apply the principles of exponential organisations	Early Adopter	High
2	Artificial intelligence	Medium	Transformational: AI is disrupting dominant institutions which relied on the scale of assets; mass production;	Early Adopter	High

			exclusivity of relationships; high switching costs; and dependence on human ingenuity. But in the future, institutions will be built on: scale of data; tailored experiences; optimisation and matching of digital connections; high retention benefits; and the value of human performance being augmented by technology. The WEF (2018) notes “This shift will have far-reaching consequences for the make-up of financial services, placing legacy business models under pressure from those whose businesses are built around these new attributes,”		
3	Big Data	Short	Transformational: it is transforming Compliance and regulatory reporting, Risk analysis and management, Fraud detection and security analytics, CRM and customer loyalty programmes, Trade surveillance, Credit risk, scoring and analysis, High speed arbitrage trading and Personalised customer pricing & experience (E&Y:2018)	Mainstream	Medium
4	Blockchain	Medium	Transformative: of the banking industry, the fiscus, insurance, ledgers, property registration and most administrative processes requiring verifiable records.	Adolescent	High
5	BPO	Short	Transformational BPO is converging typical back office administration services which are concentrated to achieve economies and efficiencies of scale.	Mainstream	Medium

6	Cloud Computing	Short	High: Cloud is greatly reducing the cost of data processing and expanding its effectiveness not least through making many exponential technologies accessible and affordable. Includes SaaS (Software as a Service), PaaS (Platform as a Service); and IaaS (Infrastructure as a Service)	Mainstream / Early Adopter	Low
7	Cryptocurrency	Medium	Transformational: once regulatory issues are dealt with, has potential to disrupt the core of the banking industry	Emerging	Medium
8	Customer engagement	Short	Transformational: Digital device ownership generally requires that customers be engaged on their own terms across multiple channels.	Mainstream	High
9	Cyber security	Short	High: the industry deals with massive amounts of financial & personal data which is vulnerable to cyber crime	Mainstream	Medium
10	Data Analytics	Short	Transformational: from actuarial algorithms to risk and credit analysis and ability to measure customer behaviour and develop product offers that respond to customised needs	Mainstream	Medium
11	Internet of Things	Medium	Transformational: includes automated processes that trigger business rules and data analytics automatically, branches and ATMs that self-monitor and report status automatically (E&Y: 2018)	Early Adopters	High
12	Mobile connectivity	Short	Transformational: includes mobile apps for consumers to carry out banking activities & manage their profiles and products	Mainstream	High

13	Multi Sided Platforms	Short	Transformational: are converging matchmaking and financial services at low cost that connects service providers, consumers, advertisers and value add services in instant time. This convergence directly benefits ecosystems of partners which provide value add, technology and intermediation services around the platforms	Mainstream	High
14	Omni channel Marketing	Short	Transformational: competing for tech savvy, mobile only Millennials requires integration over multiple channels	Early Adopters	High
15	Shared Services Centres (SSCs)	Short	High: are converging the full spectrum of business services under one roof to provide these services to one or more large enterprises.	Mainstream	High
16	Robotic Process Automation (RPA)	Short	High: RPA carries out routine and repetitive activities more accurately and quickly than a human. Main usage areas – audit, insurance claims approval, legal contract creation etc.	Early Adopters	Medium
17	Social platforms	Short	Transformational: customer engagement, loyalty, verification and marketing	Mainstream	High
18	Virtual Assistants & Chatbots	Short	Transformational: will greatly reduce the need for human beings as information transmitters and query managers	Early Adopters	High
19	Voice recognition	Short	Transformational: will remove need for screens & translation and assist with cyber security	Early Adopters	High

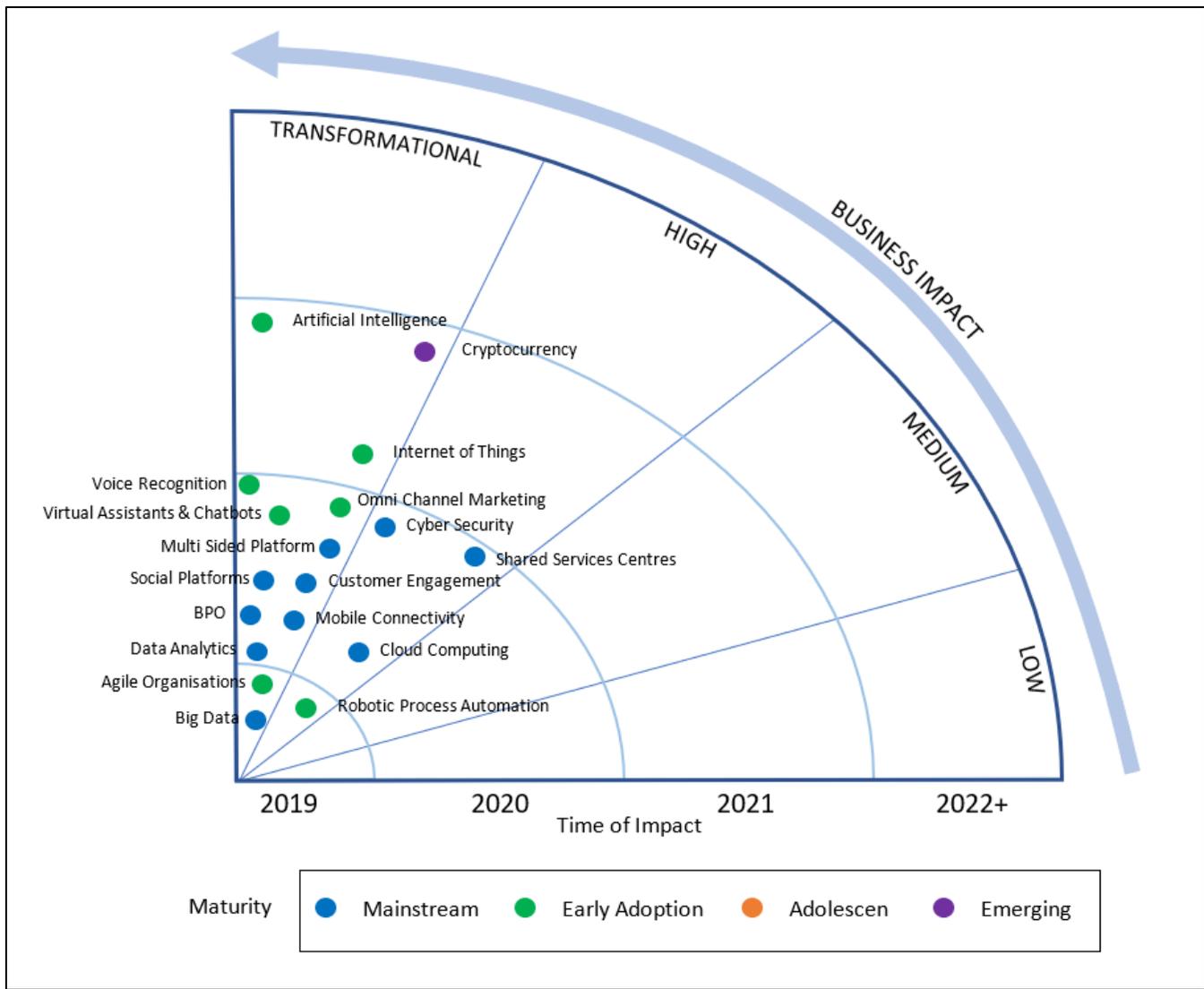


Figure 39: Business Impact Radar – Financial and Business Services – Based on Lookout 2020+ Technology Radar³⁴

7.2 Wholesale and Retail sector

Items	Digital Transformation Influencers (DTI)	Time of impact	Business Impact	Maturity of DTI	Skills Impact
Description	Digital Transformation Influencers (DTI) are technologies, innovations or paradigms that will (or already do) impact businesses and every-day life	Short term: 1-2 years; Medium term: 2-5 years; Long term: 5-10 years	Transformational: likely to require major changes within organisations; High: will have a high impact on the organisation; Medium: will impact organisation processes and services	Mainstream: well developed and main organisations are already implementing; Early adopter: some organisations are using already; Adolescent: discussed widely very few implementations; Emerging: academic and research and development only	Effect on existing workforce, skills needed: High: major shift in skills/jobs requiring urgent attention sector under threat; Medium: impact on skills/jobs but with changes sector can cope; Low: sector can cope
1	Artificial intelligence	Medium	Transformational: will greatly augment the capability of all current transformative technologies and analytical professions. Analytics & predictive models to help personalise experiences, enhance inventory demand visibility & forecasting.	Early Adopter	Medium
2	Augmented Reality (AR)	Medium	High I: will enable huge augmentation of in store marketing, promotion and sales	Early Adopter	Medium
3	Blockchain (Inventory & Supply Chain)	Medium	High: will automate stores and supply chain	Adolescent	Medium
4	Cashless & no checkout stores	Medium	Transformational: will replace the checkout infrastructure	Adolescent	High

5	Cloud Computing	Short	High: will make access to all other transformative technologies cheaper and more effective	Mainstream	Low
6	Cryptocurrency	Medium	High: frictionless transactions and barter will be possible at vast scale	Emerging	Medium
7	Cyber security	Short	High: retail holds vast amounts of personal data and financial transnationality	Mainstream	Medium
8	Data Analytics & Big Data	Short	Transformational: it is transforming business processes and enabling personalised customer pricing and market analysis including <ul style="list-style-type: none"> • Campaign management and customer loyalty programmes • Supply-chain management and analytics • Event and behaviour-based targeting • Market and consumer segmentations 	Mainstream	High
9	Digitally enabled work environment	Medium	High: all aspects of the store environment will be digitalised, automated and tracked	Early Adopters	High
10	E-commerce	Short	Transformational: E-commerce in this sector is anticipated to show a phenomenal compound annual growth rate of 23% globally, between 2012 and 2019.	Mainstream	High
11	Face recognition & universal surveillance	Medium	Medium: high levels of personalisation and zero crime will be enabled	Emerging	Medium
12	Hyper Personalisation	Medium	Transformational: one-to-one customer engagement will be automated and cognified	Emerging	High
13	Improved in-store experiences	Short	HIGH: much higher levels of design, user experience and store customisation will be possible	Early Adopters	High
14	Internet of Things	Medium	Transformational: Enhanced supply chain visibility leading to stock-out prevention, transparent supply chain enabling customers or wholesalers to track product flow, connect	Early Adopters	High

			infrastructure, stock and systems, location-based offers and service customisation		
15	Location Based Services	Short	Transformational: smart cities and smart malls enable 24/7 engagement with responsive messaging, signage and even purchase	Early Adopters	High
16	Loyalty programmes	Short	High: traditional source of data analytics	Mainstream	High
17	Mobile connectivity	Short	Transformational Mobile point-of sales devices to improve payment process, engagement of customers to provide detailed product information and devices to assist with scanning and distribution of goods (E&Y:2018)	Mainstream	High
18	Multi Sided Platforms	Short	Transformational: a vast array of platforms facilitate payment, transactions, on line commerce and combine with social media	Early Adopters	High
19	Omni channel Marketing	Short	Transformational: the millennial customer expects to be engaged across channels	Early Adopters	High
20	Personal data trading	Short	Medium: The aggregation of personal data across platforms to facilitate re-selling of personal data to retailers and others	Early Adopters	High
21	Robotics	Medium	Transformational: drones to monitor stock levels, virtual assistants to place and receive orders, robotic product picking & packing. Automated inventory and warehouse management	Early Adopters	High
22	Social platforms	Short	Transformational: customer engagement, loyalty, verification and marketing	Mainstream	High
23	3D Printing	Long	Medium: will eventually enable in-store production and product enhancement	Emerging	High
24	Virtual Assistants & Chatbots	Short	Transformational: will greatly reduce the need for human beings as information transmitters and query managers	Early Adopters	High

25	Virtual Reality (VR)	Medium	Medium: will enable online and in-store engagement with products and multiple variants and settings	Early Adopters	High
26	Voice recognition	Short	High: will remove need for screens and tagging and support virtual assistance	Early Adopters	High
27	Wearable electronics	Medium	Transformational: a new generation of trackable and tracking responsive clothing is emerging	Early Adopters	High

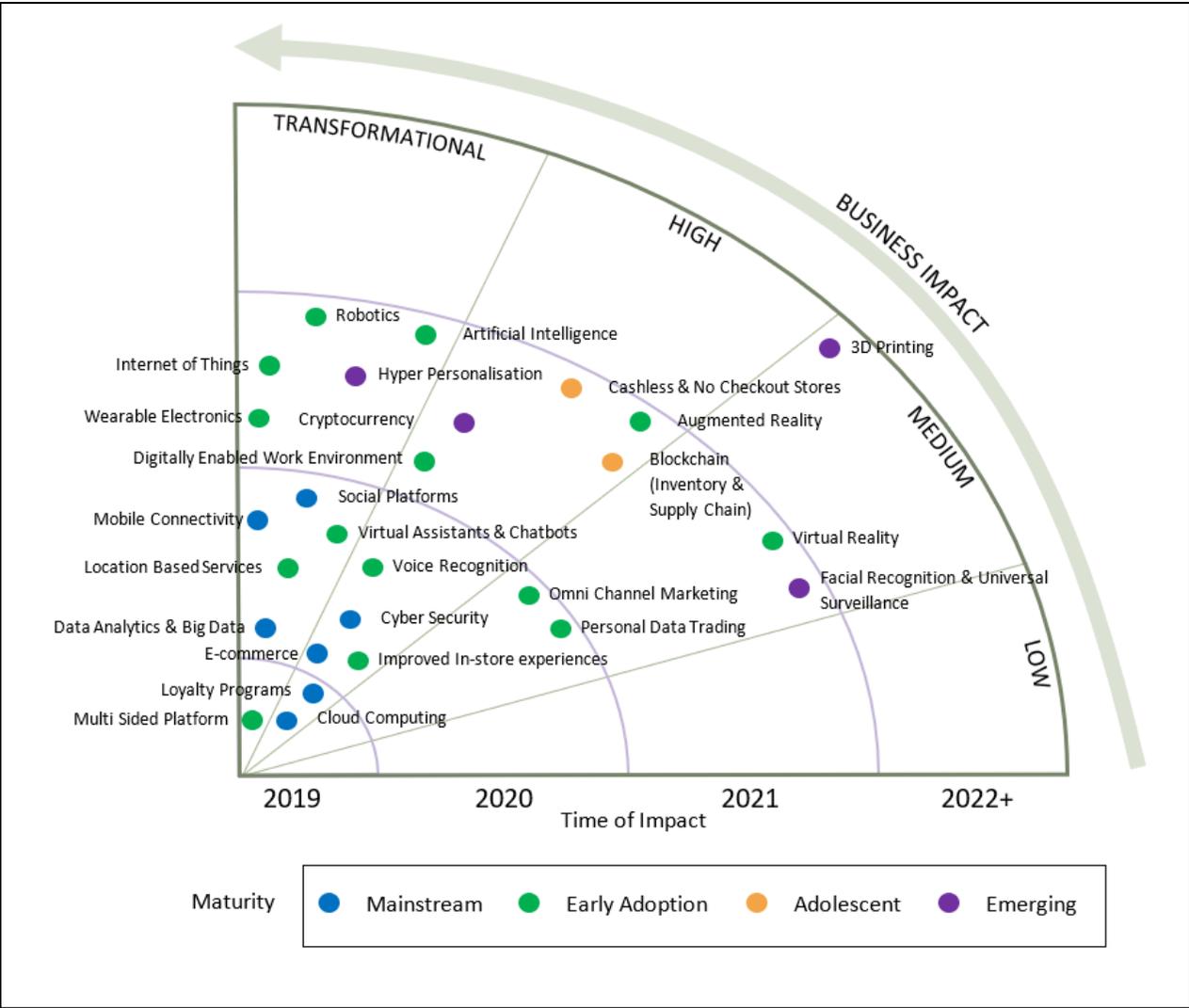


Figure 40: Business Impact Radar – Wholesale and Retail – Based on Lookout 2020+ Technology Radar³⁷

7.3 Tourism

Items	Digital Transformation Influencers (DTI)	Time of impact	Business Impact	Maturity of DTI	Skills Impact
Description	Digital Transformation Influencers (DTI) are technologies, innovations or paradigms that will (or already do) impact businesses and every-day life	Short term: 1-2 years; Medium term: 2-5 years; Long term: 5-10 years	Transformational: likely to require major changes within organisations; High: will have a high impact on the organisation; Medium: will impact organisation processes and services	Mainstream: well developed and main organisations are already implementing; Early adopter: some organisations are using already; Adolescent: discussed widely very few implementations; Emerging: academic and research and development only	Effect on existing workforce, skills needed: High: major shift in skills/jobs requiring urgent attention sector under threat; Medium: impact on skills/jobs but with changes sector can cope; Low: sector can cope
1	Artificial intelligence	Medium	Transformational: will facilitate hyper personalisation and hyper responsive itineraries, products & destinations	Early Adopter	High
2	Augmented Reality (AR)	Medium	Transformational: enables multi layered information in the visitor experience	Early Adopter	Medium
3	Blockchain	Medium	Transformative: a consumer can book directly with a hotel or airline through the execution of a smart contract	Adolescent	High
4	Cloud Computing	Short	High: SaaS (Software as a Service), PaaS (Platform as a Service); and IaaS (Infrastructure as a Service) underpin the	Mainstream / Early Adopter	Low

			capability of digitalised global tourism companies		
5	Cryptocurrency	Medium	High: direct payment, removal of forex intermediation	Emerging	Medium
6	Cyber security	Short	High: the industry deals with massive amounts of sensitive personal data	Mainstream	Medium
7	Data Analytics & Big Data	Short	Transformational: enables very high levels of tracking, personalisation, customisation and engagement.	Mainstream	Medium
8	Drones	Short	Transformational: provides unprecedented visitor collateral and media	Early Adopter	Medium
9	Face recognition & universal surveillance	Medium	Transformational: enables highest levels of safety, security and personalisation	Emerging	Medium
10	Inbound (two way engagement) marketing	Short	Transformational: builds customer loyalty and engagement	Early Adopters	High
11	Internet of Things & Smart (digitalised) visitor destinations	Medium	Transformational: a huge impact on businesses, automating processes without any human-to-computer or human-to-human interaction. Large scale volume of adoption and the ability to offer advanced interconnection and communication among devices, systems, and services.	Early Adopters	High
12	Location Based Services	Short	Transformational: an element of Smart Tourism	Early Adopters	High
13	Loyalty programmes	Short	Transformational: it is the key value proposition to most frequent customers & basis of much of current analytics	Mainstream	High
14	Mobile connectivity	Short	Transformational: enables almost all other transformational elements		

15	Multi Sided Platforms B2B, B2C (DIY), C2C (e.g. Airbnb)	Short	Transformational: the basis of most transactions, marketing & destination development	Mainstream	High
16	Omni channel Marketing	Short	Transformation: converts smart tourism into sales	Early Adopters	High
17	Rich media	Short	Transformational: linked to AR, VR and live streaming video	Mainstream	High
18	Social platforms	Short	Transformational: the ABC of visitor engagement, loyalty, verification and marketing	Mainstream	High
19	Virtual Assistants & Chatbots	Short	Transformational: will greatly reduce the need for human beings as information transmitters	Early Adopters	High
20	Virtual Reality (VR)	Medium	Transformational: will enable fine tuned marketing (e.g. room tours)	Early Adopters	Medium
21	Voice recognition	Short	Transformational: will remove need for screens & translation	Early Adopters	High
22	Wearable electronics	Medium	Transformational: will support behavioural tracking & analytics	Early Adopters	Medium

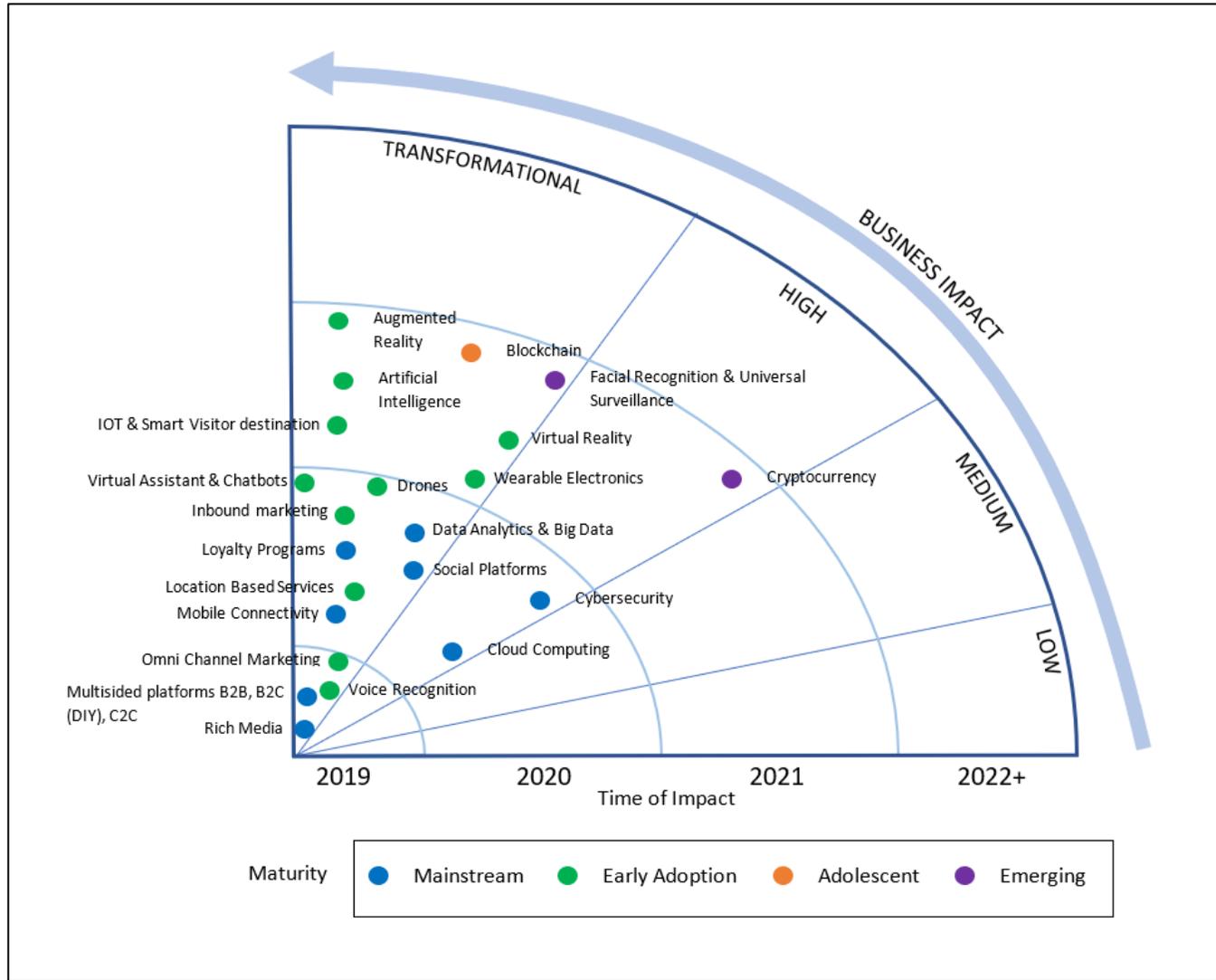


Figure 41: Business Impact Radar – Tourism – Based on Lookout 2020+ Technology Radar³⁴

7.4 Film, Media, Gaming and Animation sectors

Items	Digital Transformation Influencers (DTI)	Time of impact	Business Impact	Maturity of DTI	Skills Impact
Description	Digital Transformation Influencers (DTI) are technologies, innovations or paradigms that will (or already do) impact businesses and every-day life	Short term: 1-2 years; Medium term: 2-5 years; Long term: 5-10 years	Transformational: likely to require major changes within organisations; High: will have a high impact on the organisation; Medium: will impact organisation processes and services	Mainstream: well developed and main organisations are already implementing; Early adopter: some organisations are using already; Adolescent: discussed widely very few implementations; Emerging: academic and research and development only	Effect on existing workforce, skills needed: High: major shift in skills/jobs requiring urgent attention sector under threat; Medium: impact on skills/jobs but with changes sector can cope; Low: sector can cope
1	Big data	Short	Medium: Big data and predictive analytics of large datasets, will help organisations predict consumer behaviour and preferences, thereby assisting strategic decision making and content development.	Early adopter	Medium
2	Predictive analytics	Short	High: Big data, predictive analytics and machine learning are being used to enhance the video online experience. Enables content providers to understand how consumers interact with the content.	Early adopter	Medium
3	Cloud computing	Short	Medium:	Early adopter	Medium

			Service-Oriented Architecture, a digital supply chain and the cloud allow media companies a faster time to market: content to the right consumer, anywhere, anytime at lower costs. Video gaming: cloud computing's added processing power, some of the tasks normally associated with consoles and PCs can be offloaded to the cloud.		
4	On demand viewing (streaming). 5G services via mobile technology	Medium	Medium: Growth of video streaming and mobile video causing a move away from pay TV. Examples, Amazon Prime Video, Netflix, Youtube and Pandora.	Early adopter	Medium
5	Second screen (multiple platforms)	Medium	High: A second screen is a second electronic device used by television viewers to connect to a program they're watching. A second screen is often a smartphone or tablet, where a special complementary app may allow the viewer to interact with a television program in a different way - the tablet or smartphone becomes a TV companion device. The second screen phenomenon represents an attempt to make TV more interactive for viewers.	Early adopter	Medium
6	Open souce (gaming)	Medium	Medium: Video game published under a free license that allows and enables everyone to inspect, modify, contribute to, and create derivative works from the source code	Early adopter	Medium

7	Wearable gaming technology (VR headsets, body suits, controller sticks)	Medium	High: Wearable gaming technology allows players to be deeply immersed in games and allows them to stand up and walk around in the game's map. Wearable gaming technology creates a fully immersive experience by creating halo deck like experience with the help of virtual reality and augmented reality.	Early adopter	High
8	Virtual Reality	Medium	High: Current VR technology most commonly uses virtual reality headsets or multi-projected environments, sometimes in combination with physical environments or props, to generate realistic images, sounds and other sensations that simulate a user's physical presence in a virtual or imaginary environment. A person using virtual reality equipment is able to "look around" the artificial world, move around in it, and interact with virtual features or items. Used in film, animation and gaming to enter into the created environment offering the view a 360 degree perspective.	Early adopter	High
9	Augmented Reality	Medium	High: Augmented reality (AR) is a live, direct or indirect view of a physical, real-world environment whose elements are augmented (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data.	Early adopter	High

10	Very high definition graphics and displays (gaming)	Short	High: Example: The 4K HD video display has a resolution of approximately 4000 pixels by 2160 pixels. This screen offers unsurpassed graphics, effects, clarity, sharpness and quality. In gaming, when used with 4K content, the results are almost lifelike.	Early adopter	High
11	Gesture control (real sense technology and 3D cameras) (gaming and animation)	Medium	High: Gesture recognition is a type of perceptual computing user interface that allows computers to capture and interpret human gestures as commands. Gesture recognition is an alternative user interface for providing real-time data to a computer. Instead of typing with keys or tapping on a touch screen, a motion sensor perceives and interprets movements as the primary source of data input. In vision-based interfaces for video games, gestures are used as commands for the games instead of pressing buttons on a keyboard or moving a mouse.	Early adopter	High
12	Voice recognition technology (gaming)	Medium	High: The game recognises natural speech as opposed to requiring players to stick to simple commands. The game recognises different ways of saying a certain phrase or responding to a prompt need to be considered. Voice recognition makes games more immersive, feel more real, and therefore enhances the experience of the players.	Early adopter	High

13	Facial recognition / facial performance capturing and 3D scanning (gaming and animation)	Medium	High: Use of facial recognition to monitor video game players' emotions as well as security clearance to play certain games (China). Example: 3D scanning and facial recognition technology allows systems to actually create the players likeness for gaming puposes (a custom Avatar that looks just like the player), or to inventively transfer the person's expressions to other digital creations. A 3D camera could allow developers to create games that adapt to the emotions of the gamer by scanning 78 different points on a person's face.	Early adopter	High
14	Deep reinforcement learning (gaming)	Medium	High: Deep Learning is a subset of Machine Learning that trains a computer system to iteratively perform calculations so that it can determine patterns by itself. Deep Learning classifies, clusters and makes predictions based on the extracted data.	Early adopter	High
15	Blockchain	Medium	High: Used for royalty tracking, collections, the control of piracy and copyright infringements. Blockchain maintains a record of transactions through the various stages of the digital distribution channel.	Early adopter	Medium
16	Cyber security	Medium	High: The prevention of online fraud and theft of confidential information.	Early adopter	Medium

17	Drone technology (film)	Short	Medium: Aerial photography and live video streaming are being used in the film and media industry	Early adopter	Medium
18	OTT (Over the Top).	Short	High: Over the top (OTT) is a term used to refer to content providers that distribute streaming media as a standalone product directly to viewers over the Internet, bypassing telecommunications, multichannel television, and broadcast television platforms that traditionally act as a controller or distributor of such content. Examples Netflix and Showmax.	Early adopter	Medium
19	Crowd sourcing / funding through audience interactive communication and social media	Medium	Medium: As films begin to incorporate crowdsourcing to fund their projects, the making of films is becoming a collaborative, community-driven process. Allowing interested people to participate in the creative process.	Early adopter	Medium

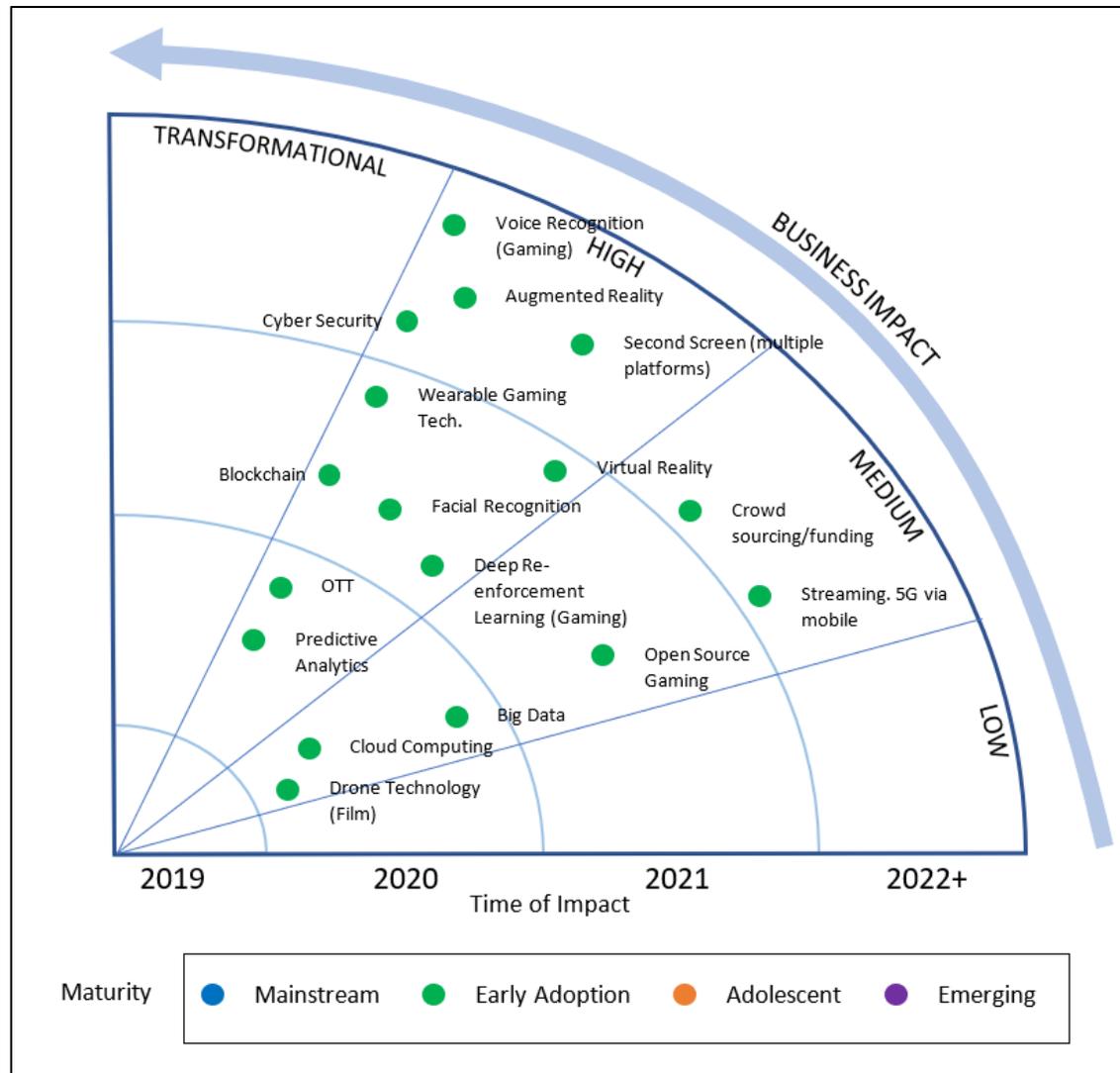


Figure 42: Business Impact Radar - Film, Media and Animation – Based on Lookout 2020+ Technology Radar³⁴

8 Summary

The “As-Is” report, and this “To-Be” analysis, present an overview of the digital skills environment characterised by the following:

- The need for digital skills merely to participate in the economy, and to be employable. Digital literacy is no longer enough to obtain access to formal employment. Staff will need to continually learn and develop new skills as business and society is engulfed by the Fourth Industrial revolution. The kinds of jobs available for people to pursue, and the very nature of work, are headed into uncharted directions.
- A current requirement by businesses to hire or develop staff with appropriate digital skills, with demand currently not being met, especially at the intermediate and high end. Digitally capable staff are (or will be) needed by all companies just to survive and compete, let alone thrive in the local as well as global marketplace. This requirement is only going to grow.
- A constantly shifting skills landscape. The specific skills that are in demand at any time are continuously evolving to keep up with new technologies, business models, and business methods. These in-demand skill-sets are characterised by a continual drift towards ever more advanced and developed skills.
- A global marketplace for people with more advanced digital skills: just as locally developed talent may leave, so the Western Cape must position itself to attract talent as well.
- A complex skills development ecosystem with multiple actors, including schools (private and public), institutes of higher education (private and public), SETAs, MOOCs, personal learning and professional development, and on-the-job training and experience providers, among others. Many of these have a long “lead-time” to produce qualified individuals with specific digital skills, but those individuals with a sufficient foundation can pivot towards new opportunities by acquiring further skills in a much more agile way.
- Many parts of the skills development ecosystem are sub-optimal, leaving large numbers of working-age local people out of the digital work environment (which means out of almost any formal employment).

Given that the enablement of the Western Cape as a globally competitive digital hub also requires a wide range of other factors to be present, what would the skills environment in particular look like for this to come about?

A globally competitive digital hub must have access to a:

1. **Skills pool:** A pool of people that collectively has the wide range of digital skills required by business, whether as specialist ICT skills or as broader digital user skills.
2. **Flexible skills supply:** A continual supply of digitally-skilled employees (whether produced by the formal education sector, or through self-development, or by migration in to the region), that is sufficient in volume and quality to ensure that the “skills demand gap” is first reduced and then remains narrow, without any reduction in demand (i.e. the skills gap is not reduced because businesses fail or move away).
3. **Dynamic labour market:** A dynamic employment environment allowing and encouraging people to move jobs, roles, and employers easily, including encouraging people to move into the region (from elsewhere in the country, Africa, or the beyond), accepting that people will also move in the other direction as well.
4. **Supportive Skills Ecosystem:** The supporting structures, institutions, services, and social culture that encourage and enable individuals to continually learn, grow their skills and capabilities, and act entrepreneurially on a lifelong basis, so that as some move “up” and eventually “out”, others can easily move “in” and then “up”.

At any given time, the overall result should be a close match between the supply (and availability) of digital skills, and the local demand for them, even as this demand grows in size and velocity, and in directions that are inevitably uncertain.

9 Annexure A – Survey Questions

Q1. Which of the following sectors best describes your primary field of business?

- a. Retail
- b. Tourism
- c. ICT Services
- d. Financial Services
- e. Media Services
- f. Other
(please specify) _____

Q2. Which of the following options best describes your role in your company?

- a. Senior Management
- b. Human Resources
- c. Operations
- d. IT
- e. Other
(please specify) _____

Q3. Do you have plans to expand your ICT operations (by increasing ICT budgets, implementing major technological changes, or adding more ICT practitioners) within the next two (2) years?

- a. Yes
- b. No

Q4. Are you planning any significant (digital skills) upskilling or re-skilling of your workforce, or employees, in the next 12 months?

- a. Yes
- b. No

Q5. What do you believe are the top five (5) Technology/ ICT areas that will have a significant impact on your company in the next five (5) years?

- | | |
|-----------------------|-------------------------------|
| a. Virtual Reality | i. Blockchain |
| b. Big Data | j. Artificial Intelligence |
| c. Cyber Security | k. 3D Printing |
| d. Augmented Reality | l. Robotic Process Automation |
| e. Data Analytics | m. Quantum Computing |
| f. Machine Learning | n. Robotics |
| g. Cloud Computing | o. Other |
| h. Internet of Things | (please specify) _____ |

Q6. From the Technology/ ICT areas selected in the previous question, what is the single most important Technology/ ICT area that will have the most impact on your company in the next five (5) years

Choice dependent on options selected in Q5.

Q7. Based on the previous answers, what do you anticipate to be the top three (3) most important Technology/ ICT skills/Digital Skills for your company in the next five (5) years

- a. Skill 1 _____
- b. Skill 2 _____
- c. Skill 3 _____

Q8. What is the most likely talent source of the Technology/ ICT /Digital Skills identified in the previous question?

- a. Universities
- b. Labour brokers
- c. Immigration
- d. TVETs
- e. Vendor Academies
- f. Other companies
(please specify) _____

Q9. Which of the following will be the most important for new hires in ICT roles in the next five (5) years?

- a. University Degree
- b. Demonstrated appetite for continuous learning
- c. Certified Online Courses
- d. Vendor Accredited Program
- e. Portfolio of work done previously
- f. Other
(please specify) _____

Q10. What do you anticipate will be the major challenge faced by your company in acquiring and keeping the appropriate Technology/ ICT/ Digital practitioners (select one)?

- a. Limited pool of skilled applicants
- b. High skill individuals moving jobs regularly
- c. High salary expectations
- d. Lack of experience of applicants
- e. Applicants having qualifications but not possessing the appropriate skill set required by the Company
- f. Poor skills set of applicants
- g. Lack of business/professional acumen

- h. Other
(please specify) _____

Q11. Select One (1) governmental intervention that, in your opinion, could assist in supporting the growth of digital skills in the region?

Support Internships or job-shadowing programmes to provide job experience

- a. Subsidise reskilling and upskilling of the existing workforce
- b. Improve Tertiary education and training (University and TVET colleges)
- c. Improve basic education and training (school level)
- d. Ease immigration requirements to attract skills
- e. Support bridging skills programmes, to enable graduates to become work ready
- f. Other
(please specify) _____

Q12. Select One (1) intervention by the private sector that, in your opinion, could assist in supporting the growth of digital skills in the region?

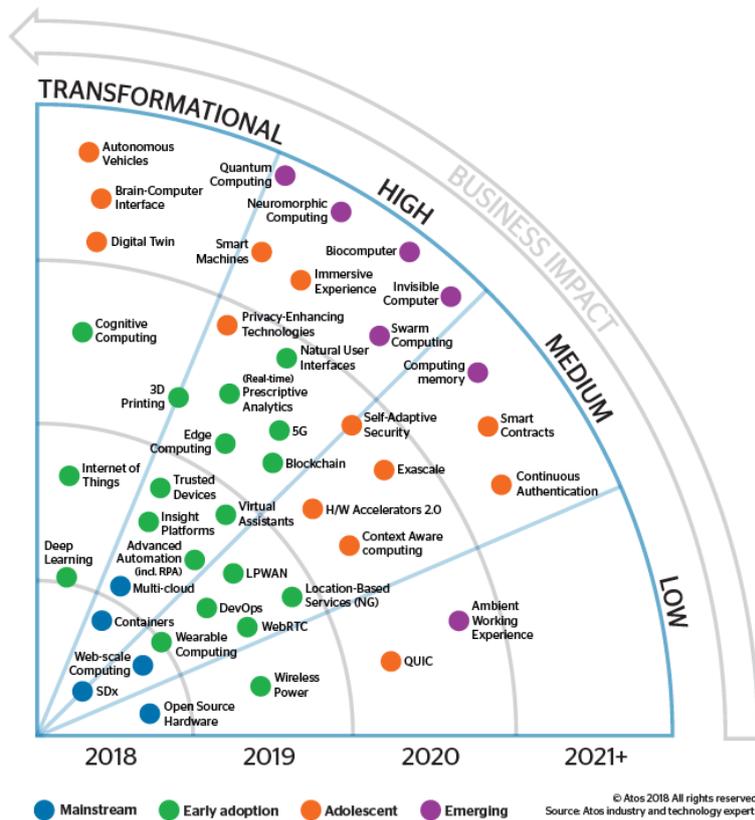
- a. Develop a closer relationship with academic institutions to match future demands
- b. Support bridging skills programmes, to enable graduates to become work ready
- c. Support reskilling and upskilling of the existing workforce
- d. Invest in developing private sector skills training institutes
- e. Support Internships or job-shadowing programmes to provide job experience
- f. Other
(please specify) _____

Q13. Please provide any additional comments/suggestions you would like to add.

Comments: _____

10 Annexure B: Extracts from global studies on transformative digital technologies

10.1 Look Out 2020+ Technology Radar



Look Out 2020+ Technology Radar: key technologies set to impact you in the coming years.

Want to know more? Examine the Look Out 2020+ Radar online to get deeper insights into these strategic technologies and understand the steps you should take today for success tomorrow: atos.net/lookout

Time of impact

- 2018** Look today at how solutions could address your needs.
- 2019** Consider potential solutions by running pilots, for example.
- 2020** Understand now. Consider potential implications and how these could be addressed in your strategic technology planning.
- 2021+** Follow for now. Watch how it's evolving.

Business Impact

- Transformational** Likely to require radical changes within organizations.
- High** Will have a high impact at work and in people's home lives.
- Medium** Will impact organizations' processes & services or affect users' & consumers' lives.
- Low** Will impact specific processes & services or affect some aspects of users' & consumers' lives.

Maturity

- Mainstream** There's a clear need and many clients are implementing solutions.
- Early adopter** Clients are starting to look for solutions.
- Adolescent** Discussed more widely by analysts and thought leaders.
- Emerging** Mainly seen in academia and a small number of specialized markets.

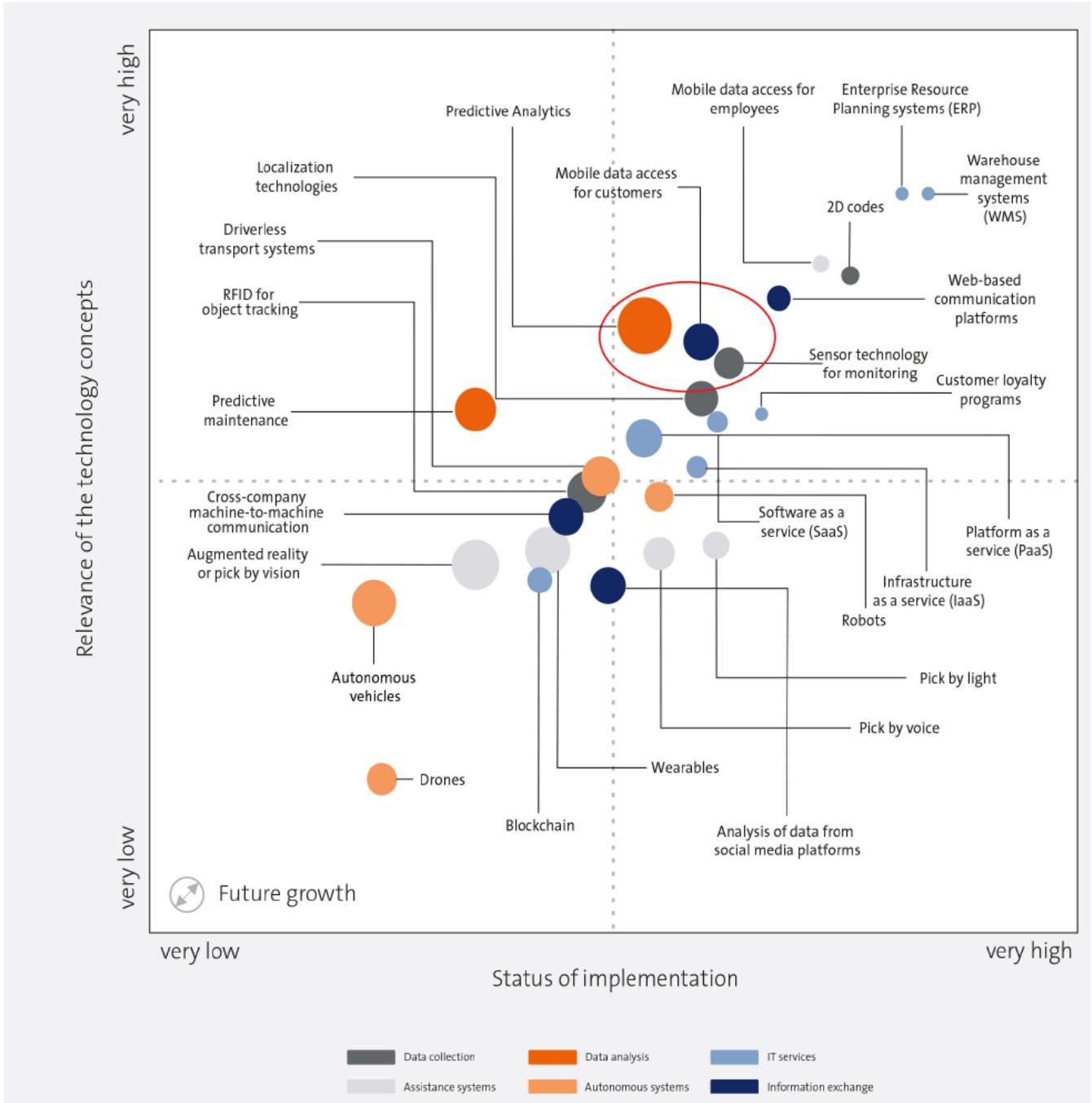
10.2 WEF: Technology adoption: specific technologies and industry sectors³⁵

Table 5: Technology adoption by industry and share of companies surveyed, 2018–2022 (%)

	Overall	Automotive, Aerospace, Supply Chain & Transport	Aviation, Travel & Tourism	Chemistry, Advanced Materials & Biotechnology	Consumer	Energy Utilities & Technologies	Financial Services & Investors	Global Health & Healthcare	Information & Communication Technologies	Infrastructure	Mining & Metals	Oil & Gas	Professional Services
User and entity big data analytics	85	84	89	79	85	85	86	87	93	65	62	87	85
App- and web-enabled markets	75	76	95	71	88	65	89	80	93	53	50	61	74
Internet of things	75	82	95	58	73	85	65	67	86	76	50	83	74
Machine learning	73	87	79	58	82	77	73	80	91	53	69	70	74
Cloud computing	72	76	79	67	67	73	65	73	91	71	62	78	76
Digital trade	59	68	68	62	82	58	70	53	70	47	50	57	59
Augmented and virtual reality	58	71	68	50	48	65	59	67	72	59	62	65	53
Encryption	54	58	53	25	42	38	73	67	67	41	25	57	53
New materials	52	71	32	79	79	65	22	60	30	82	62	83	41
Wearable electronics	46	61	53	46	45	42	49	73	49	24	25	70	35
Distributed ledger (blockchain)	45	32	37	29	39	54	73	67	67	18	38	48	50
3D printing	41	61	21	58	42	54	19	53	35	41	50	57	29
Autonomous transport	40	74	58	54	39	46	16	20	44	41	50	30	41
Stationary robots	37	53	37	50	42	35	27	47	35	35	38	52	29
Quantum computing	36	29	32	25	33	46	43	33	44	24	19	43	41
Non-humanoid land robots	33	42	26	21	36	27	32	40	37	29	25	30	24
Biotechnology	28	18	0	42	52	42	11	87	23	12	44	39	24
Humanoid robots	23	29	26	17	18	8	35	13	33	12	25	13	24
Aerial and underwater robots	19	18	16	17	12	35	5	0	19	29	25	52	21

10.3 WEF (& BVL Int.): Mapping technologies in relation to Supply Chain Management³⁶

Figure 3: The relevance and implementation status of the technological concepts studied ¹⁰



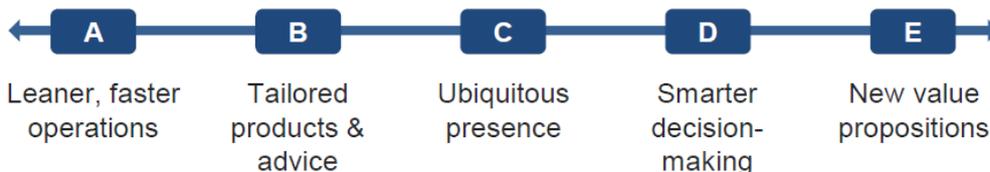
Source: BVL International

10.4 WEF: Key financial services opportunities enabled by AI³⁷



Doing the same thing, better

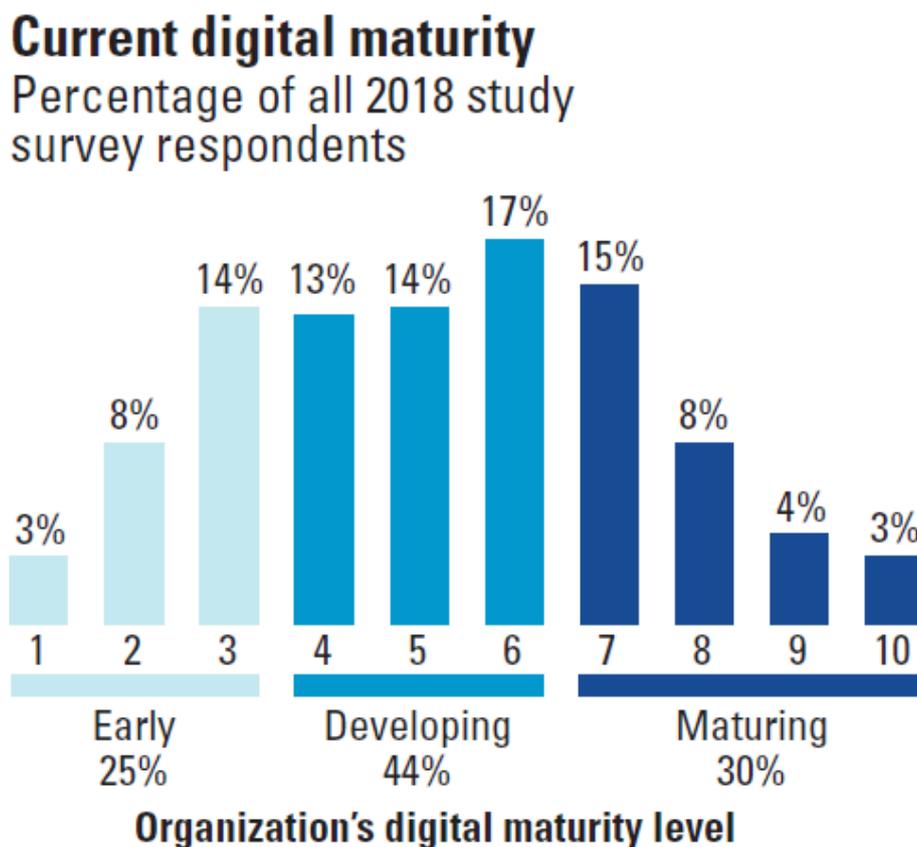
Doing something radically different



10.5 Spread of companies across digital maturity levels

The diagram below indicated the spread of companies across a number of maturity level, in this case 10 levels. The survey was undertaken by MIT Sloan Management Review and Deloitte, and included more than 4,300 managers, executives, and analysts, as well as interviews with a number of interviews with executives and thought leaders.

The question to the participants: “We asked respondents to “imagine an ideal organization utilizing digital technologies and capabilities to improve processes, engage talent across the organization, and drive new value-generating business models.” We then asked respondents to rate their company against that ideal on a scale of 1 to 10. Three maturity groups were observed: early (1-3), developing (4-6), and maturing (7-10).”³⁸



10.6 Moving towards greater maturity in the world of production/manufacturing, etc.³⁹

Achieving progress and moving towards increased levels of maturity will take different shape in different areas of implementation of 4IR skills. Thus, for example, in the area of technology-intensive agriculture, maturity levels might in many respects be different from the situation in a production/manufacturing or assembly context with high levels of advanced technology implementation.

In the case of production/manufacturing or assembly, the maturity model reflected below could be applicable.

Note that digitalisation only relate to the first two stages in this maturity model. ***The really significant benefits of the application of the new digital technologies are achieved only from stage 3 onwards.***

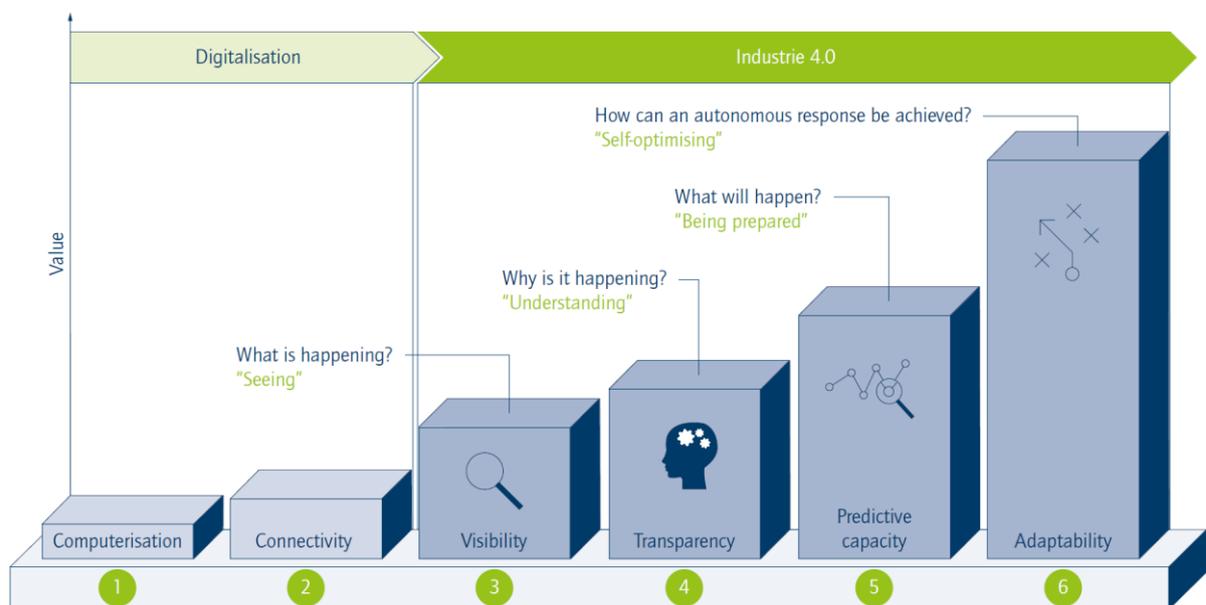


Figure 5: Stages in the Industrie 4.0 development path (source: FIR e. V. at RWTH Aachen University)

10.7 South Africa in terms of skills needed for the 4IR

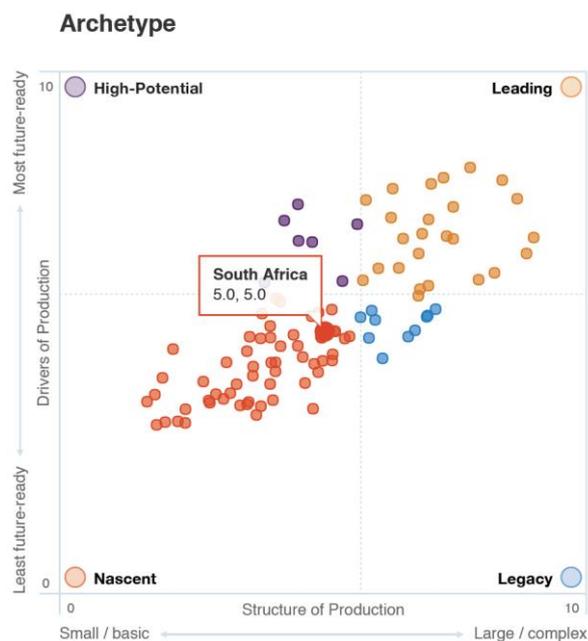
The *Readiness for the Future of Production Index* by the WEF provides a perspective that includes multiple factors involved¹⁵. The ranking covers 100 countries.

The Index distinguishes two components:

- * In the component “Structure of Production”, SA is on position 45.
- * In the component “Drivers of Production”, SA is on position 49, but within this component the rankings on the relative sub-components vary largely.

For more information on the sub-component “Human Capital” in the latter, see the third page of this Annexure.

Overall:



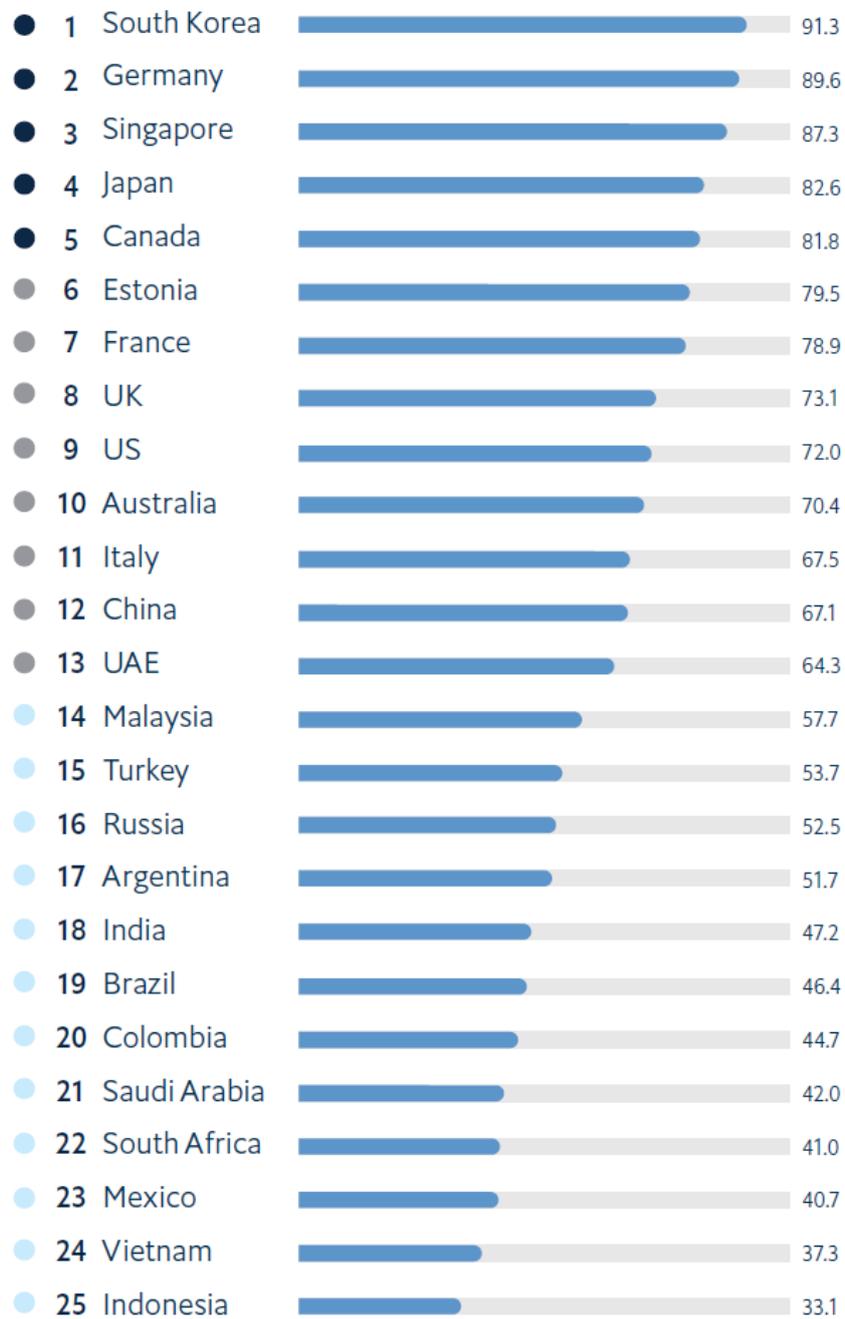
Region	Country	Structure of Production		Complexity		Scale	
		Score	Rank	Score	Rank	Score	Rank
	Croatia	5.50	37	6.97	28	3.29	72
	Indonesia	5.41	38	4.31	73	7.06	6
	Bulgaria	5.23	40	6.26	38	3.68	61
	Brazil	5.22	41	5.33	54	5.05	31
	Serbia	5.18	42	6.28	37	3.53	63
	Ukraine	5.17	43	6.05	41	3.85	57
	Saudi Arabia	5.16	44	5.43	50	4.76	35
	South Africa	5.03	45	5.35	53	4.55	40
	Egypt	4.99	46	4.90	61	5.13	29
	Costa Rica	4.97	47	5.61	47	4.01	53
	Viet Nam	4.96	48	4.37	72	5.83	17
	Latvia	4.91	49	6.49	35	2.55	79
	Argentina	4.91	50	4.71	62	5.20	27

Region	Country	Drivers of Production		Technology & Innovation		Human Capital		Global Trade & Investment		Institutional Framework		Sustainable Resources		Demand Environment	
		Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
	Cyprus	5.65	33	5.01	33	6.44	24	6.36	24	6.28	35	5.33	74	3.80	79
	Chile	5.60	34	4.36	50	5.32	46	6.02	31	6.91	24	6.87	31	4.89	48
	Saudi Arabia	5.44	36	4.50	44	5.21	48	5.41	50	6.19	38	5.00	76	6.19	19
	Latvia	5.39	38	4.54	42	5.63	37	5.64	39	6.42	33	8.44	7	3.45	89
	Mauritius	5.37	39	5.08	30	5.15	49	5.95	33	6.48	32	6.21	54	3.48	87
	Bahrain	5.31	41	4.43	48	5.60	38	5.96	32	6.26	36	4.78	81	4.16	71
	Oman	5.13	45	4.62	40	5.11	50	5.81	36	6.07	40	3.53	97	4.19	66
	Brazil	5.03	47	4.49	45	4.42	74	5.27	54	4.51	72	7.55	19	6.10	21
	Bulgaria	5.02	48	4.76	36	5.07	52	5.40	51	4.97	55	6.89	30	4.27	60
	South Africa	5.02	49	4.49	46	4.54	67	5.61	41	5.03	49	5.26	75	5.50	33
	Greece	4.96	50	4.10	57	5.33	44	5.36	52	4.89	59	6.61	41	4.62	54
	Croatia	4.93	51	4.23	52	4.92	58	5.54	46	5.27	47	8.15	11	3.54	84
	Viet Nam	4.93	53	3.09	90	4.48	70	7.00	13	4.99	53	4.59	87	5.22	39
	Georgia	4.92	54	5.02	32	4.46	71	5.48	47	5.95	41	4.40	92	3.47	88
	Jordan	4.91	55	3.92	63	5.50	41	5.15	56	5.63	45	4.80	80	4.17	70
	Costa Rica	4.90	56	3.87	66	5.67	35	4.19	76	5.87	43	6.94	26	4.23	64
	Panama	4.89	58	3.91	64	4.90	60	5.60	42	4.95	56	7.60	17	4.26	62
	Indonesia	4.89	59	4.00	61	4.99	55	5.06	61	4.59	69	4.09	94	6.38	15



Overall Index: ranks and scores

Average **62.1**



● Mature ● Developed ● Emerging

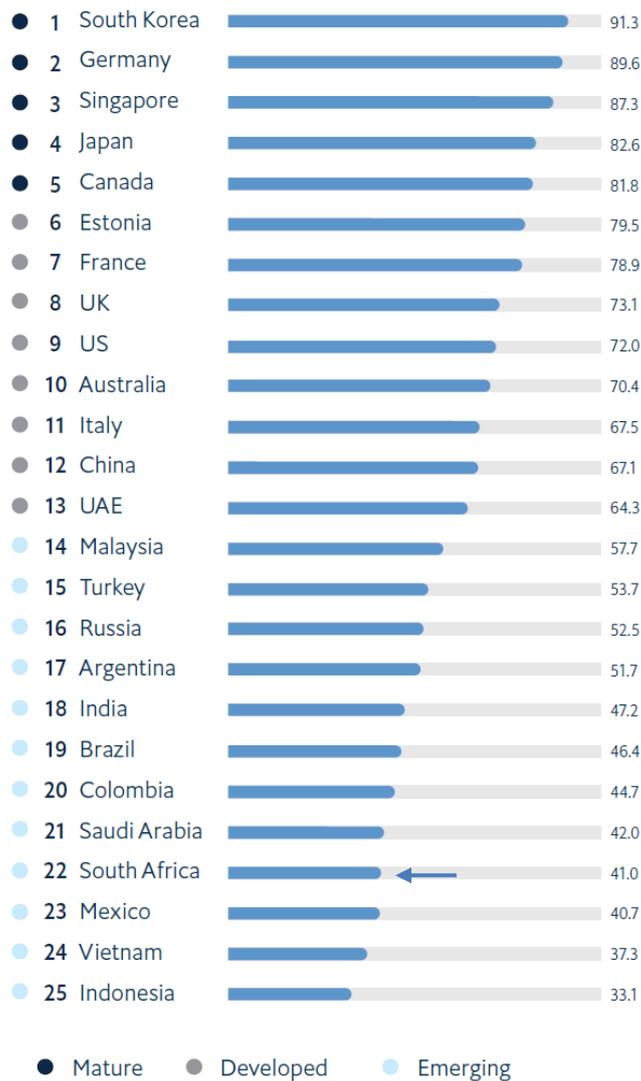
In regard to *Human Capital* (which carries a weight of 20% in the component “Drivers of production”), the following is applicable in the case of South Africa (the values are based on different measures for each element; of key importance is to look at the ranking out of 100, evidently with lower/smaller ranking position being better):

Index Component	Rank /100	Value
 Driver: Human Capital 0-10 (best)	67	4.5
Current Labor Force 0-10 (best)	53	6.0
3.01 Manufacturing employment % working population	54	11.2
3.02 Knowledge-intensive employment % working pop.	56	22.5
3.03 Female participation in labor force ratio	48	0.79
3.04 Mean years of schooling Years	45	10.3
3.05 Availability of scientists and engineers 1-7 (best)	86	3.5
3.06 Digital skills among population 1-7 (best)	94	3.3
Future Labor Force 0-10 (best)	78	3.1
3.07 Migration migrants/100,000 pop.	60	-1.8
3.08 Country capacity to attract and retain talent 1-7 (best)	61	3.3
3.09 Quality of universities Count	23	9.0
3.10 Quality of math and science education 1-7 (best)	95	2.6
3.11 Quality of vocational training 1-7 (best)	72	3.6
3.12 School life expectancy Years	65	13.3
3.13 Pupil-to-teacher ratio in primary education Ratio	90	33.6
3.14 Critical thinking in teaching 1-7 (best)	69	3.1
3.15 Active labor policies 1-7 (best)	88	2.7
3.16 On-the-job training 1-7 (best)	38	4.5
3.17 Hiring and firing practices 1-7 (best)	90	2.9

The *Automation Readiness Index* by The Economist Intelligence Unit focuses largely on the existence of appropriate policies and initiatives in 25 countries. In this way, they actually look towards the future, instead of working with existing statistics. In this index, South Africa is in position 22 out of the 25 countries covered.⁴⁰

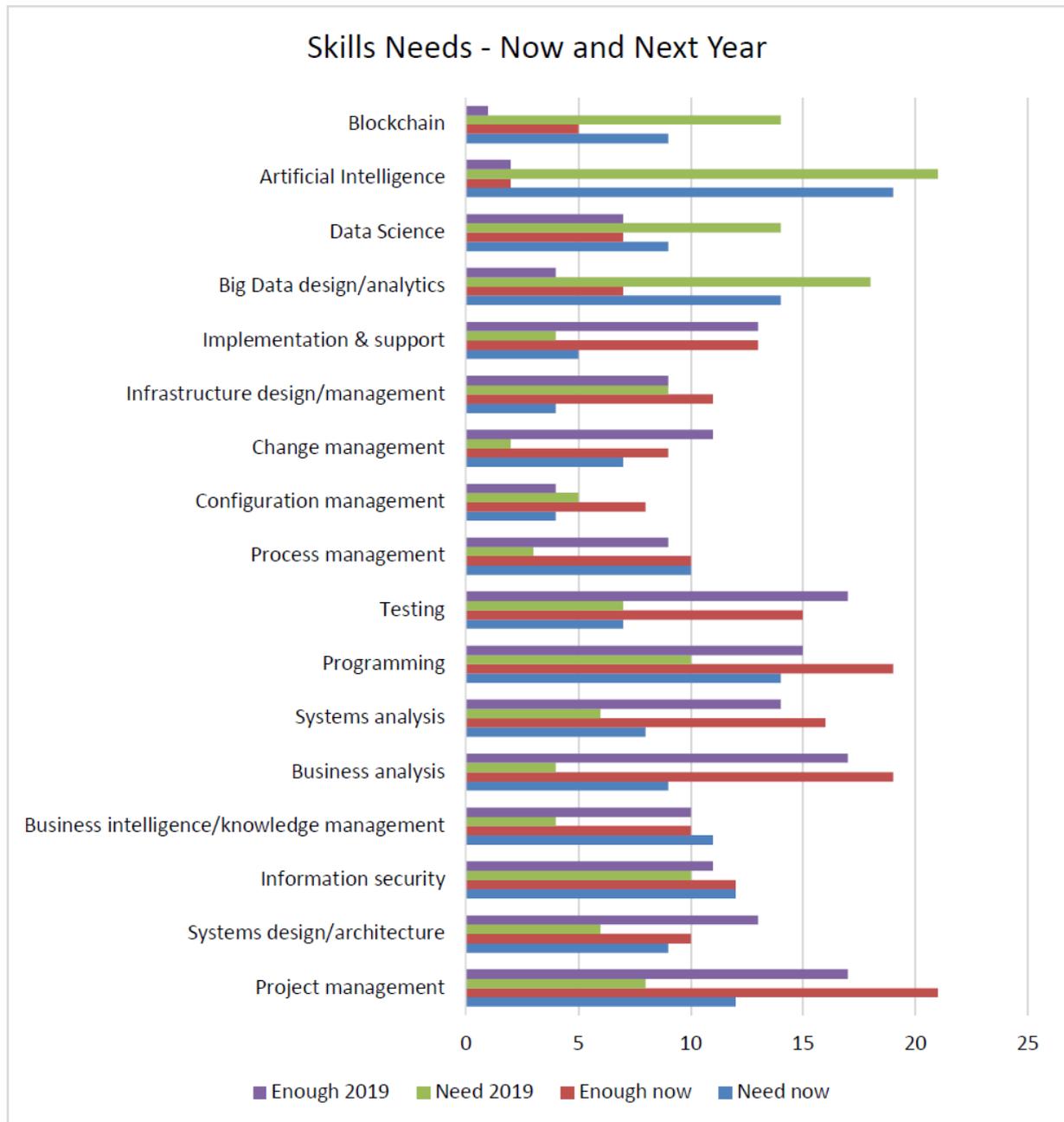
Overall Index: ranks and scores

Average **62.1**



10.8 The need for specific digital skills needs relating to TDTs (JCSE Report 2018)⁴¹

SKILLS NEEDS



For a future digital skills needs perspective, it is important to look at the green bars, indicating “Need 2019”. The blue bars indicate a need already identified in 2018; there might have been a shortage of skills in a specific area in 2018 already, for some respondents. (The large needs in regard to Blockchain, might have been the result of high interest, and little understanding by respondents in the organisations regarding cryptocurrencies. Possibly the prominence might have been less, after the changes in the cryptocurrency popularity.)

11 References, and Notes

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- ¹ Eurofound. (2018). *Game changing technologies: Exploring the impact on production processes and work*. Luxembourg
- ² OECD. (2018b). *Transformative Technologies and Jobs of the Future (Background report for the Canadian G7 Innovation Ministers' Meeting)*. Paris
- ³ Deloitte. (2018). *ACS Australia's Digital Pulse. Driving Australia's international ICT competitiveness and digital growth*. Sydney
- ⁴ WEF. (2018b). *The Future of Jobs Report 2018*. Geneva
- ⁵ Penprase, B. E. (2018). The Fourth Industrial Revolution and Higher Education. In N. W. Gleason (Ed.), *Higher Education in the Era of the Fourth Industrial Revolution* (pp. 207–239). Singapore: Palgrave Macmillan (Springer)
- ⁶ Hajkowicz S., Dawson D., "Digital Megatrends – A perspective on the coming decade of digital disruption", CSIRO, 2018
- ⁷ See State of the Nation Address, 2019
- ⁸ <http://www.theagileelephant.com/what-is-digital-transformation/>
- ⁹ For this over-arching use of the word cognitive, see Deloitte (2017).
- ¹⁰ One of the fastest-growing areas in robotics is that of the so-called "cobot", for "collaborative robot", robots that are intended to work together with humans in shared workspaces. In some areas the designation "Intelligent Assist Device" (IAD) is used for devices of this kind. These cobots can be anything from single arm devices doing repetitive work to sophisticated multi-function equipment, such as that used in some areas of medicine (surgery), where devices of this kind have become indispensable.
- ¹¹ This set of technologies includes much more than e-learning or first generation "learning management systems (LMS)"; intended, is primarily a number of new technologies that came to the fore in the past few years, centered around the concepts of "micro-learning" and "just in time" learning (also called "learning in the flow of work"). Making provision for learning in this way, is *an essential approach in the era of the TDTs*, where learning of the past becomes outdated rapidly, where new technologies require ongoing learning, and where the extent of information potentially to be learnt, is by far too much for once-off learning or for sending users of the technology on regular training courses. See Bersin (2018a).
- ¹² SFIA. (2018). *SFIA7. The complete reference guide*. London
- ¹³ Bersin, J. (2018b). *HR Technology Disruptions for 2018. Productivity, Design, and Intelligence Reign*. London
- ¹⁴ WEF. (2018a, p. v.). *Readiness for the Future of Production Report 2018*. Geneva
- ¹⁵ WEF. (2018a). *Readiness for the Future of Production Report 2018*. Geneva
- ¹⁶ EIU. (2018). *The Automation Readiness Index: Who is ready for the coming wave of automation?* London
- ¹⁷ Schuh, G., Anderl, R., Gausemeier, J., ten Hompel, M., & Wahlster, W. (2017) p. 34. *Industrie 4.0 Maturity Index. Managing the Digital Transformation of Companies (acatech Study)*. Munich
- ¹⁸ Nedelkoska, L., & Quintini, G. (2018). *Automation, skills use and training (OECD Social, Employment, and Migration Working Papers)*. Paris
- ¹⁹ Jim Phelps, 2018, p.34, "Scenarios, Pathways, and the Future-Ready Workforce", Educause Review
- ²⁰ See (Oblinger, 2018) and (UniversitiesUK, 2018) for clear recognition and acknowledgement of the problem and the need for a more agile response from universities on this matter, also in conjunction with industry/business.
- ²¹ <https://www.surveymonkey.com/>
- ²² "The average cost of a data breach in South Africa hits R36.5 million", Business Tech, 11 July 2018, <https://businesstech.co.za/news/it-services/257855/the-average-cost-of-a-data-breach-in-south-africa-hits-r36-5-million/>
- ²³ "Five massive data breaches affecting South Africans", Fin24, <https://www.fin24.com/Companies/ICT/five-massive-data-breaches-affecting-south-africans-20180619-2>
- ²⁴ "CapaCiTi calls for ICT firms to hire interns", IT Web, 12 December 2018, <https://www.itweb.co.za/content/8OKdWqDEGYgvbnzQ>

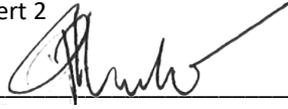
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- ²⁵ “Announcement: CiTi unlocks R250m to support technology skills and job creation in SA”, <http://www.citi.org.za/capaciti/release-capaciti-scale-up/>
- ²⁶ “Support SA youth to launch their tech careers”, IT News Africa, 9 January 2019, <https://www.itnewsafrika.com/2019/01/support-sa-youth-to-launch-their-tech-careers/>
- ²⁷ “UCT launches first specialist Fintech degree in South Africa”, 17 August 2017, <https://businesstech.co.za/news/it-services/193108/uct-launches-first-specialist-fintech-degree-in-south-africa/>
- ²⁸ “Standard Bank job cuts to hit executive, managerial bands”, Business Report, 15 November 2018, <https://www.iol.co.za/business-report/companies/standard-bank-job-cuts-to-hit-executive-managerial-bands-18125559>
- ²⁹ “Scarce and Critical skills in the publishing and print media sectors”; October 2006, Human Sciences Research Council
- ³⁰ OECD (Organisation for Economic Co-operation and Development). (2017) *Getting skills right: Skills for jobs indicators*. OECD Publishing
- ³¹ ManpowerGroup. (2017) Global talent shortages. Report. Available at: http://www.manpowergroup.com/wps/wcm/connect/21578885-8cd1-477b-a05a-8c88bbcb2a5e/ZA_4Q17+MEOS.pdf?MOD=AJPERES&CACHEID=21578885-8cd1-477b-a05a-8c88bbcb2a5e
- ³² Vijay R., Rogan M., Mncwango B., Chabane S., “Occupations in High Demand in South Africa, A Technical Report”, 2017
- ³³ “Workforce of the Future: The competing forces shaping 2030”, 2018, PWC
- ³⁴ Atos. (2018). *Look Out 2020+ Tech Trends. Which technologies will power your business tomorrow?* Bezons, France
- ³⁵ WEF. (2018a, p.16). *The Future of Jobs Report 2018*. Geneva.
- ³⁶ Lehmacher, Betti, Beecher, Grotemeier, & Lorenzen, 2017, p. 6. *Impact of the Fourth Industrial Revolution on Supply Chains*. Geneva.
- ³⁷ WEF. (2018c). *The New Physics of Financial Services. Understanding how Artificial Intelligence is Transforming the Financial Ecosystem*. Geneva.
- ³⁸ Kane, G. C., Palmer, D., Phillips, A. N., Kiron, D., & Buckley, N. (2018), p.7. *Coming of Age Digitally. Learning, Leadership, and Legacy (MIT Sloan Management Review. Research Report) (in collaboration with Deloitte Insights)*. Boston
- ³⁹ Shute, V. J., Sun, C., & Asbell-Clarke, J. (2017), p.16. Demystifying computational thinking. *Educational Research Review*, 22, 142–158. <https://doi.org/https://doi.org/10.1016/j.edurev.2017.09.003>
- ⁴⁰ EIU. (2018). *The Automation Readiness Index: Who is ready for the coming wave of automation?* London
- ⁴¹ JCSE. (2018), p.29. *2018 JCSE-IITPSA ICT Skills Survey*. Johannesburg.

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Dr Raven Naidoo.

SHORT TERM EXPERT: Expert 2

Date: 15 February 2019



Report Quality Assurance Review Completed by:

Mr/Ms ...

CBPEP AECOM TAT

Date:

Recommended/Not recommended

Mr... To include GTAC Project Manager

DIRECTOR:

Date:

Approved/Not approved

Comments