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South African ICT Skills Deficiency

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ABSTRACT

Information Communication Technology (ICT) is part of everyday life and the skills needed are quickly becoming a prerequisite for daily life. There is a dire shortage of ICT skills in South Africa and any attempt to circumvent this problem creates an even greater urgency. Several reports and much research have been conducted to establish the extent of the problem and many proposals and initiatives have been established to address it, but the problem seems to prevail. The aim of this study is to investigate the problems contributing to ICT skills shortages in South Africa, the initiatives in place to address it and to determine a possible need for skills by looking at other research and reports.

Keywords

ICT skills, ICT skills shortage, ICT skills needs, addressing ICT skills.

INTRODUCTION

The importance of Information Communication Technologies (ICT) has in today's business environment is increasingly being realized (Merkofer et al., 2009). It is said that "*Computing will be one of the fastest-growing job markets through 2018...expected to grow between 24%-32% through 2018.*" (Hoffmann, 2010: 19). ICTs encompass almost every aspect of our daily lives, therefore it is imperative for people to have basic skills or training in the utilization of technology as part of survival in the 21st century.

ICT skills make an immense contribution to the growth of the South African economy, but the shortage of ICT skills is impeding this growth. A considerable number of factors contribute to the problem of providing the required ICT skills to industry players (Merkofer et al., 2009).

Many definitions and explanations have been provided and formulated on what ICT skills comprise and what abilities are to be included in this definition. We will use the definition as provided by the South African E-skills Council. The definition of e-skills, as formulated by the European E-skills Forum, is also used extensively in research papers and is similar to the one used here and illustrated in the South African E-Skills Council's ICT skills pyramid (Vanska et al., 2008).

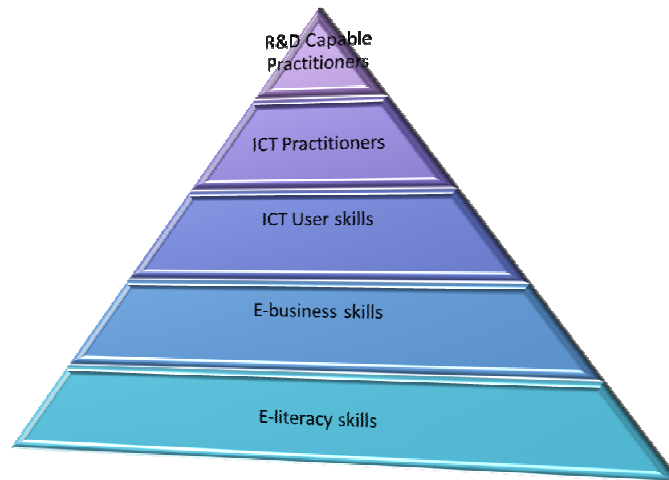


Figure 1: ICT Skills Pyramid

Each layer in this skills pyramid has been defined as follows:

- a. **R&D Capable Practitioners:** *Capabilities required for researching, designing and developing ICT systems*
- b. **ICT Practitioners:** *Capabilities required for researching, developing, designing, managing, producing, consulting, marketing, selling, integrating, installing, administrating, maintaining, supporting and servicing ICT systems*
- c. **ICT user skills:** *Capabilities required for effective application of ICT systems and devices by the individual. ICT users apply systems as tools in support of their own work, which is, in most cases, not directly related to ICT. User skills cover the utilization of common generic software tools and the use of specialized tools supporting business functions within industries other than the ICT industry*
- d. **E-business skills:** *Capabilities needed to exploit opportunities provided by ICT, notably the Internet, to ensure more efficient and effective performance of different types of organizations, to explore possibilities for new ways of conducting business and organizational processes, and to establish new businesses.*
- e. **E-literacy skills:** *Capabilities needed to socially appropriate ICTs for local development. This concept extends the digital literacy concept as defined by the European e-Skills Forum, namely that, “Being digitally literate implies being able to search and retrieve information to navigate and communicate on-line, to participate in digital and virtual communities. It is perceived as a key element in the battle to overcome social exclusion and division in the information society”.*
(Vanska et al., 2008)

For the purposes of this paper our main focus will be on (a) – (d) above, as they are considered to be the main contributors, in terms of ICT skills, to the South African business economy and ICT professionals in the particular industry.

PROBLEM STATEMENT

Insufficient ICT human resources exist in the South African business industry (Alexander et al., 2009). The inability of the education sector to provide these resources and the difficulty in determining the demand are but two of the reasons for this shortage, according to Alexander (2009). News articles report on the amount of cross industry job losses in South Africa due to economic difficulties and the staggering figures of graduates without employment (DPRU, 2006). These conflicting reports are a cause of great difficulty in determining the extent of the problem and in fact, whether there really is a problem.

A recent ITWeb publication indicated that ICT skills are the second most required profession at this moment, with the finance sector in first place. It was also revealed that ICT jobs are the fourth most difficult for which to find candidates (Mawson, 2011).

RESEARCH QUESTION AND DESIGN

The purpose of this research is to find out what the South African economy demands in terms of ICT skills at present. In Roode’s article (1993) a generic research question model in order to “*explore different aspects of the problem or situation at*

hand” is proposed (Roode, 1993). The different questions we could pose to look at our research questions from all possible angles are depicted in figure 2.

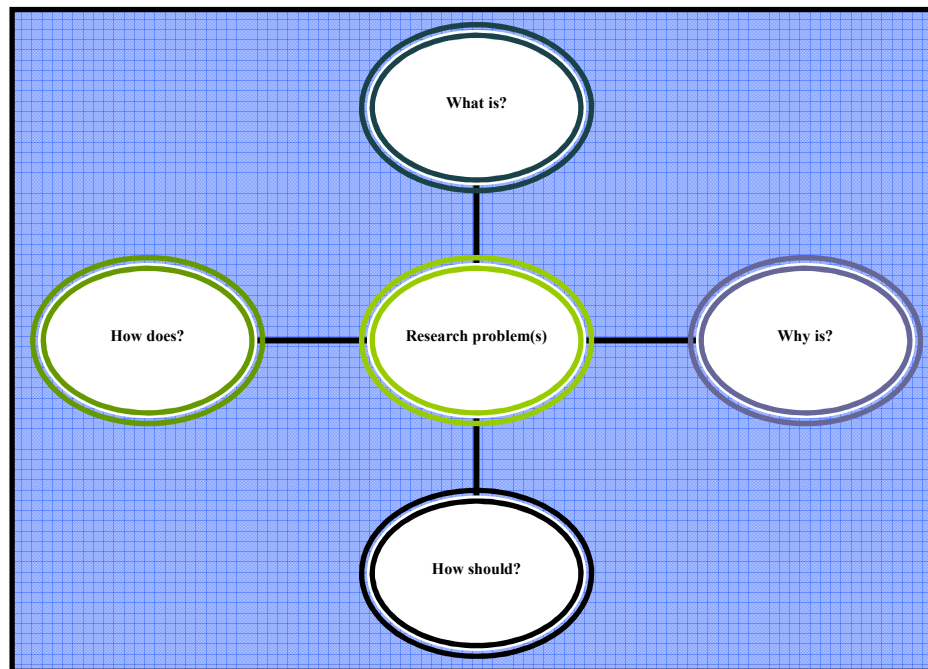


Figure 2: Generic research questions

This research is aimed at answering the following question and sub-questions:

What does the South African economy need in terms of ICT skills now?

- a) **What are** ICT skills?
- b) **Why is** there an ICT skills shortage (from an industry perspective)?
- c) **How should** ICT skills shortages be solved?
- d) **How do** ICT industry players overcome skills shortages?

The interpretive philosophical paradigm is applicable to this research as it “*is concerned with understanding the social context of an information system*” (Oates, 2006). Our aim is to understand ICT skills, why there is a problem, what we are going to need and how we are going to address this. We will be using qualitative data analysis i.e. understanding what the research participants say and interpreting the words they use rather than looking at numbers and figures. Another important characteristic about this type of research is the elucidation thereof. We do not anticipate reaching a single conclusion or understanding of the topic, but rather multiple interpretations and explanations of the situation.

Two data gathering endeavours were undertaken in order to meaningfully understand and interpret the research questions. The research method that was used in this research is questionnaires as a means of conducting a survey. These structured questionnaires were sent out to South African ICT business organizations. Finally an investigation was launched into the five most popular job advertisement websites with regard to the ICT vacancies to determine the most needed ICT skills at the moment. The questionnaires were placed on an online survey website and the link was sent to the research participants via e-mail. The population (ICT industry) had to be carefully selected to obtain results that would meaningfully contribute to the research.

LITATURE REVIEW

A considerable amount of research and reports regarding the ICT Skills situation in South Africa have been published since the year 2000 (Lotriet et al., 2010). These research reports address the urgency of skills shortages in South Africa and the

initiatives that are in place to try and circumvent these. It seems as if the skills shortage prevails and no viable solution has been developed yet. Academic articles that pertain particularly to the ICT skills situation in South Africa are scarce, with many of them reporting out of date and contradictory information (Lotriet et al., 2010). Various reports and articles will be used to provide the reader with insight into the work that has already been done and to place the research that will be performed within the context of this research topic.

ICT and the 21st century

Businesses are increasingly looking and relying on the improvement of business processes and mapping how ICT will play a role and support the transformation of the organization's business model in providing them with that competitive edge. It is said that industry and governmental institutions alike should strive for innovation, competitiveness and employability (also known as the 'ICE' triangle) in today's tough economic times (Lanvin et al., 2008). Because of the rapid rate with which technology develops and the fact that it is readily available and easy to distribute, the only way to sustain its competitive advantage is through the *innovative* ideas from the minds of the people working in the organization. It is quite apparent that having ICT, business processes and infrastructure alone will be of little benefit to the organization if there is insufficient human involvement; therefore - organizations are now competing for skills and talent (Lanvin et al., 2008). Being computer literate, whether it is performing basic day to day tasks with word processing, e-mail application or a more advanced use of technology for software development, is a prerequisite for almost any profession in today's business world. New words such as 'e-inclusion', 'e-competence', 'e-literacy' and 'e-readiness' have even been coined to describe this phenomenon (Lanvin et al., 2008).

Apart from the fact that ICT and its accompanying skills contributes to economic growth and human resource development, it also contributes to people being part of the 'global information economy and society' (Schmidt et al., 2008). Being able to make more informed decisions, to be more optimal in conducting business by for example making use of the internet, to form part of the 'information age' are all in some way associated with being e-skills literate. The problems described in the growing gap in the so-called digital divide and 'e-inclusion' are linked to the impediment of the growth of business organizations and also employees (Van der Vyfer, 2010).

Supply versus Demand

The supply versus demand issue must be one of the most generally cited problems contributing to ICT skills shortages in South Africa. In James et al. (2001)'s article a rather grim picture regarding the supply and demand issues that South Africa is faced with is brought to the attention of the reader. Factors unique to the South African context create an even higher urgency to address the issue. The increasing number of people being diagnosed with HIV/Aids, Broad-Based Black Economic Empowerment (BBBEE) and the very poor percentage of people with degrees or any form of higher education are only a few to be mentioned here (James et al., 2001). As a developing country, having sufficient infrastructure available to support the development of these skills may create some challenges (Merkofer et al., 2009).

The supply of ICT skilled workers stems from secondary education system's inability to provide the basis for ICT training (Census at School, 2009). Census at school (2009), a research initiative by Statistics South Africa in conjunction with the Department of Education has published the following in their 2009 results: only 24.6% of schools had a library, 53% had a computer (with no reference to a computer lab or what it is used for) and less than 15% had access to e-mail or the Internet. Only 5% of South African schools present ICT as a subject. These are indeed alarming figures, considering the fact that we are supposed to be living in the information age. The school goers of today will be the next generation to enter the ICT industry, it is therefore imperative that ample exposure to technology is provided early on. Without access to computers, the ICT skills shortages issue is almost a lost case. To the knowledge of the researchers a newly available survey hasn't been conducted since 2009, but they anticipate that a considerable amount has been done to address this. The fact that there is a discrepancy with regard to the standard of training that school goers receive and the divide that this is creating, leaves tertiary education institutes with additional challenges. Another worrying attribute with regard to the supply of technology workers is the small number of school learners who enrol for subjects such as mathematics and science that are critical prerequisites for ICT related degrees (Makapela, 2007). In the same survey it was established that only 68% of schools had a Maths teacher (Census at school, 2009). In August of 2004 the then Minister of Education presented a White paper on e-Education with the intention of ensuring that all South African pupils are "*ICT capable by 2013*" (PNC, 2010). Whether the projects described to be undertaken by government in order to achieve this, are successful is debatable.

Brain Drain

The migration of South African skills to more developed countries for improved work opportunities, circumstances and lifestyle poses as a further threat to the availability of ICT skills in the economy. The brain drain problem has been mentioned as one of the main obstructions in Africa's economical, technological and socio-cultural development . It is estimated that up to 20 000 skilled professionals leave Africa on a yearly basis (Ezema, 2010). Africa, Central America and the Caribbean have been mentioned as the countries with the highest rate of skilled professionals leaving these countries (Beine et al., 2008).

ICT Skills Initiatives

The 2008 – 2011 Scarce Skills list as prepared by the MICT SETA has released figures on skills that are most in demand now (Mopaki, 2009).

Job Title	Total
Computer Network and Systems Engineer	464
Developer Programmer	417
ICT Business Analyst	410
Software Developer	408
ICT Customer Support Officer	390
Team Manager	366
ICT Support Engineer	334
Computer Systems Technician	259
Software Engineer	215
Systems Analyst	167
Technical Support Services Manager	161
ICT Sales Representative	142
ICT Project Manager	134
Analyst Programmer	115
Database Administrator	111
ICT Security Specialist	102
Systems Administrator	102
Total	4297

Table 1: MICT SETA Scarce skills list

The 2008 National Scarce Skills list as prepared by the Department of Labour has also released figures on skills that are most in demand now (Department of Labour, 2008).

Job Title	Magnitude of Scarcity
ICT Managers	885
ICT Support Technicians	1630
Business and Systems Analysts	910
Multimedia specialists and Web developers	105
Software and Application Programmers	2890
Database and Systems Administrators, and ICT Security Specialists	220
Computer Network Professionals	820
ICT Support and Test Engineers	700
Total:	8160

Table 2: National Scarce Skills, 2008

By looking at the two tables above, one can readily see the discrepancy in the numbers and skills listed by each. Table 2 (Department of Labour) indicates much higher figures than that of Table 1 (MICT SETA). The skills breakdown is much more refined as prepared by the MICT SETA, than the list produced by the Department of Labour, the latter for example also indicates a much higher magnitude of scarcity for software and application developers. Both these institutions are believed to be credible sources of information, which reflect a really confusing situation.

Many initiatives by private institutions, government and even tertiary education institutions have been launched to try and address ICT skills shortages (Alexander et al., 2009). The success of these initiatives is to be questioned as the skills problem remain. There also seems to be a lack of standardization between them, and the question remains: why do multiple initiatives exist to address the same problem?

The key initiatives in place to address ICT skills in South Africa are:

- Ne-SDI (Ne-SDI, 2009).
- JIPSA (JIPSA, 2008)
- MICT SETA (MICT SETA, 2011).

ITWeb Skills Survey: 2008 – 2010

ITWeb (www.itweb.co.za), a leader in technology focused publications in South Africa, have been conducting research with regard to ICT skills from 2008. For the purposes of this research report we will have a look at the results of 2008, 2009 and 2010. For further information on how the research was conducted, the methodology and processes, the reports can be found online at the aforementioned website. One of the objectives of the study is to estimate the number of ICT employees in Southern Africa. The current figure stands at a 175 000, yet the study indicates that this figure is ‘open to debate’ (Jovanovic et al., 2011).

As part of the research done by ITWeb, participating companies were asked to categorize the importance of their ICT priorities. The results of the three years follow in Table 4 (ITWeb, 2008, 2009, 2010).

2008	2009	2010
1. Business Intelligence and Knowledge Management	1. Application Development	1. Application Development
2. Application Development	2. Business Intelligence and Knowledge Management	2. Web Development
3. Software as a Service (SaaS)	3. Network Infrastructure	3. Software as a Service, BI and KM

Table 3: ICT Priorities

It is expected and evident from this information that there has been a definitive change in organizations' ICT priorities. The change however is not that significant with Application Development and Business Intelligence and Knowledge Management still receiving much attention throughout these three years.

As part of the ICT skills survey, participants were also asked to identify the skills most lacking. Skills that have been identified as being in highest demand follow in Table 5 (ITWeb, 2008, 2009, 2010):

2008	2009	2010
1. Process Management	1. Testing Business Intelligence and Knowledge Management	1. Systems design
2. Business Intelligence and Knowledge Management	2. Systems Design / Architecture Project Management	2. System Testing
3. Business Analysis	3. Programming and Development	3. Business Intelligence / Knowledge Management
4. System Analysis	4. Business Analysis System Analysis	4. Business Analysis

Table 4: ICT Skills most lacking

The research suggests that Programming and Testing will be a skill short in supply in 2011. In the 2008, 2009 and 2010 skills surveys the Java, C# (C Sharp) and VB (Visual Basic) software development programming languages were constantly in high demand. This reveals the established nature of the technological platforms on which application development takes place.

Adrian Schofield, the author of the skill survey makes the following very important statement: *“We can expect that the growth in the country's economy will remain at relatively low levels for the foreseeable future, but this creates an opportunity for us to close the skills gap by improving the performance of our education institutions and honing the skills of the current employee base.”* (Jovanovic et al., 2011). He then continues by saying that it is extremely important that the skills shortages in South Africa receive attention to increase our competitiveness in the global marketplace.

The 3rd Software Engineering Colloquium held in Cape Town in 2010 reconfirmed the ICT skills shortage and even reckoned that it is becoming a catastrophe (de Beer, 2010). The author of the article makes the following valid statements: the South African ICT trade cannot look to all levels of government to provide a resolution to the ICT skills problem and universities and other tertiary education establishments are too slow to respond to the required skills need. The conclusion that was made here is that the ICT industry needs to take responsibility for the skills crisis *“through an ecosystem of scalable initiatives”* (de Beer, 2010).

DATA ANALYSIS AND FINDINGS

Industry responses

Of the 168 questionnaires sent out to the industry, 29 responses were received for a 17.3% response rate. Although the response rates from industry are relatively low, the researcher still believes that the data gathered could provide important information for the purposes of this research.

In the industry questionnaire, managers were asked what ICT skills were lacking most in their organization. The following results were obtained:

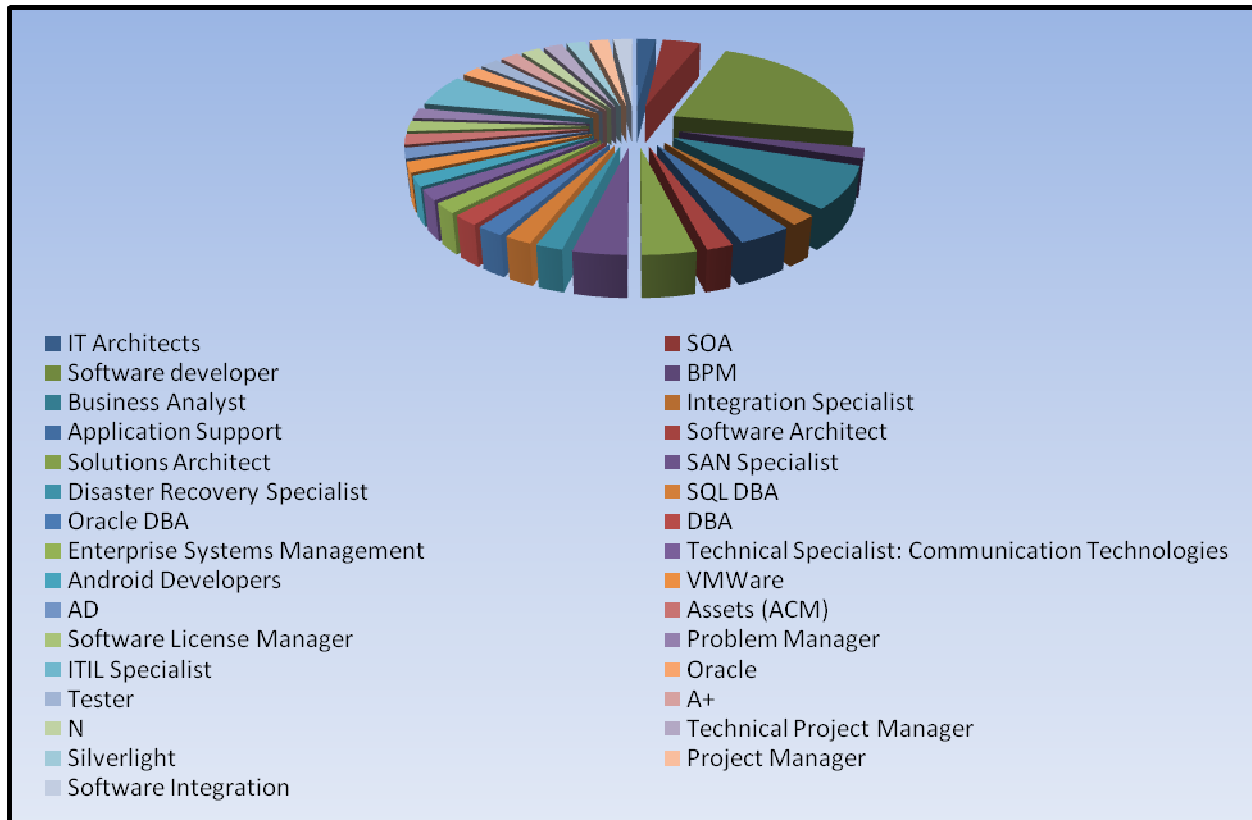


Figure 3: ICT Skills lacking most in organizations

From the data gathered the research identified 36 different skills lacking in the organizations that participated in the study. The top most skills that are lacking, were identified as:

- Software Developers followed by
- Business Analysts and
- ITIL specialists.

Respondents indicated specific programming languages that are required and were all grouped into the ‘Software Developer’ group. The following specific software developer skills were mentioned: C#, mainframe, Java, Apple IOS and SQL.

As can be seen, quite a range of ICT skills are lacking in organizations, even the – what is to be believed – ‘old’ mainframe developers are in demand. Many of the responses also included that they are in need of ‘senior’ skills. A rich understanding of business and data which assists with good design and configuration, combined with technical skills was also mentioned as a requirement. Another interesting factor that was found was that there is a necessity for ICT skilled persons in various technologies. Upon further investigation it was revealed that there is a need, for example, for a developer who is familiar with an object-oriented programming language together with a mainframe programming language. Many banks and even some governmental institutions still run on legacy mainframe systems, but there is a need to upgrade these systems to newer technologies. Legacy systems are characterized by their lack of documentation, there is therefore the need for mainframe programmers who are still able to read and interpret these old pieces of code in order to extract the business rules. Current mainframe programmers also find it necessary to upgrade their skills to something more recent. Cross platform skills i.e. being comfortable in a Microsoft and Linux/Unix environment are also an important skill requirement. The communication and analysis around business requirements was highlighted as very important, hence Business Analysts can be found at the top of the list.

CONCLUSION

What does the South African economy need in terms of ICT skills now?

What are ICT skills?

The South African E-Skills Council has identified five categories of ICT skills as depicted in the ICT skills pyramid, (Vanska et al., 2008):

- R&D Capable Practitioners
- ICT Practitioners
- ICT User Skills
- E-business skills
- E-literacy skills

For the purposes of this research paper we are mostly concerned with the first four categories of skills, although e-literacy is an obvious pre-requisite for the other skills. We also saw the inclusion of soft skills, business skills, technical skills and programming skills falling under the ICT skills domain (Aken et al., 2007). The importance of soft and business skills have been confirmed by industry survey responses.

ICT skills encompass numerous abilities and covers a wide variety of the industry, anything from the automotive, banking and governmental institutions are included. This requires industry and tool specific ICT skills, as many organizations use knowledge and tools tailored to their area of expertise.

ICT skills are indeed composed of a complex set of skills, as we saw in the job advertisement section of this paper where we identified almost 150 different ICT job titles being advertised within only a few months' time. Even the small number of responses from industry identified a myriad of ICT. Who knows what the ICT landscape will look like in five years' time? It seems, that the software development languages, business and system analysts' skills remain popular throughout.

Why is there an ICT skills shortage? (Industry perspective)

In order to address ICT skills shortages in South Africa we have to identify the underlying causes thereof. A number of topics, some of which are unique to the South African context, have been identified in the literature review, in previous research papers and has been reconfirmed in the data analysis and findings.

A graphical depiction on the aspects contributing to ICT skills shortages in South Africa as we discussed in the literature review and the data analysis, follows in Figure 4:

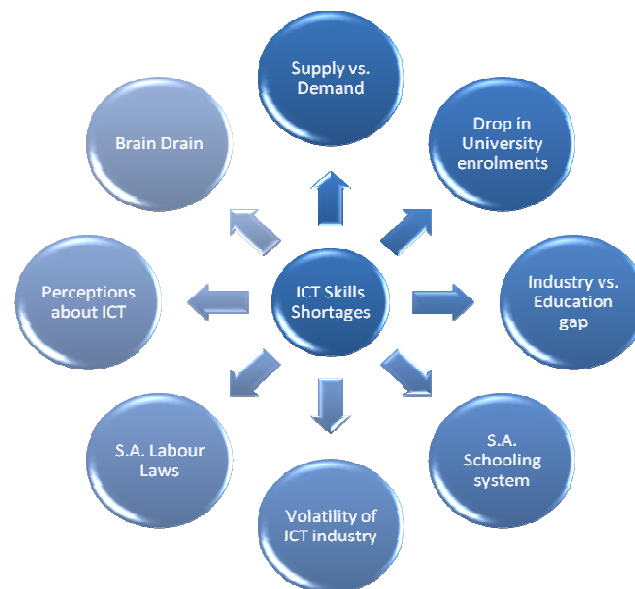


Figure 4: ICT Skills Shortages Causes

The aspects as depicted in Figure 4 are interlinked in some way or another and follow a bad chain of events. Because of the restrictions of the South African labour law on certain groups of people, many look for better opportunities elsewhere, hence the brain drain. This is of course not the only reason for skilled people leaving the country, the state of the economy and politics and other aspects as mentioned also play a part in this phenomenon. This in turn affects the ‘supply vs. demand’ as there is a decrease in the supply of ICT skilled workers because of the brain drain. The volatility of the ICT industry many times creates a negative perception in this field, this causes less students to be interested in this field and a drop in university enrolment rates. This – again – affects the supply and demand of skilled ICT workers. The unfortunate state of some of the secondary schools in South Africa and its inability to provide school goers with the necessary education for university admission also plays a role in the drop in university enrolments. These problems do not exist in isolation and by solving one of these, the solution may impact another and hopefully contribute to solving the problem piece by piece.

The research respondents who participated in this study were asked why they think ICT skills shortages exist and all of the aspects as mentioned in Figure 4 were confirmed.

Unfortunately many of the aspects contributing to the problem are beyond the control of tertiary education institutions and the ICT industry. We do however have some suggestions on addressing ICT skills shortages as gathered from the data analysis and findings, which lead us to answering the next question.

How should ICT skills shortages be solved?

There is no definite solution on solving ICT skills shortages, which is what we expected considering the causes, problems and research approach as discussed above.

The reader would note the inclusion of graduate / internship programmes as part of the literature review discussion and survey questions. Although very good suggestions were made from industry respondents, the researchers would like to believe that these graduate or internship initiatives, whether they are initiated from an educational perspective or industry, play a very important role in partly solving the ICT skills shortages crises. We do have to acknowledge that these initiatives are not available to all, but at least it is a great way to bridge the industry vs. education gap as well as introducing the graduate into the ‘real world’.

Changing someone’s perspective on something is often a very difficult task and even more so trying to make something more attractive, especially in the ICT industry. The researcher believes that the negative aspects regarding labour laws and the schooling system of this country lie within the hands of the Government and the appropriate action and changes need to come from them.

How do ICT industry players currently overcome skills shortages?

The ICT skills shortages in South Africa have required business organizations to take matters into their own hands and hence necessitate some drastic measures to be taken to overcome the problem. It is evident that the industry places a high value on a tertiary education. In the section on the ICT job advertisements one of the requirements on almost all of the advertisements was that of having an appropriate ICT related degree. Not only are the technical skills being taught at university important to industry, but also the other skills that come with such an education. These include soft skills such as communication, time management, ensuring a disciplined hard working person entering the vacancy.

Businesses have many ways of dealing with skills shortages as we gathered from the data analysis and findings. Sending employees on training courses is the obvious and expected method, however, this is resource intensive and is costing companies a lot of time and money. There was also a clear indication of resource partnering with other organizations – even offshore – in dealing with needed skills. Now, one has to think about the implications this has, for example, how many ‘skills’ a resource-partnering organization is willing to ‘share’ when one considers competition and strategy. Numerous comments and discussions were made around the necessity for universities and industry to work closely together in curriculum formulation and instilling a sense of practicality among ICT students. This seems to be a very viable option and is definitely something that can be investigated further.

Limitations of the study

Although some research with regard to ICT skills and shortages in South Africa has been conducted, many are unfortunately not published in an academically recognized journal. These research papers are mostly conducted by the ICT industry and government and some of these reports result in contradictory information. The lack of finding adequate research respondents to participate also poses a challenge to any research study. The researchers would’ve liked to involve more industry players within the study in order to gain a broader perspective on the ICT skills crisis.

Concluding Remarks

In the research conducted by Lotriet et al.(2010), the suggestion was made to form a ‘Research Methodologies group’ with “...professional researchers, academics interested in the matter, representatives from ICT professional bodies such as the Computer Society of South Africa and the research teams in the public services divisions.” as part of the group. This group should be following a research perspective in ensuring that research data is consistent, therefore obtaining research from the sources and using the most optimal research methodologies (Lotriet et al., 2010). The researchers believe that the formation of such a group would be beneficial to form a holistic view on the South African ICT landscape.

Many research reports on ICT skills have been published worldwide. A few aspects, as identified in this paper, would warrant some further investigation. Performing research on ICT skills will be ongoing as ICT skills will always be needed.

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