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Breeding ICT Skills for the Industries: The South African Experience

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Abstract. Skilled and competent personnel are required in the use of information and communication technology (ICT), for organisations' competitiveness and sustainability. Many organisations rely on institutions of higher learning to produce ICT skilled personnel for them. However, many of the graduates are said to be incompetent in their roles and responsibilities. In an attempt to close that gap of incompetency, some organisations source for postgraduate candidates. Unfortunately, the gap of ICT skill shortage seems to remain, leading to this study. The study was carried out in South Africa, one of African countries to examine and understand the extent, as well as impact of ICT skills in the country. Different approaches and techniques of research methodology, such as qualitative and quantitative, and interpretivism were applied in the study. As found in the empirical study, the underlying factors in the challenges of ICT skill short in South Africa are the gap between the qualification and competency. Other influencing factors include government interference, organisational need, and curriculum development and transformative scheme.

Keywords: Skill-set, Alignment, Curriculum, Organisational need, Environment trend

1 Introduction

Human resources, particularly skill set are fundamental to the development and growth of a country's economy. As such, in order for a country, including South Africa to develop sustainability, skill shortage must receive significant attention. This has never been an easy task by any standard, in any environment, and whether in a developed or developing country. An assessment revealed that different sociotechnical factors are involved in the fulfilment of the quest to bridge the gap of skill shortages [1]. Some of the factors often considered are either societal or governmental. Some studies attributed the challenges of skill gap to factors, such as ageing nature of employees which has impact on their growth; none availability of qualified individuals; cultural orientation; lack of retention strategy; and cost implication for trainings and retraining of workers [2], [3], and [4]. In the zeal to reduce skill shortage, there exist misalignment and of interest and requirements. This results to creating more gaps. Hamer [5] argued that the academia and industry expect

and produces two very different skills sets, respectively. Harmer therefore proposed that aligning the available skills sets can only result in positive outcomes.

Many organisations in Africa rely on fresh university graduates, and develop them further over time. Some organisations have various development strategies, through which they develop their employees, such as internships and mentorships programs. This is in order for them to gain the necessary skills and experiences as required by the organisation. Hamer [5] argued that internships, mentorship, and other cases in organisations can be used at the universities, but it is critical for the organisations to participate. The Mentorship programs would be a good solution to the skills gap as it assists with skill transfer of knowledge, however, companies still do lose skilled employees for various other reasons [6].

Poverty and previous disadvantage stems from political imbalance also contribute to skill shortage in many countries, Africa in particular. Johnston et al. [7] argued that South Africans that came from previously disadvantage background have poor primary and secondary schooling. In that study, it was argued that such poor background make it difficult for them to succeed in their higher education pursuit, contributing to the skill shortage in the country [7]. This argument could be considered to be fair, and attributed to the challenges some black South Africans uphold when it comes to finding job.

Skills shortage exists in every country, but worst in developing countries. Natarajan [8] presents statistics of global skills shortage: at the time of his study, in the USA there was a skills shortage of 126,000 in the nursing profession; a 615,000 shortfall of IT networking skills in Europe; 40,000 vacancies in the engineering sector also in Europe; and in India there were a shortfall of 500,000 ICT professionals. This could be argued to be relative to the population of the countries. However, the figures are still high, a case of one too many.

Many countries have developed initiatives and emphasis that the universities need to help reduce skills shortage. To skills shortage, the stakeholders from the industries in South Africa argued they notice poor performance by the Universities in the country, which according to them contributes to the high unemployment rate [9]. The assessment by Macgregor [9] has inspired organisations to invest on numerous strategies, such as short term training courses, internship, and mentorship, in addressing the challenges of skills shortage. After few years of such investment by many organisations in the country, fundamental questions are raised: What has been the return on investment of that front? Did the strategies invigorated brain drain? These are some of the questions that need to be answered with time. According to Haskins [10], the South African Institute of Measurement and Control, aim to contribute to addressing the skills shortage in the country, focusing on process control industry. The institute promote synergy between students and industry, and as such, is expected to help provide some statistics in answering the questions, overtime and in perspectives.

Skills are categorised to be either generic or specialised, and carries the ingredients of competency. They are a necessity in organisations' production and reproduction, for competitive advantage and organisational objectives. Haag, Cummings and Phillips [11] explained that companies require skilled people in the field of IT in order to be productive and innovative and thus give the company a commercial advantage over its competition. General skills are the same in many countries, including South

Africa. Saunders, *et al* [12] Skills gap focuses on specialized areas such as engineering, medical, nurses, and IT professionals. Leung's [13] list of the Global Knowledge top 10 IT skills in demand as follow: (i) Project management, (ii) Security, (iii) Network administration, (iv) Virtualization – cloud, (v) Business analysis, (vi) Business process improvement, (vii) Web development, (viii) Database management, (ix) Windows administration, and (x) Desktop support.

The paper narrows its focus to ICT which includes software development, network administration and database management. This is primarily because ICT is one the areas where Africans and its organisations are generally challenged in their search for skilled personnel. According to Barker [14], 33.7% of organizations are challenged with recruiting or retaining persons with IT business analysis skills.

2 The Roles of Society and Higher Education

On the other hand, institutions of higher learning, particularly Universities of Technologies pride themselves on having hands on approach in equipping graduates with industries related skills. Universities of Technology are supposed to align their curriculum with Industries' needs. Unfortunately, this is not often the case. This has contributed to unemployment, as some graduates find difficult or impossible to align their skills to job specification. Others are tagged unemployable.

To this extent, some of the organisations sources for skills from institutions of higher learning, for basic and minimum requirements, which are at undergraduate level. Higher skilled personnel, at postgraduate levels, are also sourced from institutions of higher learning, as well as from competitors. However there are still sizeable ICT skill shortages in Africa. This study was carried to understand the factors which causes skill shortages in

This study was undertaken based on the rationale above. The study investigated the skill gap between institutions of higher learning and Industries. The objectives include understanding the factors which influence the academic curriculums and the organisation's requirements, and why curriculums of institutions of higher learning are not in alignment with industry's needs and requirements.

3 Methodology

The approaches and methods that were applied in the study include a mix method of qualitative and quantitative, for data collection; and interpretivism for analysis of the data. The data was collected from the field, of industries which has employed at least 5 fresh graduates in the last 18 months, at the time of this study. Data was also collected from organisations which sought the service of internship students. As shown in Table 1 below, a total of 18 organisations and 117 individuals, at both senior and junior participated in the study. This includes fresh graduates and internship that were also consulted, to get their perspectives on their real-life hand-on experience. The organisations were from 5 different industries.

Table 1: Participants

Industry	Organisation	Participant (Individual)	Senior Employees	Junior Employees	Graduate/ Internship
Financial Institutions	FI-1	11	5	4	2
	FI-2	8	4	1	3
	FI-3	6	3	1	2
	FI-4	5	3	-	2
	FI-5	6	4	2	-
	FI-6	7	3	1	3
Government Institutions	GI-1	9	5	2	2
	GI-2	7	4	1	2
	GI-3	7	4	2	1
	GI-4	7	5	-	2
	GI-5	4	2	1	-
Energy and Mining	EM-1	5	4	-	1
	EM-2	4	2	1	1
	EM-3	4	-	2	2
Telecommunications	TELCOM1	7	3	2	2
	TELCOM2	6	2	4	-
Transport	TP-1	9	4	2	3
	TP-2	5	3	-	2
Total	18	117	60	26	30

The mixed data of qualitative quantitative were analysed, using the interpretive method, in accordance to the research questions.

4 Factors Influencing Skill Development

As in other countries, ICT qualifications are obtained from Universities and other formal training facilities in South Africa and outside the geographical boundaries of the country. The qualifications are obtained at different, from certificate, diploma to doctorate levels. Some qualifications are considered to be basic requirement in many organisations. This is sometimes attributed to jobs, roles and responsibilities.

Sufficiently, many candidates hold qualifications from Universities and other formal training facilities, yet statistics reveals that there is shortage of ICT skills in the country. Irrespective of the number of persons with formal qualifications, and the levels of qualifications, there exists challenge of competency. Many organisations assess the challenge of competency to be more critical. Such organisations had rather have quality than quantity. This has contributed to the continued search for candidates, from the perspective of the employers. This contributes to the unemployment figure.

Qualification does not automatically manifest into competency. It is an equation of $\text{Qualification} + \text{Competency} = \text{Skill}$. As depict in Figure 1, the skill development is an iterative process, in order to meet organisational needs. As organisational vision and needs change, employees are trained to have certain competency to achieving the objectives.

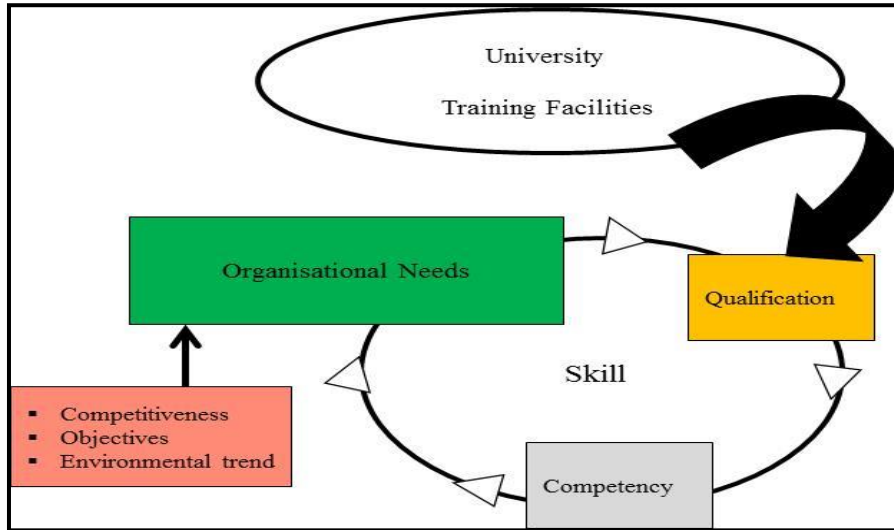


Figure 1: Skill Development

There are many factors that influence ICT skills development, from qualification stage to competence level, of individuals and groups. According to Gruba et al [15], there are factors which influence curriculum change. They include industries' viewpoints, competitive advantage (competition amongst the universities), financial pressure, and course accreditation. The factors considered to be most critical include government interference, organisational need, and curriculum development and transformative scheme. These factors are interlinked as depicted in Figure 1 below.

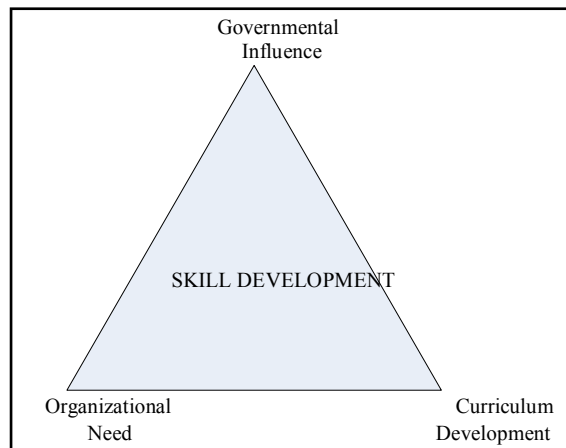


Figure 2: Factors Influencing Skill Development

The influencing factors as depicted in Figure 1 depend on each other in the course of developing skills in the country. The factors above are discussed in the remainder of this section.

4.1 Governmental Influence

The government influences are primarily either economic or political or both. The government influence is carried out through policies, rules and regulations. Also, the influence is either direct or indirect.

Some African countries including South Africa who were colonised by the British has based their education system on the Westernization system (Burger, S.a). For example, Australia and South Africa have similar education systems to that of England. African countries kept the colonial education system after their independence, but adapted the system to suit their environmental needs.

Within the context of skill development, South Africa is different to other developing and developed countries primarily because the country has recently had a political shift to a democratic state, which caused the education system to also change and it is still constantly changing. It is taking South Africa years (1994 – 2003) to find a schooling system that is equal for all. Few systems including the Outcomes Based Education (OBE) have been employed. Once the schooling system (foundation) has been stabilised, only then could a fair and equal system be realised.

The introduction of the OBE at the secondary school level, as well as the merger of Universities and Technikons (Polytechnics), brought another type of challenge to the education system in the country. The Traditional Universities including the Universities of Technology in South Africa are now faced with challenges of transforming their curriculum to suit the needs of the organisations, and the country at large. What is even more challenging is the fact that old techniques are being used to teach new initiatives. This has impact on both the educators and the learners.

The South African Department of Education divided its formal education into three sectors, namely: General Education and Training, Further Education and Training, and Higher Education and Training. Also, Sector Education and Training Authority (SETA) was established by the South African government in 2000 in an attempt to address the skills shortages in the country. The main focus of SETA is on quality of qualifications, they ensure that the learners are appropriately equipped and skilled. Through SETA, training centres with appropriate facilities were established across country.

The centres were aimed to assist organisations to train and prepare individuals for employment, so, the unemployment rate in the country could decrease. Therefore, the creation of FET colleges and the partnership with SETA started to address the skills gap in South Africa. The organisation established learner-ships programs to help alleviate the unemployment rate in the country and give people the opportunity to start their careers.

4.2 Organisational Need

Organisations have their individual goals and objectives, mission and vision for existence. The organisations are in various classified disciplines and industries such as Energy, Financial, Information Technology (IT), Manufacturing, and Transport. The factors which motivate the existence of organisations are enabled, supported and managed by specialized skill sets. The skill sets creates and supports competition and competitive advantage.

It is critical for the organisation and institution of higher learning to have a common understanding of job titles and its roles and responsibilities. For example, business analyst is defined and understood differently by both the organisation and institution of higher learning. As a result, a business analyst is often confused with technical positions such as a systems analyst or IT systems requirement engineer. A business analyst must have some technical experience to be able to translate what the user wants into a technical form that the programmer can understand. A business analyst is defined as an information technology worker who improves the efficiency and productivity of business operations through information systems. According to Evans and Hoole [16], a business analyst translates requirements, design process, manage skills and knowledge, and analyses system development.

4.3 Curriculum Development

Universities, both in developed and developing countries have different timeframes and causes for reviewing their curriculums. This is driven by factors such as societal (organizational need), and sustainability. Programs, whether accredited or not, should be reviewed at least once every five years. For accredited programs, the frequency should coincide with accreditation cycle. This is mainly to respond to rapid changes in the environment.

Industries require specialized skilled people to use the latest technology to give the company a competitive advantage and Institutes of Higher Learning are supposed to be training these specialized skilled people but they are not because Institutes of Higher Learning are not keeping up with Industries changes.

5 Skill Alignment Framework

Neither the universities nor organisation can achieve the goal to improve skill development alone by itself. Collaboration within a framework is needed. The collaboration should be a consortium, consisting of the primary stakeholders, which includes the university, organisations, and government, as revealed above. The roles and responsibilities of the stakeholders should be defined and reviewed overtime in accordance to the political, economy and social factors at the time.

Skills development could be achieved and supported through experiential training or institutions of higher learning (universities). Itin [17] defines Experiential training as the transfer of knowledge, skills, experience, between a teacher who is

knowledgeable in that environment and a student. Experiential training could take place at any level, and at any facility, other than the Universities. According to Fletcher [18], students should participate in real activities and experience the real consequences. Some Universities have created a module within their curriculum that allows the students to work in organisation (industry) of their choice but related to their field of study, for a set period of time. This is for the students to gain experience and hands-on practices from their learning at the university.

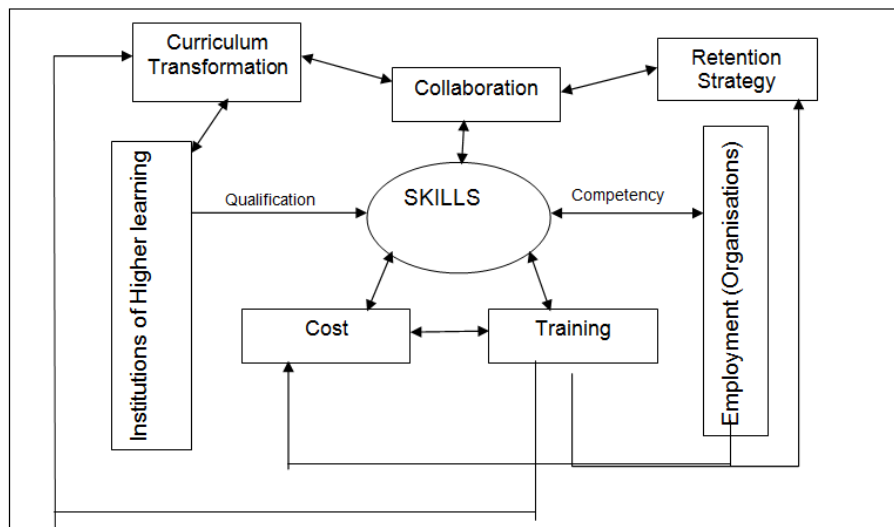


Figure 3: Skill Development

The skill alignment framework would require all participants (universities, government and organisations) to work together as one entity, to teach and prepare students for employment. As depicted in Figure 2, some of the factors required to carry out these tasks, and achieve the goal involved: cost, training, retention strategy, curriculum transformation and collaboration. The factors are discussed as follow:

5.1 Cost Implication

Cost is essential if the skill development is to succeed. Unfortunately, some candidate takes longer to develop and acquire the necessary skills for employment as required by different organisations. Likewise those that are employed also take longer to develop further. The time and other facilities that are used in the development can be cost prohibitive or scarce. As a result, it becomes a serious challenge for one entity to embark on it alone. Hence collaboration amongst the primary stakeholders is crucial.

On another front, if a limited number of employees is adequately trained for a certain type of job, that company would be facing a high risk of staff turnover. That would mean that companies will have to offer their employees more incentives and rewards, such as salary increase in order to keep the skilled staff. Otherwise, the

employees would leave to pursue other more beneficiary and challenging employment elsewhere. This leads to a higher cost of sustainability for the company. Also, this can be attributed to the company's low return on its investment.

5.2 Training

Continuous training and mentorship are critical in the pursuit to closing the skill gap. Training at various levels from the schooling to working environment with the aid of government and organisations contributes to the reduction of skills shortage in the country. For example, a mentoring program between the Australian Library and Information Association and the Queensland University of Technology was created to help postgraduate students prepare for their careers [19]. The mentorship program was a formulated collaboration amongst: a professional association, the educators, practicing professionals, and the potential employees. The aim was to prepare the candidates for employment in various fields for their career. This was done while the students were still at the University, and about to enter the job market.

Training at any level requires many factors, such as time, cost, and interest. The factors are not easy to come by as seen from afar. They require some political will, social influences and economy implication. It is difficult to separate the factors from one another. Time and cost are invested because there is interest, and interests are pursued with resources, such time and finance. Also, finance is used to acquire resource of interest, which is aimed to save time.

5.3 Retention strategy

Many companies are reluctant to send their employees for further training, to improve and enhance their skills. This is attributed to the costs involved, as they are sometimes challenged with return on investment. Other organisations are sceptical because they might lose the employees to their competitors. Haskins [10] argued that companies are required to increase their effort to recruit and retain trained workforce, for competitive advantage. According to Saunders et al [12], the importance of training and creation of a learning environment contributes to the success and competitive advantage.

In the process of keeping and holding-on to workforce, many organisations have adopted retention strategies, which involve factors such finance and cost. The retention strategy impacts different levels and area disciplines within the organisation that deploy it. Some of the organisations adopt the mentorship program to identify personnel for retention.

In some organisations, it is argued that the mentorship programs are timely and not a cost effective solution for bridging the skills gap in both short and long terms. Teaching and learning takes and consumes resources and time, which is equated and valued to money. Companies are willing take the responsibility, but the fear of brain drain remains a disturbing factor. It has been of high risk in the last decade. Once the person has gained the necessary knowledge required, they leave the company for

better opportunities. If the curriculum in institutions of higher learning is continuously transformed, there little or no need for retention strategy or fear of brain drain.

5.4 Curriculum Transformation

Some countries, as well as universities are expected to take the lead in addressing the skills gap at both short and long terms. One way of doing so is for the universities to be transformative in their curriculum. The transformation of curriculum should be imbibed as a culture, only then, the approach and can survive at a longer term. The aim is for the transformative process to evolve and adapt to the constant environmental changes.

Students are more interested in Universities that could assist them find employment. This conclusion is based on curriculum assessment by the students. Maharasoa & Hay [20] argued that students choose a University based on the courses offered, especially if the student is guaranteed a job at the end of the course. Students are more interested in working towards a chance of being employed than having a degree and being unemployed. This notion could be attributed to one of the reasons why students often would prefer a University of Technology (or polytechnics) to traditional university. The University of Technology (or polytechnics) seem to focus more on what industry needs. For example, some Universities of Technology constitute an advisory board, made of academics and professionals (industry personnel). The primary aim of the advisory board is to guide and advise the university on course contents. Based on the guidance and advice of the board, curriculum of courses are frequently reviewed and transformed.

Another approach through which curriculums could be transformed is continued research on curriculum matters. Currently, there seems to be limited research studies on curriculum matters, particularly in the areas of computing and engineering. Curriculum transformation would help mainly because many institutions of higher learning are sadly not up-to-date with factors of changing social needs, intellectual and technology trends, and industries' competitive need.

The concept of cooperative learning at institutions of higher learning is fundamental to curriculum development and transformation. Cooperative learning is the exposure of students to the industry 'real world' and practical environment. The assessment of students during this period is vital for curriculum development and transformation. It assists the institution to shape and reshape its content in preparation of students.

5.5 Collaborative

Closing the skill gap in any community or the country at large requires collaboration of the primary stakeholders, which include learners, educators, organisations and government. The collaboration is aimed to solidify the empowerment of institutions of higher learning and organisations towards achieving the same goal. It assures the quality of the products, thus improving the attractiveness for employability of the qualified student (graduates).

The role of the government is critical. The roles could be carried out through different means and methods such as policies and programs. For example, the department of Education in South Africa has imposed on all institutions of higher learning (Traditional University and Universities of Technology) to adapt and improve and transform their curriculums before 2014. This is to ensure that the curriculum aligns with the general needs of the country. This policy requires collaboration of organisations, the government and the focal actor, universities. This is aimed to improve poverty alleviation through fostering sustainability and development.

6 Conclusion

Specialised skills are needed in organisations for competitive advantage, and in the country for sustainability, development and growth. The basis and foundation for skills and specialisation are the responsibility of institutions of higher learning. The responsibility is shared. Otherwise, quality and appropriation of the skills become a challenge. Hence collaboration is significantly vital.

Industries employ new workforce (both new graduates and experienced personnel) but are challenged by leadership or mentorship programs which has many implications such as costs and time. As a result, they are retrained. Hence the collaboration with other stakeholders such as the government is critical.

Undertaken of roles, responsibilities and accountabilities of the stakeholders as revealed in this paper would help bridge the skills gap in the country. Partnership is vital, collaboration is critical, and monitoring of the forms of bridging the skill gap is of utmost significant.

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