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Supporting postgraduate engineering education in South Africa through the learnership initiative and Work-Based Learning

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ABSTRACT: Globalisation and the Knowledge Revolution have produced social and economic forces that national economies cannot ignore in planning their strategies for economic growth. As a consequence, social, economic and education policies are now structured in an interdependent manner, with education playing a significant role in satisfying labour market demands for specific skills and social policy issues that are related to access to education, subsequent employability and continued professional development. In this article, the authors suggest a number of consequences of globalisation and the knowledge economy that have a direct bearing on education policy for both established and emergent economies. The development of engineers and engineering skills is an essential element of economic growth. The Learnership Programme currently in place in South Africa reflects a particular response to these pressures. Based on these observations, the capacity of a Work-Based Learning (WBL) methodology used in conjunction with the learnership framework is examined in order to assess its potential in relation to a knowledge led development within the engineering industry in South Africa.

INTRODUCTION

Globalisation has been characterised as a vehicle for *world economic integration*; this can be achieved through markets that cross national and geographic boundaries and the removal of trade barriers, ie unrestricted trade. The World Bank Organization (WBO) and the International Money Fund (IMF) have both been closely associated with the economic view and development of globalisation. However, not all the initiatives and interventions of these organisations have been considered successful. For example, the Russian Federation followed a market economy that has led to significant instability in its economy and labour markets, while China has embraced globalisation at its own pace, leading to considerably less instability in its economy [1].

Technology is one of the key foundations upon which successful globally operating economies are based. Investment in this infrastructure is a common feature of almost all national economies. Technology cannot, on its own, deliver economic benefits; it requires a skilled workforce who can utilise the resources to generate wealth. The level of skills within a workforce is, therefore, another key determining element in the effectiveness of economies within a globalised marketplace.

Drucker has written extensively on the transformation of societies and economies brought about by globalisation and, specifically, the need for a new kind of labour resource: a knowledge worker. The concept of the knowledge worker, as described by Drucker, is now a recognised part of the knowledge paradigm that has come to characterise the globalisation of economic activities [2][3]. As a key component of transforming the resources that a national economy needs to compete in the global marketplace, the investment in human resources has been a major consideration in many governmental policy decisions. The diversity of debate based around the concept of a knowledge economy as it relates to society and economics and, therefore, education is complex. Yet the fact remains that these considerations have an impact on the average person in terms of employability, social inclusion and, ultimately, the happiness of the individual and so the stability of society [4][5].

SKILLS, EDUCATION AND KNOWLEDGE

In recent years, the consistent themes of many national reports has been *the skills gap* and the ability of the education system to provide a supply of suitably qualified people to the labour market. National policies for skills development and their importance to economic survival in the global marketplace are seen in the formation of education policies in such a way that the perceived skills gap is being addressed [6-8]. An integral part of these policy developments is the maintenance and improvement of economic performance, the provision of a route to employability (thus preventing serious labour market reactions), and the supplying of the opportunity to individuals to gain the skills necessary to secure continued employment. The order of these priorities is not accidental, as it is clear that economic considerations were uppermost in the policy development. Specific examples of these policies can be seen in the UK, USA and the European Union [9][10]. It is clear that the early drivers for economic change can be traced directly to the need to have economic sustainability and competitiveness during a period when methods of doing business have been undergoing rapid change [11].

Education, in a very general sense, is a process that is intended to allow each individual to achieve skills appropriate to their potential. The development of knowledge led economies – and the recognition of the need to provide labour markets with a range of skilled people – has, through policy directions, resulted in education services being tasked to provide the following:

- Enhance opportunity to access a wider range of society;
- Make provision for people to enter and re-enter education at different times in their careers;
- Increase significantly the number of participants in higher education [12].

In addressing these objectives, national governments have developed policies relevant to their own situation; however, most have encouraged the development of educational practices that recognise learning can take place in many diverse situations. A particular example of this is the concept of life-long learning, which recognises the reality that a particular skill set gained at a particular time will require updating and possible complete renewal during an individual's working life [8].

Structural Changes

Traditionally, universities have concentrated on the provision of programmes of study leading to qualifications that give entry into recognised professions, develop skills appropriate to particular communities of practice and provide a level of education consistent with a university graduate [13][14]. Globalisation has created a knowledge paradigm that has led to a significant change in the organisational views of the skills profile of potential employees [15]. National education policies have sought to address the provision of opportunity through life-long learning, social inclusion and wider access programmes. At the same time, many higher education institutions have developed programmes of study that are more firmly focused on the employability of their graduates.

Many authors have commented on the type of skills that the standard education process provides, commenting on the lack of knowledge skills development among students. The difference in these skills has been characterised by Gibbons as mode 1 and mode 2, with mode 1 being concerned with essentially explicit knowledge or *know-what*, and mode 2 being concerned with a much wider context related to experience, transdisciplinary working and the ability to integrate new knowledge into their existing knowledge framework or *know-how* [16]. Mode 2 skills are those usually associated with post-graduation experience and the development of professional knowledge, a process that relies on experience and the development of *know-how* assisted by pre-existing *know-what*. *Know-how* and *know-what* are descriptions utilised by Polanyi to differentiate explicit and tacit knowledge [17].

ENGINEERING: A CHANGING DOMAIN

Engineering, in the most general sense, has played a crucial role in the development of a nation's ability to prosper since recorded history. In particular, the ability of a nation to develop manufacturing capabilities, which in turn enable economic prosperity, rely heavily on engineering skills. The training and development of professional skills in the discipline of engineering has gone through a number of evolutions that were responses to the pressures that social and economic forces brought to bear on education policy. The Finniston Report and The Engineering Councils, UK Standards and Routes to Registration (SARTOR) for chartered engineers, are examples of the UK's response to these pressures [18][19].

Traditionally, engineering was composed of three broad subject areas, namely: electrical, mechanical and civil, and within these there were a number of major specialisations. Employment of a major proportion of these graduates in the manufacturing sector usually involved the management of production lines, the infrastructure required to maintain these facilities, the development of new facilities and bringing new ideas to the traditional manufacturing industry. The expanding engineering knowledge base has seen the emergence of computing science, telecommunications, electronics and many others as distinct disciplines. Higher education institutions have responded to these new knowledge domains with the generation of programmes that have drawn on the developing explicit knowledge related to these subjects. The result of the rapid increase in the engineering knowledge available, along with the concept of the knowledge worker engineering as a discipline, has changed quite dramatically in both the range of programmes that are available, and the levels of recognition or accreditations that are offered.

Changes in Engineering Education

It is a recognised fact that recruitment into engineering programmes in the UK is poor. Thus, if engineering education is to contribute to the labour pool, it will need to offer programmes that can respond to individual and corporate needs. The industries created around this expansion in knowledge, and the global markets developed as a consequence, have created a demand for skills that traditional engineering programmes were not designed to deliver. Many higher education institutions have developed programmes that specifically target specialist engineering functions, eg multimedia engineering, telecommunications, engineering graphics, etc. Each of these developments have contributed to the provision of skills for expanding demands; however, while these programmes have followed institutional Quality Assurance (QA) processes and been subjected to validation by external peers, they have not always met with the approval of the main engineering accreditation bodies. Instead of attaining the accreditation necessary for professional engineer status, these programmes were accredited typically for incorporated engineer status. Thus, programmes have been developed to address the needs generated by increasing knowledge related to specific areas of engineering, yet they are not accredited at the professional engineer status. The whole issue of accreditation is based on the notion that there is a definable knowledge base, which is required to meet the perceived academic needs. Yet it is precisely this that prevents higher education institutions reacting to the knowledge need of the marketplace. If knowledge is to be transferred successfully to the marketplace, then it is more and more recognised that the knowledge required is not necessarily highly specialised; rather it is the skills in the process of learning and the use of knowledge access and generation tools. This conception of an undergraduate programme is not readily adaptable to the criteria required for accreditation.

Pedagogic Developments

It was noted earlier that, as education polices have developed, it was recognised that learning can – and does – take place in many different environments. In response to this, different methodologies have developed for recognising attainment and awarding credit. The most common of these are Assessed Prior Experiential Learning (APEL) and Accredited Prior Learning (APL) [20]. APL is the recognition of credit previously achieved and confirmed through a transcript. APEL is the award of credit by an assessment of experiential learning against

learning outcomes for a specified module. Typically, APEL was used to accredit work experience; starting from this point, Work-Based Learning (WBL) methodologies have developed.

WBL has provided a new approach to encouraging interaction between academia and industry generally. It is designed to support the interaction between academia and industry through a tripartite arrangement between the student, organisation and academia to develop a learning programme based on organisational strategic objectives. Within the context of the knowledge economy, WBL offers industries the opportunity to be involved in the knowledge generation process such that it reflects their strategic need and also offers the opportunity to be involved in a process of skills growth without requiring the participants (employees) to be absent from their daily employment.

Typically, postgraduate WBL will offer creditation for the award of a postgraduate certificate, postgraduate diploma, Master of Science and professional doctorate. The programme of study is defined in terms of a series of learning or research goals that set out the learning/research outcomes, activities, assessment criteria and mode, as well as the resources necessary to complete each individual goal [21-23]. A significant difference between the WBL model and more traditional models of postgraduate study is the incorporation of the strategic objectives of the organisation in the development of the learning programme. Again, in the context of the knowledge economy, this model addresses the need for academic institutions and industry to acknowledge each other's interest in the content and outcomes of the programmes of study. To characterise this, Table 1 gives some indications of the relationship between organisational objectives and programme objectives.

Table 1 indicates that programmes for specific awards can be structured to address particular knowledge needs for an individual and the organisation, and relates to the strategic objectives of the organisation. From an academic perspective, the development of programmes for individuals is resource intensive for a limited financial return, so these programmes are usually developed for groups of students in partnership with corporate clients.

The MSc and Doctorate levels are more appropriate for one-to-one supervision, although the MSc level still has a significant resource implication without the potential advantage of research production that may result in publications or intellectual property value. In academic terms, institutions are under greater financial strain than they have ever previously experienced and this affects their ability to devote resources that do not produce some form of return to balance the resource costs. Many institutions have developed a model of thematic Master of Science where the basic programme structure is the same for all students with a potential for some differentiation within the programme through projects. The thematic model is usually utilised for knowledge updating or the introduction of new skills in line with the organisation's strategic objectives.

There is ample evidence that education and training plays a major role in the income generation or Gross National Product (GDP) of a country, particularly one with an emerging economy. The contributing factors are manifold, diverse and regionally driven. Within the broad area of education and training, there exists a number of levels, eg the basic skills development necessary for learners to perform simple functions, the trades assistance skills necessary for learners to actively help artisans in their duties, para-professionals in professional activities, tertiary education at the certificate and diploma levels, as well as higher education at the degree and postgraduate levels.

Learnership Programme

The Government of the Republic of South Africa (RSA) has recognised the significant contribution of education and training at all levels to the present and future wealth of that country in a number of commendable ways. The Preliminary Annual Report of the RSA Department of Labour 2002/2003 presents an excellent insight into the value of the individual in reaching the economic and social goals of an emerging economy, along with the difficulties associated with that region [24]. In that report, the Minister of Labour, M.M.S. Mdladlana, MP, states the following:

> *The year 2002/03 was a year in which skills development received a high profile in which the emphasis in government fell on implementation and consolidating the progress made in previous years …* [and details the] *Amendment to the income Tax Act, published in October 2002, whose purpose, among other things, was to introduce tax rebates for employers who employ learners* [24].

This provides positive incentives to employers to embrace learnerships. The report describes the way in which the 25 Sector Education and Training Authorities (SETAs), which were formed on 20 March 2000, are contributing to the development of skills and education via learnership development programmes.

In an address to the Growth and Development Summit held in Johannesburg in June 2003, President Thabo Mbeki outlined *the common agreement between government and business, labour and community organizations about the steps we need to take to speed up economic growth and development* [25]. This far-sighted document describes the strategy by which the aforementioned goals can be achieved in a coordinated manner

Table 1: Comparison of organisational and programme objectives.

Outcome	Organisation		Academic Institution
Award	Knowledge/Skills	Strategy	Knowledge and/or Service
PgC	Update/new skills	Staff development	Leader/provider
PgD	Update/new skills	Staff development	Leader/provider of
MSc	New skills/knowledge	Staff development	Explicit/tacit
Doctorate	New knowledge	Strategic/staff	Research partner

by the National Economic, Development and Labour Council (NEDLAC), stating that *the structural expression, in our setting, of our common intent to work together to build a firm foundation for a better quality of life for all South Africans*. In this address, the President described the contribution of the Presidential Working Groups that exist in addition to NEDLAC *and regularly interact with big business, black business, labour, commercial agriculture, religious leaders and recently, leaders of higher education institutions*.

The four key challenges to be addressed through partnerships were identified by the President as follows:

- Addressing the investment challenge;
- Developing more jobs, better jobs and decent work for all;
- Advancing equity, developing skills, creating economic opportunities for all and extending services;
- Effecting local action and implementation.

The key agreements outlined by the President included:

- To boost the number of employed people in learnerships to more than 80,000 by May 2004;
- To place high-level representatives on the Boards of the Sector Education and Training Authorities (SETAs) in order to improve their importance.

All of the aforementioned confirms a commitment to education and training as a vital component in the growing economic future of South Africa.

LEARNERSHIPS

Learnerships are divided into eight levels with levels 7 and 8 directed at postgraduate activities. As of September 2002, their distribution was outlined as shown in Table 2 [26][27].

From Table 1 and Figure 1, it is clear that a broad range of sectors is being addressed, with a particular focus on sub-degree levels. Indeed, the numbers indicate almost a perfect normal distribution with the mean around level 3. They also illustrate the potential for the development of learnerships at levels 7 and 8, postgraduate diploma and Masters levels, respectively. Postgraduate learnerships have the potential to contribute to the knowledge base of companies to improve their competitive advantage – a key requirements in an increasingly competitive global marketplace to retain competitive advantage.

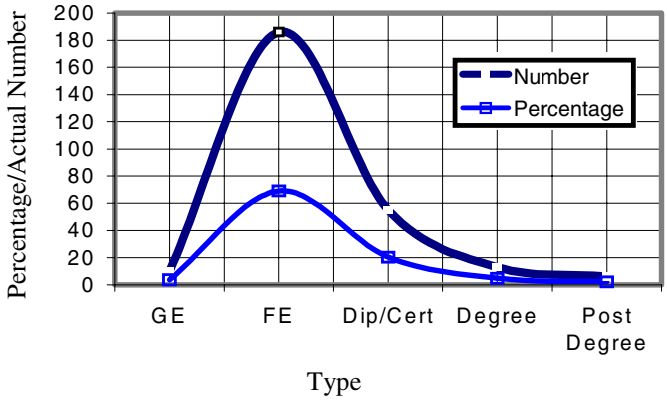

Figure 1: Number and type of learnerships (September 2002).

Learnerships and Work-Based Learning

The pedagogic model described earlier characterises the concept of Work-Based Learning (WBL) as essentially supported workplace learning. In the UK, the development of WBL at the postgraduate levels is generally agreed to have commenced in the early 1990s. To some extent, this was influenced by discontent among much of the manufacturing

Table 2: Learnership programme numbers (September 2002).

Level	1	2	3	4	5	6	7	8	Total
Finance/Accounting	0	0	1	0	1	3	4	0	9
Chemical	0	10	0	0	0	0	0	0	10
Textiles	0	36	3	0	0	0	0	0	39
Construction	0	1	3	0	0	0	0	0	4
Defence etc.	0	0	0	0	1	0	0	0	1
Education/Training	0	0	0	3	4	3	0	0	10
Energy	1	1	1	1	0	0	0	0	4
Food	0	3	19	10	1	6	0	0	39
Health	0	0	3	3	0	0	0	0	6
IT	0	0	0	4	4	0	0	0	8
Insurance	0	1	1	12	5	0	0	0	19
Local Government	0	0	0	0	1	1	1	0	3
Media/Advertising	0	0	0	11	20	0	0	0	31
Manufacturing	0	6	6	6	3	0	0	0	21
Police	0	0	1	1	1	0	1	0	4
Primary Agriculture	6	1	0	1	0	0	0	0	8
Secondary Agriculture	0	3	0	1	2	0	0	0	6
Services	2	1	1	10	4	0	0	0	18
Tourism	0	3	4	8	6	0	0	0	21
Transport	0	0	3	0	1	0	0	0	4
Wholesale	1	2	0	2	1	0	0	0	6
Total per level	10	67	46	73	55	13	6	0	270
Percentage per Level	3.7	24.8	17.	27.04	20.4	4.81	2.22	0	

industry regarding the academic nature of engineering graduates and the perceived lack of practical and business skills.

Today in the UK, WBL (mode 2 learning) is an accepted form of achieving learning goals and of equal standing to those attained through campus-based instruction (mode 1 learning). History has shown that it is particularly suited to study at the postgraduate level (levels 7 and 8 of Table 1). Many illustrations of successful implementations of WBL at the doctorate and other levels can be found elsewhere [23][28][29].

As the name implies, WBL allows the student (employee) to remain in the workplace and continue to actively contribute to the success of the employer. It is uniquely flexible in nature and recognises the occasional needs and pressures of a working environment. It also provides a vehicle for personal educational advancement that, for financial or business reasons, might otherwise be unavailable.

To be successful, WBL must concurrently meet the needs of the employer and the aspirations of the employee (student). The former can be addressed by ensuring that any learning outcomes directly relate and contribute to the strategic objectives of the employer, ie underline the rationale for allowing the learning to progress. Likewise, the employee (student) must transparently recognise the personal and employer-related benefits that will form learning outcomes of the proposed areas of study.

The university is required to ensure that the identified learning goals are consistent with those expected for a particular academic award, ie Quality Assurance (QA) procedures must be in place. This partnership between employer, employee (student) and university can be visualised as illustrated in Figure 2.

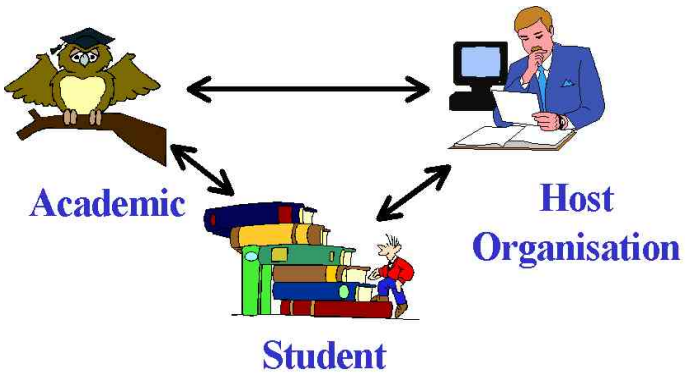

Figure 2: The Work-Based Learning (WBL) partnership.

In summary, this is a partnership that facilitates:

- Industry-academia collaboration;
- Employees to update/acquire new knowledge;
- Academics to engage in research with industry;
- Industry to achieve strategic aims and develop employee's aspirations.

It also reflects the aspirations of the Government of the Republic of South Africa [24]. This is diagrammatically shown for degree and postgraduate levels in Figure 2.

SUMMARY AND CONCLUSIONS

In the later part of the 20th Century and the early years of the 21st Century, the globalisation of markets, the increased access to knowledge and the dramatic improvement in communication technologies have introduced knowledge as a key component of competitive advantage. For emerging and established economies, this challenge, establishing knowledge-led economic development, is now a major policy consideration.

Different national governments have approached this in different ways; however, all the approaches share a common theme, namely the development of skilled workforces. These skills development programmes can be seen as addressing labour market shortages. However, if companies are to develop competitive advantage, then they must also develop their knowledge base. In order to develop this, they must interact with sources of knowledge – usually higher education institutions.

The nature of the interaction is often a form of funded support for programmes that are linked to a certain government strategy, such as technology transfer or knowledge transfer. Companies also have their own priorities and it is through programmes (generally termed supported workplace learning – of which Work-Based Learning is an important example) that the interaction can be set in a context that reflects the strategic aims of the company, the academic aspirations of the employee and the necessary academic rigour to justify an award.

The aims of the learnership programme and the pedagogic basis of Work-Based Learning are uniquely matched for the development of level 7 and 8 programmes. Programmes at this level are postgraduate and involve knowledge transfer, thus improving the potential competitive advantage of the organisation. They are also structured around the strategic objectives of the organisation and support employee development.

All of these features reflect the aims of the learnership programme and, in addition, offer the opportunity to deliver real knowledge transfer for the organisation to expand its economic performance. The proven effectiveness of Work Based Learning (WBL) at the postgraduate levels in the UK make it an attractive proposition for development within the existing framework of learnerships at levels 7 and 8 in South Africa.

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