

# SKILLS SHORTAGE IN TRANSPORTATION ENGINEERING - EDUCATION PERSPECTIVE

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## 1 INTRODUCTION

When navigating through the American pavement website of <http://pavementinteractive.org> one identifies South Africa's **CSIR** as one of the participants in this informative websites. Apart from this, South Africa's contribution in the current state of art in Pavement Engineering is well recognized internationally (Monismith, 2004). In his presentation Monismith continually made reference to work of South African engineers such as P. Rigden, C.Freeme, H. Maree and others.

An inference that one makes from the above is that at some point in time in history this country was doing very well in terms of quality of engineers that were produced. However, there is an outcry at the moment that engineering field is facing serous skills shortage from two perspectives, numbers and competence. This situation is more prevalent in government, arms-length institutions, local government and also institutions of higher learning. This is attributed to failure of above mentioned institutions to retain staff. Apart from this there has also been brain-drain to the disadvantage of South Africa to overseas countries.

At the heart of skills development of every country is the education and training. Education in this country has been subject to many major changes. The recent ones that can be recalled are the splitting of the ministry of education into two ministries, one for basic education and the other one for higher education and training, the introduction of new qualification framework, the OBE system at basic education level and the introduction of new senior certificate.

The discussion that follows hereunder highlight the prevalence as well as the extent of skills shortage as perceived by different stakeholders groups such as professional bodies, technocrats themselves, government officials and others. It then goes on to highlight some propositions put forward to address the problem. Then the applicability of these propositions is discussed from the view point of changes in education system and from policy and/or legislative perspectives. Also linked to these propositions is an issue of difference that exists between local and international standards. This issue is also briefly discussed. Following these conclusions will be drawn. Lastly recommendations will be made.

## 2 VIEWS OF STAKE HOLDERS

From political point of view the country has experienced many protests of residents demanding better services. Services demanded included roads, water, sewerage systems, housing and electricity. In instances where the initiatives were taken to improve the situation, irregularities in award of contracts and poor contract administration undermined those initiatives. Since almost all these rest in the domain of civil engineering, the question

is whether the civil engineering community can be considered to have failed this nation or not. In trying to answer this question one unravels the fact that the numbers and in some instances the competences of engineers, technologists and technicians are not adequate. Deficiency in capacity of institutions is also common.

At ministerial level it is acknowledged that while the challenges in transport infrastructure relate in some way to funding, there are also other problems such as the diminishing pool of technical expertise in engineering (Ndebele, 2010). Furthermore, the shortage of skills has been identified as the single greatest impediment to the success of public infrastructure and private investment programmes (Joint policy statement by ministers of education and labour). At provincial level problems relating to skills shortage or capacity are prevalent. One of the biggest constraints within the province of Eastern Cape on development of multi-modal transport and adoption of logistics solution is the number of trained personnel available to the province and the local spheres of government (Soko, 2006:1).

It is not only within the government that the heat is being felt. Technical bodies such as Consulting Engineering South Africa (CESA) in their warning that SA water demand will exceed supply by 2025, have also indicated that there is need to improve staff skills. The organization's President Zulch Lotter went further to indicate that CESA was concerned about South Africa's lack of technical management capacity particularly in municipal and provincial government spheres which could become stumbling block to sustainable development (*Mail & Guardian*, 04 February 2010).

Indicators such as civil engineer per population group can be a good indication of the problem. On the basis that one civil engineer is needed for every 4000 to 5000 households, it is put to us that the current numbers should be doubled (SAICE Media release, 2007). In the same media release, it is also stated that there has been a decline in number of civil engineering staff in local government since the eighties. In terms of numbers it is stated that a net loss of 70 to 90 head count of staff per year has been suffered by the local government since the eighties.

In comparison with other world cup hosting countries South Africa ranks low in terms of number of engineers per every million citizens. The value is reported to be around 473. Japan on the other hand has about 3306 engineers per million citizens. Countries like Chile are still better than South Africa in terms of this indicator (*Engineering News*, 11 March 2009).

Peter Copley of Development Bank of South Africa jointly with Mac Mashiri of CSIR, (2009:9) in SATC presentation have indicated that human capital development in the context of construction skills development is not keeping pace with the high demands for skills required to implement rapid increases in infrastructure expenditure. By the same token the issue of skills shortage always keeps on popping up in many papers in transportation engineering, for instance, lack of qualified professionals is one reason for justifying the inappropriateness of aggregate four step transport models in South Africa (Kane and Behrens, 2002: 5).

### **3 PROPOSED INTERVENTIONS**

There are three highly advocated ways of addressing the skills shortage. The first is the importation of the skills from outside South Africa (Copley and Mashiri, 2009:9). The second one is that of increasing throughput at institutions of higher learning (Copley and Mashiri, 2009:10). The third option is that of recalling retired experienced engineers to play

mentorship role to young engineers and planners. Engineering Council of South Africa has at some stage heeded this and called on retired engineers to mentor graduate engineers (*Engineering News* 29 March 2009).

The move to use the retired South African engineers is more preferred than that of importing the skill. The reason for this preference is cost. Branscombe (as quoted by Soko, 2006 : 28) said “Here is a wealth of experience and ability that could easily be tapped for benefit of South Africa. Why a civil engineer is considered old at 65 when a politician can become president of a country at 75 is beyond me. I suggest that SAICE should compile a register of retired engineers who would be available for employment to fill the impending shortage instead of going to overseas to recruit unknowns.”

Government has initiated the Joint Initiative for Priority Skills. Through this initiative the increase in the number of engineers produced was to be increased. Placement of retired engineers in targeted local municipalities coupled with mentorship of young engineers by pairing the two were some of the positive attributes of this initiative.

The importation of skills from outside is having a backup from legislation point view. The immigration amendment act of 2004 was aimed at ensuring that temporary and permanent residence permits are issued as expeditiously as possible and on the basis of simplified procedures and objective, predictable and reasonable requirements and criteria. The option of using retired engineers seems relatively viable but to some extent may be achieved at the expense of equity targets hence a trade off has to be sought in this regard.

#### **4 EDUCATIONAL TRENDS AND POSSIBLE IMPLICATIONS**

Skill is defined as the learned capacity to carry out pre-determined results often with minimum outlay of time, energy or both. It follows therefore that education and training are the starting point in skills development hence the trends in country`s education have great implication in resolving the problems of skills. Such trends are discussed hereunder.

##### **4.1 Higher education qualification frame work (HEQF)**

It was pointed out earlier that the introduction of the new HEQF is one of the recent changes in the education system. One of the major changes that characterize the new HEQF is the phasing out of Bachelor of Technology (BTech) qualification offered by the Universities of Technology (formerly known as Technikons). Rather what has been included is the advanced diploma, a qualification which is at NQF level 7, the same level as three year non professional degree. This is an alternative qualification that a national diploma holder can pursue if interested to have an in-depth knowledge in specific area .The other alternative is that of pursuing the conventional engineering degree at traditional university.

From skills shortage point of view, this move is unlikely to yield positive results. For a national diploma holder the option of advanced diploma does not add much value as ultimately such person is still a diploma holder any way with no change in status. The previous system of Bachelor of Technology degree offered a change of status from technician to that of technologist. The second option of pursuing conventional degree at traditional university disadvantageous in that the diploma holder is likely to spent minimum of two years full time to get BSc(Eng) or its equivalent when transfer of credits is taken into consideration. The Bachelor of Technology degree in contrast, can be done in blocks release system, allowing a person to couple working with furthering of studies. So it is

therefore argued that in light of the above, the new move to phase out Bachelor of Technology is going to have negative impacts on skills development of this country.

Malcolm Knowles, in his theories relating to adult learning (andragogy) states that adults are more interested in learning topics that are relevant to their work or personal life. It therefore implies that the diploma holders are likely not to be in favour of going for 100% academic programmes such as advanced diploma or Bachelor of Engineering. Building on Malcolm`s theories the Bachelor of Technology should have been retained and be used as one strategic area where the services of the retired engineering gurus can be utilized to combat skills shortage.

#### 4.2 Higher education perspective

One of the most critical issue in context of skills but which is not given the due attention is the disparities that exists between local engineering qualifications and those of overseas. To demonstrate these disparities a superficial contrast between civil engineering degrees of Pretoria University and Brighton University revealed the following differences:-

- According to DoE (2007:23), BEng(Hons) is a postgraduate qualification characterized by specialization in a particular narrow field of study. It is common knowledge that in this University one enrolls for Honours degree after completion of four years degree and that one can specialize in geotechnical engineering, transportation, structures or water. In contrast BEng(Hons) offered in Brighton and also in many institutions in the United Kindom seems to be first degrees and does not seems to be a specialized qualification (University of Brighton, 2009).
- South African Engineering degrees are characterized by relatively high content of mathematics and natural sciences in the early years of the program.
- The cumulative number of subjects of local BEng(Hons) is far more than that of BEng(Hons) of Brighton University. The local qualification is having about 57 subjects while the latter has about 33 including electives.
- In terms of breath BEng(Hons) qualification of Pretoria University seems far better than BEng(Hons) qualification of Brighton. Locally the requirement is that at first degree all major areas should be covered, namely water, transportation, structures, geotechnical engineering. Specialization will follow after this broad based foundation. If one looks carefully it will be realized that the subject list of Brighton has only one subject of transportation as an elective.

It is worth mentioning that this is just one example of clear difference in approach philosophy between overseas Universities and local University. We can further indicate that MEng qualification takes a minimum of four years to complete in United Kingdom while in RSA it takes a minimum of six years.

The implication of the above can be twofold, that in RSA students are being overstretched or that overseas qualifications do not match local standards. Which ever way skills shortage resolution is likely to be jeopardized.

### 4.3 Basic Education

Peter Copley and Mac Mashiri cited some challenges relating to skill development from basic education point of view. They indicated that most schools do not have libraries, water, electricity and toilets. This is a very relevant contention given that basic education is a feeder system to higher education system. It implies therefore that to maintain and sustain the high standard currently prevailing at the universities the basic education system has to be equal to the task. If this is not the case we will end up with the so called 'colossus with clay feet' and collapse will follow.

In 1996 the OBE was adopted as a model for basic education. The first group set for senior certificate examination two years back, implying that this group has spent at least a minimum of one year at institutions of higher learning. This has enabled a majority of education stakeholders and public in general to assess if this model works compared to those of the past. It is worth mentioning that the pass rate of 2008 and 2009 National Senior Certificate exams were higher than that of previous years.

Despite this relative high pass rate most universities are not trusting that the results are genuine, or credible enough that they can be the only basis of determining if the student can make it in higher education or not (in *Mail & Guardian* 8 January 2010). This is reflected by move by most universities to resort to what is called bench marking tests. It is further indicated in the same article that most student struggle at the university. Moreover there is concern that the standard of the first NSC was lower than anticipated. The last controversy surrounding NSC reflected in the same article is the perception that the accreditation body is massaging the results so that they look better. The withholding of Mpumalanga Province results also caused doubts in regard to credibility of the systems in place especially the quality assurance

Despite the Universities skepticism, academics such as Dr. Mamphela Ramphele expressed their concern that the new curriculum is failing the learners of South Africa (Mgibisi, 4 June 2009:1). She states that many countries such as Canada, Netherlands and others tried this model of curriculum after which they dumped it. Still advised by the same source, mathematics teachers through their representing body known as concerned mathematics educators (CME) also expressed concern about the low standard of the exam itself.

Looking also at the number of pupils at grade one, and comparing it with the number of those that ultimately reach grade 12, there is an indication that there are many drop outs. Others are of the view that the government is focusing on improving the results only at exit level (grade 12) instead of looking at what happens at all level starting from grade one. All these problems have resulted in many calling for scrapping off OBE and adoption of another education model.

However the government`s stand point on the issue as stated by Zweli Mkize (as quoted by Mgibisi 04 June 2009) is that OBE is not going to be scrapped off, instead its weaknesses are being dealt with. This is also the view of the new director general of for Basic education Bobby Soobrayan (*Mail & Guardian* 28 May 2010).

In summing up issues around basic education there is general view that the current system is not doing well in terms of resources, content, quality assurance and synergy with the higher education system. In this way Universities are placed in difficult situation to improve throughput which is seen as the starting point in resolving the issue of skills.

## **5 DIFFERING STANDARDS**

It was pointed out that this country is not just a consumer of knowledge generated by the international community but has also generated a lot of knowledge relating to local conditions. Consequent to this there are local standards, guidelines and procedures which guide engineering practitioners in this country. In most cases these differ significantly with those of overseas. To demonstrate these differences, let us contrast between procedure of CBR test as detailed out in method A8 and procedure of the same as detailed in British Standard BS 1377.

### Method A8 Procedure

- Only three moulds containing compacted soil per sample are subjected to penetration.
- These moulds are compacted at the same moisture content (optimum moisture content as determined from method A7) and at different compaction effort.
- Only one end of the mould is subjected to penetration.

### BS 1377 Procedure

- Five moulds compacted during determination of maximum dry density and optimum moisture content are subjected to penetration.
- This implies that the moisture is not the same and compaction effort is constant
- Both ends of the compacted moulds are subjected to penetration and CBR results for top and bottom are reported.

The differences in procedure of doing tests are not prevalent only in CBR but also in other tests such as sieve analysis, ICL and others. In accordance with TMH1, particle size distribution determination is split into method A1, A5, and A6 whereas this is not the case with particle size distribution in accordance with BS 1377. There are also differences in other areas such as surveying, where coordinate system is considerably different from that used in the northern hemisphere. From contract administration point of view, General Conditions of Contract is the document that is used locally. In contrast to this, FIDIC suit of contract documents and NEC are used internationally. It is therefore of utmost importance that where overseas engineers are used, they are helped to understand and appreciate that things may differ slightly or significantly from their experiences. More critical is for those who work in institutions of higher learning since there should be close link between what is taught at Universities of Technology and what happens in the real world. Teaching a person on basis of overseas practices which are different from what happens in the industry adds to the existing problem. In SADC countries there are instances where South African standards are just confused with British standards when performing certain tests.

## **6 CONCLUSIONS**

There is an admirable wealth of engineering knowledge in this country. However the inequity issues as well as inadequate numbers are posing a threat to transportation infrastructure provision and maintenance. The initiatives taken at national policy levels are thus encouraging. Furthermore there seems to be no denial about the matter. However in the haste to conquer, care must be taken not to make the situation worse. Firstly South

Africans should appreciate what they have. Secondly every change should be properly evaluated in the context of whether such a change will add value or not. In line of all these the closing section that follows is the recommendations.

## 7 RECOMMENDATIONS

- Import skills but with care. Evaluation bodies should properly evaluate overseas qualification properly to determine their strengths and weaknesses after which workshops and other methods of enhancing information transfer can be used. ECSA and SAICE can be instrumental in this regard.
- Recall retired engineers and couple their engagement with equity targets. Also try to place them at institutions of higher learning as they can have more impact. The requirements of higher qualifications can be relaxed and compensated with experience where there is such need.
- Problems relating to basic education should be sorted at that level rather than at higher education level. Increasing the number of years to try to make up for students not fit is an expensive and uncertain way of solving problems. Sorting these problems right where they occur is much cheaper.
- Most of South Africa`s transport infrastructure is at maturity stage of their in their life cycle. At this stage of deployment maintenance is more relevant. It follows therefore that technologists would play a more meaningful role, also releasing scarce engineers to be deployed in the areas where technologists have limited knowledge. In this way, optimal use of both streams can be achieved. So the phasing out of BTech should be revisited.

## REFERENCES

Copley,P. and Mashiri, M. 2009. Harnessing Public and Private sector Resources: The role of DBSA in Capacity Building in Southern Africa (Paper presented at the 28<sup>th</sup> Annual Southern African Transport Conference held at CSIR International Convention Center on 6-9 July 2006) Pretoria, South Africa.

*Engineering News*. 2009. SA`s engineers-to-citizens ratio lower than other world cup hosting countries.11 March.

*Engineering News*. 2009. ECSA calls on retired engineers to mentor graduates. 29 March.

Kane, L. and Behrens, R. Transport Planning Models-An historic and critical review (Paper presented at the 21<sup>st</sup> Annual Southern African Transport Conference held at CSIR International Convention Center on 15-18 July 2006) Pretoria, South Africa.

*Mail & Guardian*. 2010. SA water demand will exceed supply by 2025. 04 February.

*Mail & Guardian*. 2010. More time for teaching and learning. 28 May.

Mgibisi, M. 2009. South Africa: A fateful decision (<http://chalkboard.tol.org/south-africa>) Retrieved on 08<sup>th</sup> April 2010.

Monismith,C.L. 2004. Evolution of Long-Lasting Asphalt Pavement Design Methodology: A Perspective.(Paper presented at the International Symposium on Design and Construction of Long lasting Asphalt Pavements at Auburn University on 07<sup>th</sup> to 09<sup>th</sup> June.) Alabama, USA

Ndebele,S. Address at Road Construction and Maintenance Summit on may 2010  
Midrand

RSA. 1997. *Higher Education Act, 1997* (Act No. 101 of 1997). Pretoria: Government  
Printer.

SAICE Media release on 'A Marshall Plan' model for accelerated service delivery in the  
local government, 26<sup>th</sup> November 2007.

Soko A.Z. 2006. Capacity Building & Development for Transport and Infrastructure  
Development: Are We Ready for 2010? ( Paper presented at the 25<sup>th</sup> Annual Southern  
African Transport Conference held at CSIR International Convention Center on 10-13  
July 2006) Pretoria, South Africa.

University of Brighton, 2009. Civil Engineering BEng (Hons)  
<http://courses.brighton.ac.uk/course.php?cnum=174> retrieved on 08<sup>th</sup> April 2010