DISCUSSION DOCUMENT

THE POTENTIAL IMPACT OF SKILLS SHORTAGES ON THE INNOVATIVE CAPACITY OF MAJOR CAPITAL ENGINEERING PROJECTS

NATIONAL ADVISORY COUNCIL ON INNOVATION

SOUTH AFRICA
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DISCUSSION DOCUMENT

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ABBREVIATIONS AND ACRONYMS USED IN THIS DOCUMENT

ABET	Adult Basic Education and Training
AMTS	Advanced Manufacturing Technology Strategy
BEE	Black economic empowerment
BEP	Basic Engineering Phase
BTech	Bachelor of Technology
BWW	Building Work for Women, United Kingdom
CCF	Colleges Collaboration Fund
CEA	Construction Engineers Association
CETA	Construction Education and Training Authority SETA
CIDB	Construction Industry Development Board of Southern Africa
CSC	Construction Sector Council, Canada
CSIR	Council for Scientific and Industrial Research
DBSA	Development Bank of Southern Africa
DoE	Department of Education
DoL	Department of Labour
DPW	Department of Public Works
DST	Department of Science and Technology
DTI	Department of Trade and Industry
ECSA	Management Information System of the Engineering Council of South Africa
EPC	Engineering Procurement Construction
EPCM	Engineering, Procurement and Construction Management
ESETA	Energy Sector Education and Training Authority SETA
ETQA	Education and Training Quality Assurance Bodies
FET	Further Education and Training
FET	Further education and training
HEMIS	Higher Education Management Information System
HIV/AIDS	Human immunodeficiency virus / Acquired Immune Deficiency Syndrome
HSRC	Human Sciences Research Council
ICE	Institution of Civil Engineers, United Kingdom
IR	Implementation report
IR	Industrial relations
ISETT	Information, Systems Electronics and Telecommunication Technologies SETA
IT	Information technology
LFS	Labour Force Survey
MEI	Mechanical, electrical and instrumentation skilled artisans
MERSETA	Manufacturing, Education and Related Services Sector SETA
MOU	Memorandum of understanding
MQA	Mining Qualifications Authority SETA
NACI	National Advisory Council on Innovation
NQF	National Qualifications Framework
NSA	National Skills Authority
NSB	National Standards Bodies
NSCIC	National Steering Committee for Innovation in Construction, Canada
NSDS	National Skills Development Strategy
NSF	National Skills Fund
NVQ	National Vocational Qualifications, United Kingdom
OHS	October Household Surveys
PUSET	Public understanding of science, engineering and technology
RPL	Recognition of prior learning
SACATI	South African Centre for Applied Technology and Innovation
SAISC	South African Institute of Steel Construction
SAIT	Southern Albertan Institute of Technology
SAPSE	South African Post Secondary Education

SAQA	South African Qualifications Authority
SARS	South African Revenue Service
SDF	Skills development facilitator
SDPU	Skills Development Planning Unit
SETA	Sector Education and Training Authority
SME	Small and medium enterprises
SNF	Shutdown Network Forum
SNF	Shutdown Network Forum
SSP	Sector Skills Plans
TAC	Technikon Accreditation Committee
TIC	Total Installed Cost
T&D	Training and development
UAC	University Accreditation Committee
WSP	Workplace skills plan

PREFACE

The fundamental role of innovation and technology in creating and sustaining national growth is increasingly being recognised and understood, particularly as the experience of successful economies accumulates. Such understanding is particularly important in the context of South Africa's need for economic growth, as a basis for job creation and the eradication of poverty.

Recent studies by industry[1] projected that capital expenditure on major projects would increase to over R100 billion over the next five years and predicted a shortage of appropriate skills in the construction industry. These forecasts raised concerns about the ability of the construction industry to cope with the increased demand. The problem has been identified as a national issue, which could affect all major industrial activities and impact negatively on the country's economic growth. The National Advisory Council on Innovation (NACI), in conjunction with the major stakeholders, therefore initiated this project to investigate the issue, with a view to identifying a strategy and recommendations on how to implement it.

The project included studies on the supply of and demand for engineers, technicians and artisans; the issue of scarce skills in South Africa; an overview of best international and local practices for skills development in the construction industry; and an overview of the skills development policy framework in South Africa. The studies were synthesised and discussed at a facilitated workshop with the majority of the reference group producing recommendations and possible interventions. The first draft report was subsequently reviewed at a stakeholder workshop.

The results of this study showed that the challenges facing the construction industry were broader than the skills-related issues. The four main focus areas that emerged from this project were:

- Optimising training capacity and development for skilled artisans
- Creating a globally competitive and sustainable construction industry
- Creating an attractive construction industry
- Forming a partnership of role players in the construction industry for positive change.

Against this background, it is gratifying to record that the NACI secretariat did an excellent job of co-ordinating and managing the relatively complex project dynamics, as well as the inputs from all sources. A further pleasing feature of the project is that a co-operative approach developed

[1] Sasol Technology/ Fluor in-house study, which formed the basis of the industry presentation at the NACI workshop of 16 April 2003.

among the stakeholders as together they sought to achieve a common outcome, which would be of benefit of the industry and the country as a whole. For this, I wish to thank all that were involved.

Firstly the reference group of the project:

- Bill Brunjes (Group Five)
- Hennie de Clercq (SAISC)
- Nico Doman (Sasol Technology)
- John Dreyer (AngloPlats)
- John Gosling (Eskom)
- Spencer Hodgson (CIDB)
- Rob Lloyd (Anglo American)
- Ms Nomhle Makabane (DBSA)
- Louis Smidt (BHP Billiton)
- Gordon Taylor (Murray and Roberts ES)
- Bertus van der Merwe (SAPPI)
- Wolf Wassermeier (Grinaker LTA)

Secondly, I wish to express my appreciation to the contract and voluntary researchers that did an excellent job under tight time constraints.

- Contract researchers:
  - Wilbert Boon and Attila Marcus (Fluor) for the project demand study
  - Steve Giddings (CSIR) for the scarce skills report
  - Karen van Breukelen (CSIR) for the best practices report
  - Prof Liz Greyling (Rand Afrikaans University) for the policy overview; Dr Jan Beukes (Consultant) for the demand–supply study synthesis
  - Alan Kirschner (Customer dynamics) for facilitating the final synthesis workshop

- Voluntary contributors:
  - Simon McGrath (HSRC)
  - Barry Rawlins, Jo Green and Jan Espag (Fluor)
  - Louis Smidt (BHP Billiton)
  - Spencer Hodgson (CIDB)

Thirdly, we sincerely thank Prof. Anastassios Pouris, who critically reviewed the report. His concluding remark was: “In general I am satisfied that the study has achieved its stated objectives and that it makes a contribution towards a thriving construction industry in the country.”

Fourthly, Ian Macun (Department of Labour) and Jerry Modise (CETA) made valuable contributions to the finalisation of the report for which we are grateful.

Fifthly, we are grateful to the project team, comprising Dr Bok Marais, Mpho Mosarwa, Herman van Heerden and Ria Vogel.

Finally, it is my sincere hope that the implementation of the recommendations contained in this report will lead to a competitive and sustainable construction industry of benefit to South Africa’s industrial development – in this way optimising the role of innovation in the economy of our country.

Dr Roy Marcus
Reference Group Convenor
6 November 2003

Section 1

Background and Design

This study resulted from concern expressed by components of the petrochemical industry about a threatening shortage of skills for the execution of new projects. Figures submitted to the National Advisory Council on Innovation (NACI) by Sasol forecast an undersupply of up to 60% over the next three years in construction-related skills for new projects in the industry.

In response to this scenario, NACI organised a stakeholder seminar with project owners (and subsequently with representatives of the construction industry) to obtain their perspectives on the situation and the need for an investigation. They indicated their support for an investigation, and on 31 March 2003 the NACI Executive Committee approved a study of the skills situation.[2]

This report offers an overview of the design of the study, its main findings and recommendations. This section deals with the objectives, context and design (including the level of analysis) of the study.

1.1 Objective and scope of the study

The Executive Committee of NACI approved the following objectives of the study:

- To collect and cross-validate appropriate data on the skills base in the relevant construction industries in order to determine the quantum of the skills shortage, if any, in the industry
- To develop recommendations on how to address significant shortages, if any, identified in time to deal with the anticipated workload between 2003 and 2007.

Apart from information on the demand side, the scope of the study obviously had to include the supply side (including training), the policy context and potentially relevant best practices in addressing this type of problem.

[2] 'Innovation', being the mandate area of NACI, is defined in the NACI Act as "the process of transforming an idea, generally generated through research and development, into a new or improved product, process or approach which relates to the real needs of society and which involves scientific, technological, organisational or commercial activities" (Section 1(1)(vi)). Innovation is rated as an important phenomenon by government in its "role in promoting and achieving national objectives, namely to improve and sustain the quality of life of all South Africans, develop human resources for science and technology, build the economy, and strengthen the country's competitiveness in the international sphere" (Section 3 of the NACI Act). On the basis of this definition and the link between innovation and economic growth, it follows that a project dealing with the potential impact of technical skills shortages on the innovation imperatives of the country falls, at least partially, within the purview of NACI, but that inputs from other bodies and departments would also be necessary.

The study focused primarily on the construction of major capital engineering projects. It largely excluded the building construction sector because of its size, diversity of projects and different skills base. The concept of ‘skills’ was further delineated so as to include artisans and semi-skilled workers in more detail and follow a high-level approach to engineers and management levels in construction.

1.2 Context of the problem

NACI undertook to conduct the study, since it concerned the impact of the supply of and demand for skills in the field of technological innovation. From the outset it was clear, however, that a range of interests impacted on the issues. Apart from NACI, the Department of Science and Technology (DST), the project owners and the construction industry, the following stakeholders played a role in the provision of technical skills in the construction industry: the departments of Education (DoE; e.g. further education and training), Labour (DoL; Sector Education and Training Authorities), Trade and Industry (DTI; industrial development), Minerals and Energy (DME), and the Development Bank of Southern Africa (DBSA). The project design and process consequently provided for the participation of and inputs from these groups.

1.3 Process and design

A reference group (project committee) was appointed after consultation to steer the project, and comprised: Bill Brunjes (Group Five), Hennie de Clercq (SAISC), Nico Doman (Sasol Technology), John Dreyer (AngloPlats), John Gosling (Eskom), Spencer Hodgson (CIDB), Rob Lloyd (Anglo American), Nomhle Makabane (DBSA), Roy Marcus (Convenor), Louis Smidt (BHP Billiton), Gordon Taylor (Murray and Robberts), Bertus van der Merwe (SAPPI) and Wolf Wassermeier (Grinaker – LTA).

The process followed for this study consisted essentially of three interlinked sets of activities, namely:

- Active consultation with stakeholders and experts (on the feasibility and scope of the study), as well as quality control
- Information gathering (questionnaires and documents)
- Analysis and interpretation.

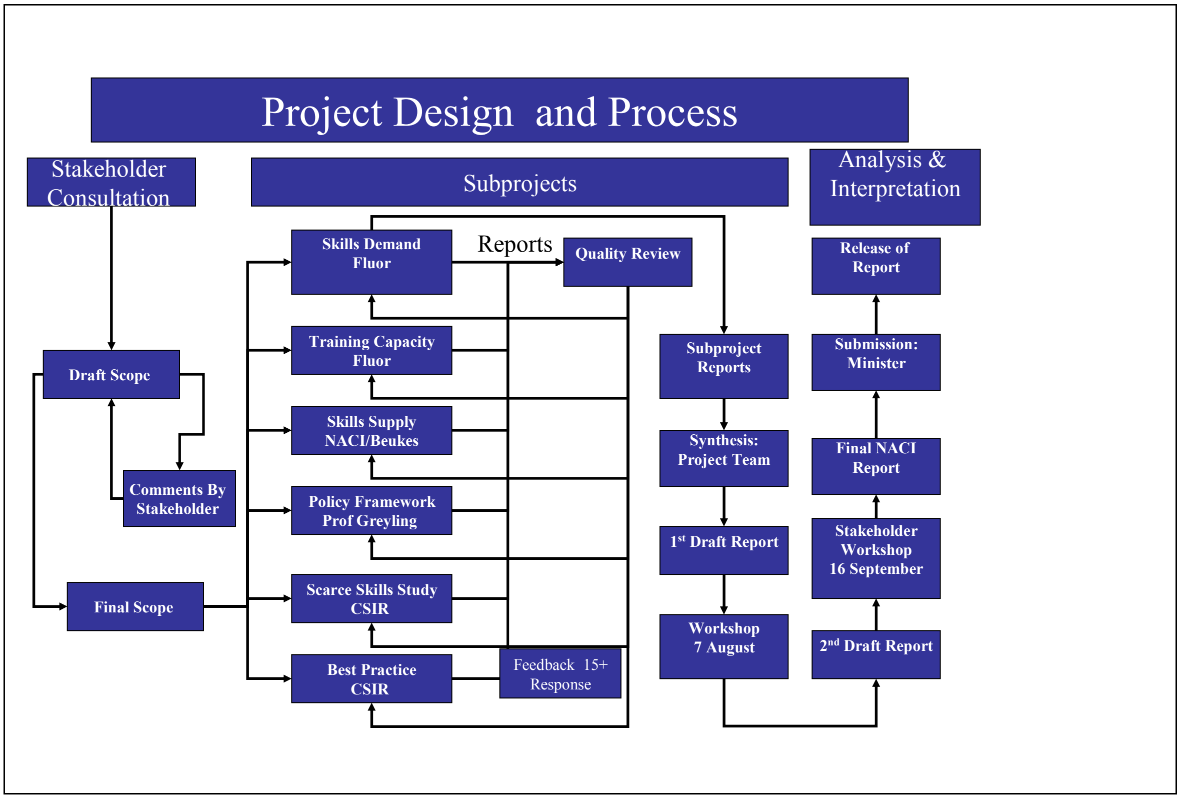
Table 1.1 summarises the interaction with stakeholders that took place:

Table 1.1: Consultations

Date	Parties	Purpose
16 April	Petrochemical industry (demand)	Validity of issues and feasibility of study
23 May	Construction industry (supply)	Validity of issues and feasibility of study
31 March	NACI Executive Committee	Approval of study
End May	Reference group	Feedback on design
19 June	Stakeholders: demand and supply	Case studies of local best practices
7 August	Reference group and experts	Generation of solutions
29 August	All stakeholders	Presentation of findings and recommendations
Early Sept	NACI Executive Committee	Acceptance of the report

The overall design of the study is shown in Figure 1.1.

Figure 1.1: Design of the study



Key aspects of the sub-projects are reflected in Table 1.2.

Table 1.2: Overview of sub-projects

Project	Objective	Method	Source	Service provider
Skills demand	Number: Artisans needed over next three years	e-Questionnaire	Project owners	Fluor
Training capacity	Number: Artisans being trained	e-Questionnaire	Industry	Fluor
Project	**Objective**	**Method**	**Source**	**Service provider**
Skills supply	Number: Engineers, technicians and artisans	e-Questionnaire; literature scan	Industry; HSRC, CCF	Fluor; Dr Beukes
Scarce skills	Understanding of skills challenges	Interviews and literature study	DoL, SETAs, etc.	CSIR
Best practice	Successful response to skills shortages	Internet study; case study	International; BHP Billiton; Fluor	CSIR
Policy context	Overview of relevant policies	Analysis of documents	Government	Prof Greyling

Note:

1. The findings of the above sub-projects served as inputs to the present report.
2. The project team noticed discrepancies between some of the data reported in the various databases, resulting in apparently conflicting trends being indicated in the analysis in some cases. The problem was resolved in the report by basing the interpretation on the more conservative of the figures in any situation of conflict.

1.4 Principles

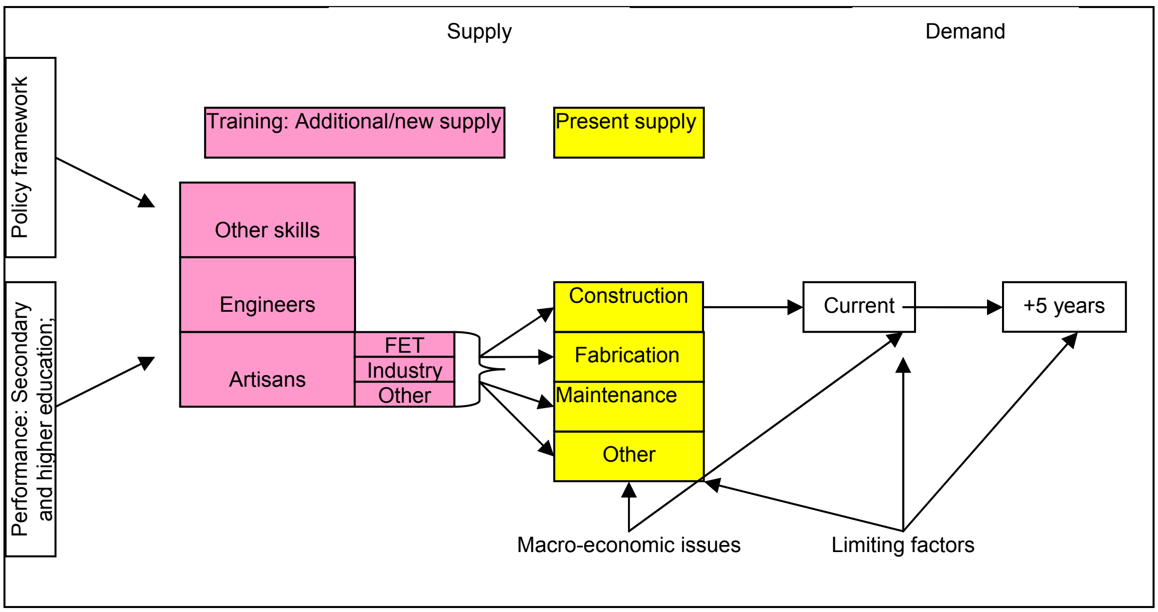
This study focused on an issue over which there would be strong competition in the given sector in any market economy. The project team consequently followed the following set of principles to ensure the credibility of the end results, namely:

- Relevance (i.e. addressing a real problem)
- Non-bias (not promoting one interest at the expense of other valid ones)
- Fairness (accounting for all perspectives)
- Comprehensiveness (i.e. covering the entire field under review, within the constraints of available resources)
- The standard canons of research methodology, such as objectivity.

1.5 This report

This document reports on a study dealing with the extent and nature of skills shortages in the construction industry[3] in South Africa, as well as possible remedies. The logic of the study and this report is shown in Figure 1.2.

Figure 1.2: Logic of the study



This report will serve as the basis for NACI's recommendations and policy guidelines to government and the respective industries. Given the extent of the field covered (e.g. industrial development, education and training, to name but two areas), it follows that this report could do no more than offer broad brush strokes to outline the nature of the challenge and direction in which solutions should be sought. This report is the outcome of a series of research projects (specially commissioned projects and secondary analyses of available data), as well as extensive consultation with the relevant stakeholders, and will be released as soon as the Minister has had the opportunity to study it.

The next section offers a quantitative overview of the demand for and supply of skills in the construction industry.

[3] The term 'construction industry', as used in this report (particularly in the recommendations), refers to the construction industry which can be defined by the following three categories of main players: CLIENTS (public and private sector), who are the project owners; CONSULTANTS, who have the intellectual capacity to convert the project concepts into designs and specifications; and CONTRACTORS, who execute the work.

SECTION 2

SUPPLY OF AND DEMAND FOR ENGINEERS, ENGINEERING TECHNOLOGISTS AND ARTISANS

The shortage of a skilled workforce to execute major capital engineering projects has been under the spotlight for a number of years. Two key issues are central to this question Firstly, it is important to understand the current supply of skills by the network of training facilities and then to compare this supply with industry's demand for appropriately skilled personnel. Secondly, the appropriateness and quality of training provided by these institutions need to be assessed in terms of changing demands.

The aim of this component of the project is to assess and contrast the supply of and demand for engineers, engineering technologists and artisans and where possible to:

- Determine the likelihood of skills shortages in certain engineering industries for the immediate future, countrywide
- Determine whether the perceived skills problems are related to the issue of 'scarce skills' or the issue of 'skills gap'
- Recommend possible remedial actions to resolve the problem.

This chapter is divided into three sections. Section 1 deals with the demand for and supply of engineers and engineering technologists. Section 2 investigates the supply of artisans both by industry trainers and public technical colleges. Section 3 presents the results of recent surveys performed by NACI, which investigated the demand for artisans in the construction industry over the next five years.

Most of the information on the supply of and demand for engineers and technologists is based on the analysis performed by the HSRC on the following databases, which appear to be the most comprehensive and reliable sources of information currently available:

- October Household Surveys (OHS) from Statistics South Africa (Stats SA)
- Labour Force Surveys (LFS) from the Department of Labour
- SAPSE database from the Dept of Education
- Higher Education Management Information System (HEMIS)
- Management Information System from the Engineering Council of South Africa (ECSA)
- HSRC surveys (1999).

Additional information on the supply of engineers and engineering technologists was obtained from the database of the Department of Education. It should be mentioned that there seems to be quite a significant discrepancy between some of these databases, the analysis of which resulted in apparently conflicting trends, particularly as far as the employment of engineers is concerned. An analysis of the data from the OHS, for instance, indicated a 15,3 % decline in employment between 1990 and 2001, while the HSRC's analysis from the LFS reflected an increase of 3,5 % over the same period. These different trends suggest that data from these sources should be treated with a degree of caution. Measures for cross-verifying and establishing the integrity of data sources have to be in place at all times in order to ensure reliability for planning and policy formulation purposes, particularly at executive levels. It is for this reason that one should focus more on trends than on absolute numbers – if a trend points in a certain direction, it would be justifiable to use it as one of several bases for strategy development.

Information on the supply of and demand for artisans was obtained from the following sources:

- A NACI-commissioned survey of 50 companies on the training capacity of the construction industry and recent skills demand
- The HSRC, Department of Labour (DoL) and Colleges Collaboration Fund (CCF) on public technical colleges
- A NACI-commissioned survey in the construction industry on project demand for the next five years
- The recently published report of the 2001 census.

Because of the limited time available for the execution of this project, surveys were not comprehensive and depended largely on expert advice provided by various representatives of industry, including the Shutdown Network Forum (SNF) and the Construction Engineers Association (CEA). Where appropriate, data were cross-validated with data from the DoL.

2.1 Skilled engineering work force

2.1.1 Training providers

The primary source of skilled engineers, technologists and artisans in South Africa is the formal education sector, which comprises a network of fairly advanced tertiary and further education and training (FET) systems. The tertiary education system consists of universities and technikons, while the FET band consists of secondary schools, technical colleges, industry trainers and private providers. This network of training facilities has to a large extent placed South Africa within the frontier of the engineering profession.

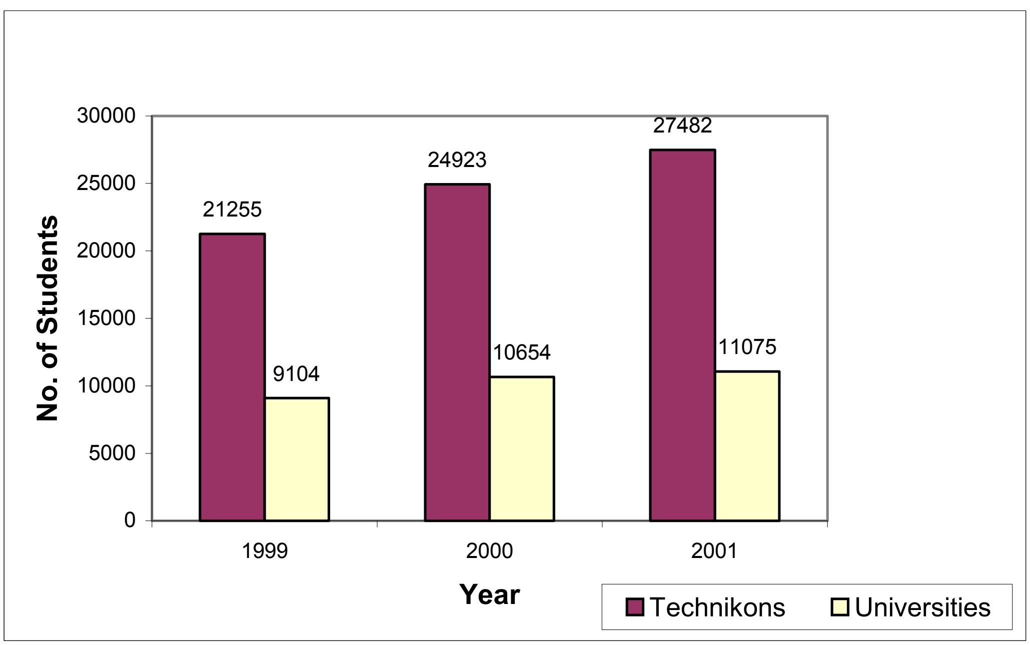
2.1.2 Supply of engineers and engineering technologists

Engineers and engineering technologists are supplied by a network of 12 universities and 15 technikons (currently being reorganised), which are situated in different provinces throughout the country. Most of the courses offered are accredited by the Engineering Council of South Africa (ECSA), which is responsible for co-ordinating standards across all faculties of engineering. University and technikon courses are respectively accredited by the University Accreditation Committee (UAC) and Technikon Accreditation Committee (TAC) of ECSA. This system ensures that all courses meet the desired standards.

2.1.2.1 Student enrolments at universities and technikons

Figure 2.1 shows the general enrolment trends for all registration categories. Although total enrolments in all categories have been increasing since 1999, certain technikon categories such as civil and chemical engineering have had a huge growth, while electrical and mechanical engineering have shown a decline over the same period.

Figure 2.1: Enrolment trends at South African universities and technikons (1999–2001)



Source: DoE database

Significant changes have taken place in the representation of students from different population groups, the main trend being a significant drop in the number of white students and an increase in the number of black students across almost all engineering disciplines.

The ability of tertiary institutions to attract new students and the propensity of school-leavers to respond to changes in the demand for engineering skills are central to determining whether the labour market succeeds in meeting the changing demand for engineering skills in South Africa. The HSRC report reveals two important factors with respect to the number of matriculants entering the engineering profession:

- The first is that the absolute number of matriculants with the requisite academic requirements (mathematics and science) has been decreasing. The HSRC reports that almost all faculties have instituted academic development programmes to compensate for the low quality of education of school-leavers entering tertiary education.

- The second factor is the attractiveness of the engineering profession to suitably qualified individuals. This is more difficult to assess, since it deals with students' perceptions of the profession. Remuneration and employability are some of the factors that are considered.

Finally, the HSRC reports that universities are willing to be more sensitive and flexible in responding to changing labour market demands in such ways as:

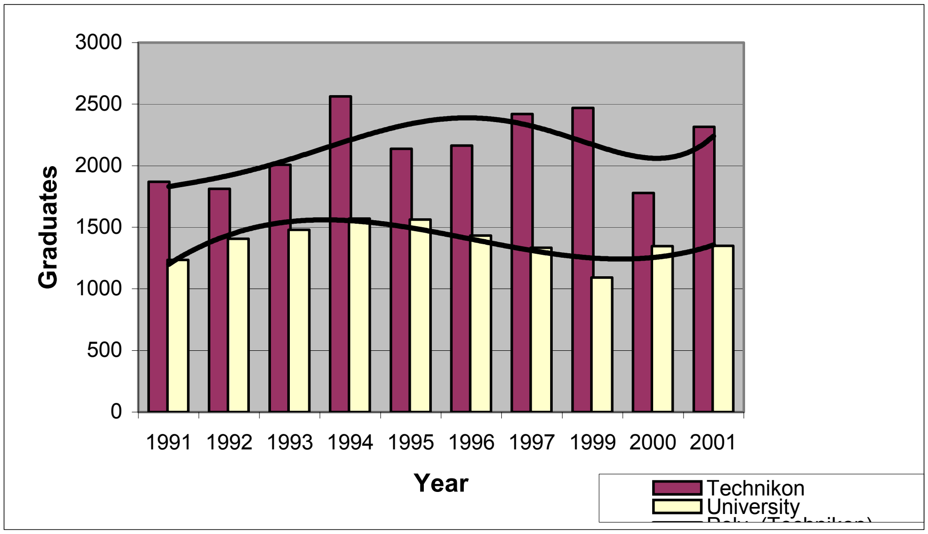
- Implementing national academic standards accredited by ECSA
- Forming programme advisory panels with industry representation.

2.1.2.2 University and technikon graduation trends

Graduation trends at South African universities and technikons are shown in Figure 2.2. As an overall trend, the tertiary education system recorded a decline in the number of engineering graduates over the past ten years. Data for technicians and technologists are unfortunately fraught with inaccuracies, which makes any comparison with university graduates unreliable.

Between 1991 and 2001, the total number of technikon engineering graduates with National Diplomas has been increasing, with a slight decrease in 2000 (Figure 2.2). This could partly be ascribed to the phasing out of the National Diploma and the introduction of a BTech degree instead.

Figure 2.2: University and technikon engineering graduates



Note: data for 1999–2001 include the National Diploma and BTech

Source: SAPSE

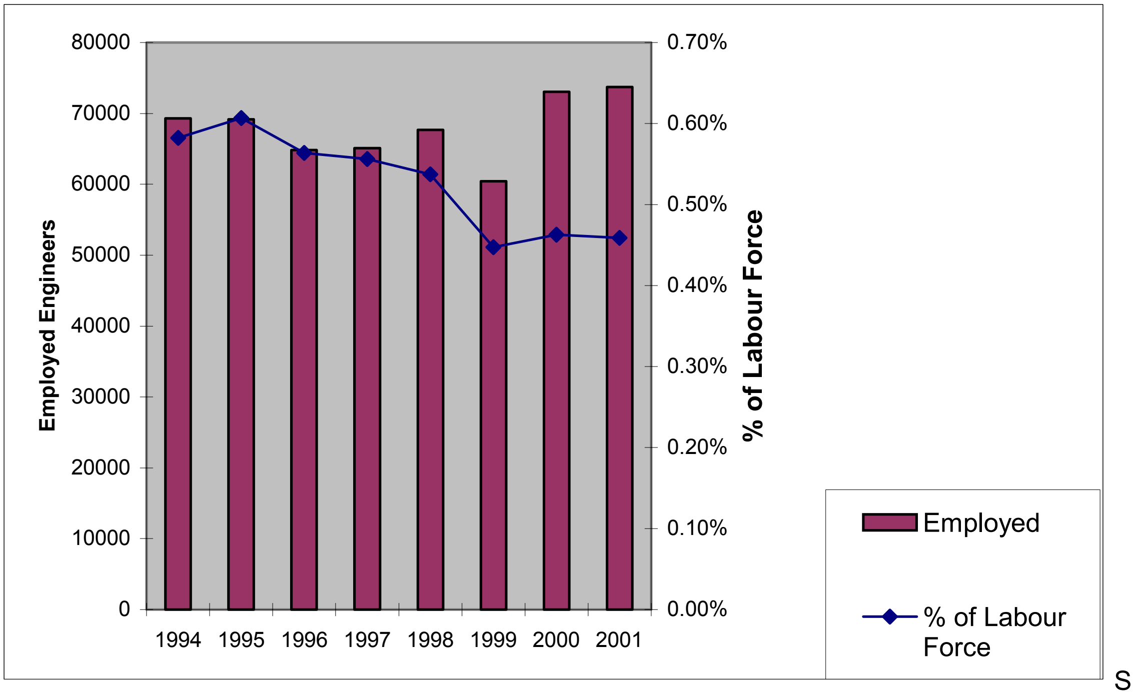
The situation at universities has been much more stable. There was a slight increase in the number of graduate engineers from universities between 1991 and 1995, followed by a slight decrease until 1999. The situation seems to have stabilised, as the number of graduate engineers has again improved since 2000. However, there has been a slight increase in the number of postgraduate engineering graduates. This may suggest, among other things, that the labour market requires a higher order of skills. Tertiary institutions seem to have responded well to this challenge, although the ratios do not match those from developed countries. The lack of reliable figures on the migration of engineers is a major concern and complicates the process of planning.

2.1.3 Demand for engineers and technicians

According to the HSRC, no recent data on the demand for engineering skills are available. Figure 2.3 shows the employment trends of engineers as a percentage of the total labour force over the past eight years.

Despite the recent decline in the number of registered professional engineers, the number of employed engineers increased in 2000 and 2001. The number of engineers as a percentage of the total labour force has, however, been stable since 1999. The HSRC reports that there has been a positive growth of more than 100% in the employment rate of electrical and related engineers and chemical engineers. Other disciplines that have experienced growth in employment include civil and mechanical engineering, at growth rates of more than 90% and 70%

Figure 2.3: Employment of engineers as a percentage of the total labour force



Source: Manpower Survey, OHS95-99, LFS2000-2001

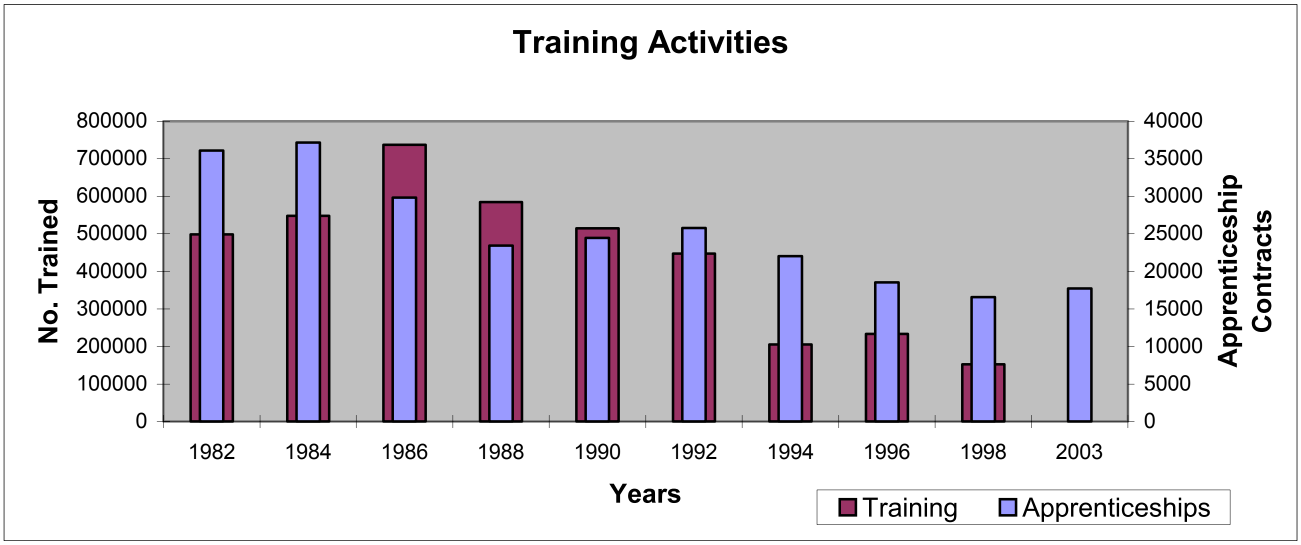
respectively. According to recently published census data for 2001, 17% (or 1 588 237) of the working population aged between 15 and 65 years were employed as professionals and technicians, and 73 750 engineers were in permanent employment in 2001. Therefore, although engineers represent 0.46% of the total labour force, they represent 4.6% of all professionals and technicians employed in the country.

2.2. Supply of artisans

Over approximately the last two decades, South Africa has experienced a drastic decrease in the total number of people trained as artisans, both by the private sector and public training centres. This trend has been accompanied by a drop in the number of apprenticeship contracts registered with the Department of Labour.

Figure 2.4 shows the level of training performed in the country and the number of apprenticeship contracts signed between 1985 and 1994. The graph not only shows how the number of trainees has declined over the past 20 years, but also shows a drop of 46% in the number of apprenticeship contracts signed between 1982 and 1998. As at March 2003, the number of apprentice ship contracts were already 17735 which is a 7% improvement on the 1998 number, this is possibly an indication that apprenticeship training within the country is regaining

Figure 2.4: Training of artisans in South Africa



Note: data for 2003 are not available

Source: DoL, HSRC

momentum. The recently published State of Skills in South Africa, which was published by the Department of Labour, shows that there has been an enormous growth in the number of structured learning programmes in 2002/2003. There is an indication that the low levels of apprenticeship training in the country could be associated with the level of uncertainty surrounding learnerships and the future of apprenticeships in South Africa.[4]

2.2.1 Training in the construction industry

The significant drop in the number of apprenticeship contracts signed between industry and learners over the past 20 years clearly indicates a worrying decrease in the overall number of learnerships in South Africa overall. A recent NACI-commissioned survey among 50 companies on the availability and capacity of major industry training facilities and the number of artisans of different disciplines currently undergoing training (Table 2.1) revealed that all the companies surveyed provide training not only for their own needs, but also for other organisations.

[4] In his speech during the opening of the 2003 National Skills Development Conference, the Minister of Labour (in addressing this issue) is on record saying: … "no one need be concerned that apprenticeships will suddenly cease to exist in the near future. I do not want to fully merge apprenticeships and learnerships until we can be sure that the graduates from the learnership system can command a similar level of recognition from the labour market as artisans do."

Table 2.1: Training capacity of SA construction industry (April 2003)

Discipline	Estimated training capacity p/p per annum	Institutionalised training
Welders/ Coded	1 918	1 224
Pipe Fitters	582	386
Boilermakers	1 196	1 610
Riggers	1 048	483
Mechanical Fitters	878	614
Instrument Fitters	808	322
Electricians	1 466	965
Civil Artisans	10 660	7 312
	18 556	12 916

Source: NACI Survey

A comparison with similar data from the Department of Labour shows that the NACI survey, although limited in scope, does indeed cover 73% of the total number of apprenticeship contracts reported by the Department of Labour in 2003 (Figure 2.4). The NACI survey clearly revealed that only about 70% of the reported available training capacity is currently being utilised.

The survey further confirmed the desirability of industry-based training, as qualifications are then far better aligned with the industry and with company-specific requirements. However, industry-based training may also have some limitations; for instance, concerns are sometimes raised that:

- Some trainers are not aligned with or accredited by SAQA, rendering the qualification worthless outside the current places of employment and not a suitable platform for further education.
- Some organisations do not issue certificates for training and employment, limiting the mobility of artisans as regards job seeking and further education.

2.2.2 Training at technical colleges

The following engineering courses are currently being offered by a number of FET colleges throughout the country: chemical, mining, electrical (heavy and light current), instrumentation and control, mechanical, construction, computer technology and telecommunications. According to a recent report published by the Colleges Collaboration Fund (CCF), 470 788 FET students sat for engineering examinations in 2000 but only 213 140 passed, a pass rate of 45%. A very similar pass rate was recorded in 2000 for the post-N3 level, when only 74 497 of a total of 153 053 engineering student passed their examinations.

Recent media reports have cast a shadow over the impact of this sizeable number of graduates, however, stating that only 28% of graduates from technical colleges are in permanent employment, with a further 6% self-employed and the remainder unemployed (*Business Day*, 23 July 2003). NACI enquiries among experts from industry and Sector Education and Training Authorities (SETAs) as to the reasons for this unsatisfactory situation elicited inconclusive responses, the most typical being that such institutions are “poorly equipped for practical artisan training and do not provide good learnerships”. Hence, graduates from such institutions “enter the job market without a complete qualification and as a result may not find suitable employment”.

2.3 Demand for artisans

Whereas the level of demand for labour is determined primarily by the rate of growth of the entire economy, which in turn is affected by a wide range of influences, including government policy, external shocks (such as oil price increases, threats of war and the attacks on the Twin Towers in New York) and business cycle fluctuations, the supply of labour to the economy is usually derived from flows of graduates from the various training institutions into the labour market, which is even more directly affected by government policies.

Some decades ago, it was thought that the co-ordination between supply and demand could be solved by means of planning through the so-called ‘manpower requirements’ approach which:

- Began by setting a goal for the level of the gross national product after a number of years
- Based on these goals, estimated the need for labour and the required educational qualifications
- Contrasted the demand for labour with the current workforce and the flows of graduates from the various training institutions.

Based on this information, it was then supposedly possible to plan requisite human development programmes. This methodology did not work as visualised, however. To date, the issue of demand information continues to present serious problems for planning. As a result, a number of SETAs have instituted programmes aimed at sourcing Work Place Skills Plans from the industry, but this process has not been very successful, and a number of SETAs have reported problems in trying to source data from industry.

In order to estimate the skills requirements for the construction industry, NACI was informed by two surveys to determine the labour resource requirements.

2.3.1 Labour resource requirements survey

A survey performed as part of this project used the total installed cost (TIC) of major capital projects earmarked for execution in South Africa over the next few years to estimate a high level view of the associated construction labour resource requirements. The TIC used for the projects includes the cost of the following areas within a project phase – study, BEP (basic engineering phase), EPCM (engineering, procurement and construction management), construction labour and all equipment, materials and subcontracting activities. The TIC was established by using information provided by clients or sponsors who are aware of the scope of requirements per project. Using past project experience and estimating methods within the Fluor system, the actual labour force requirements can be predicted. Based on the project start and finish dates, a realistic manpower loading within the industries investigated can be prepared for the near future.

Information used to compile this study was gathered from two industry-wide surveys. The first survey was performed by Fluor and Sasol Technology, and the second was commissioned by NACI after a review of the results of the first survey, in order to update and expand the original data set. NACI collected the data and Fluor performed detailed estimates, incorporating in-house knowledge and past experience to produce an estimated future requirements survey giving a ‘snapshot in time’ view. Figure 2.5 gives details of the projects included in this survey, broken down by industry.

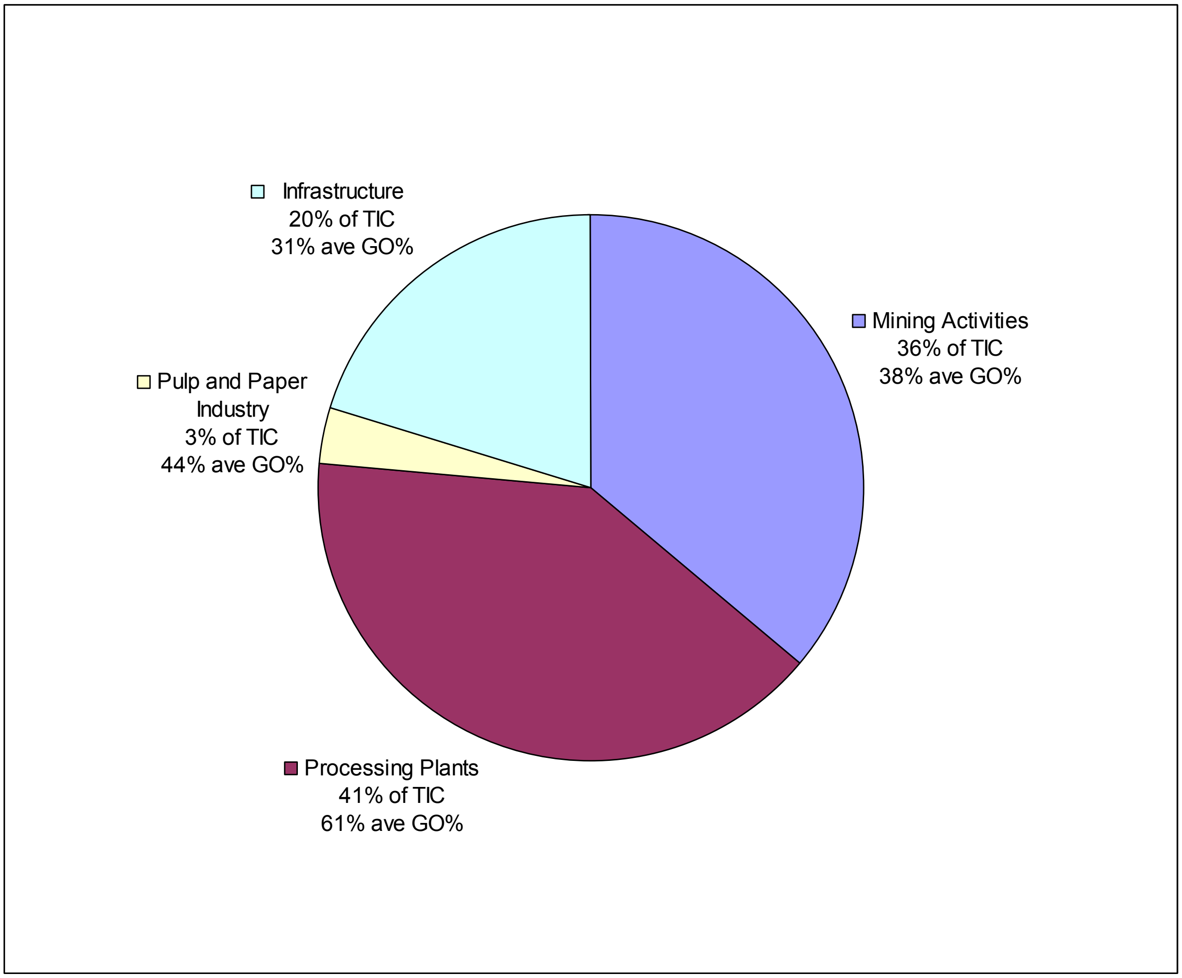
The sum of the TIC for the 320 projects included within the survey amounted to R342.5 billion.[5] Each project was reviewed in relation to its approval status on the basis of which a percentage of the TIC has been used to indicate the statistical chance, referred to as the GO%, that the project will actually commence as planned. An average GO% of 44% was calculated for these projects, indicating that approximately R150.7 billion will possibly be spent on major capital projects within the next seven years. It should be noted that projects occurring later in the decade have lower GO%’s and thus the labour requirements are affected proportionately

Figure 2.6 shows a breakdown of skills requirements over the next few years. According to this graph, a peak period of project construction is expected to occur in 2004, drawing on an average 103 000 additional construction workers of all skills, of which 66 000 will be in the skilled and semi-skilled categories. According to Census 2001, the construction industry currently employs

[5] It should be mentioned that this project concentrated only on large-scale engineering projects. It is therefore possible that most of the smaller projects have been excluded. A total installed cost (TIC) of R342.5 billion should therefore represent a conservative estimate of construction projects to be undertaken in the country.

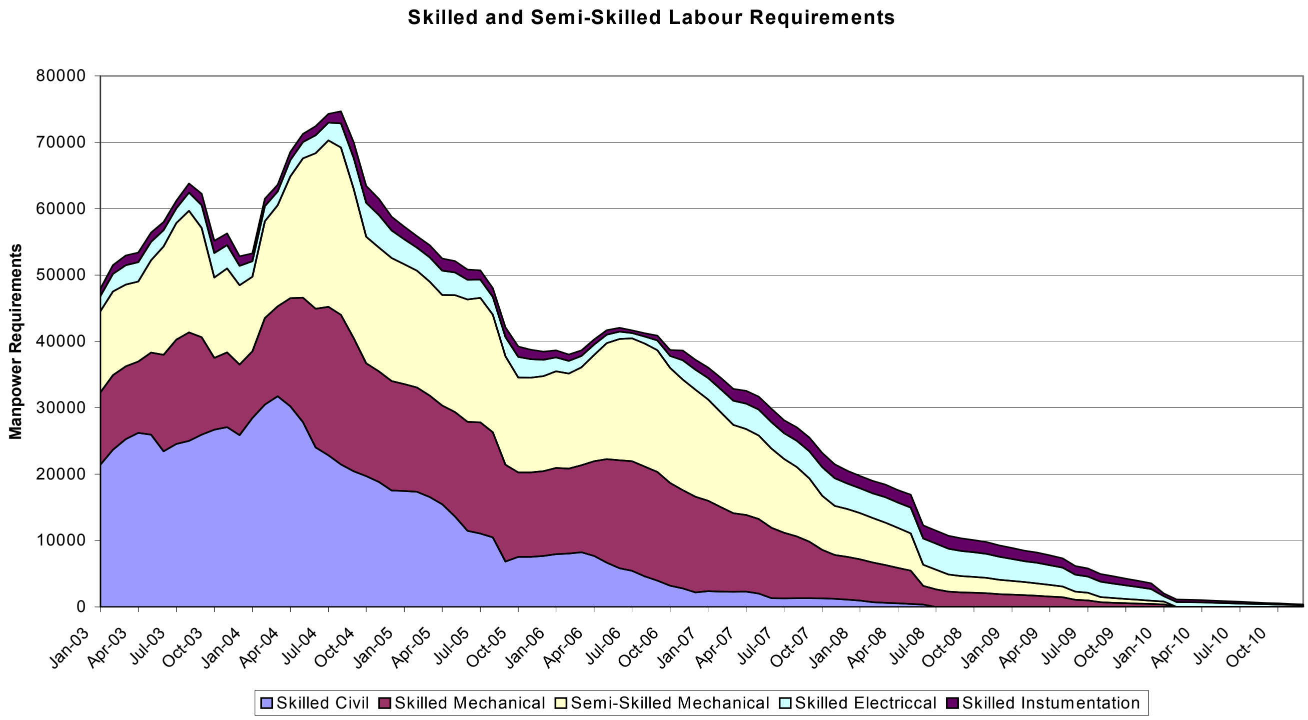
520 486 workers of all skills. The results of this survey therefore predict a 20% increase in employment by the construction industry. Figure 2.7 presents a further breakdown of the skills requirements by category of skills. The time lines indicated in the graphs are dependent on the individual project timing assumptions at the time of the survey. Any subsequent major decisions impacting on the assumptions could affect the time lines and labour requirements proportionately.

Figure 2.5: Industry breakdown of projects earmarked for implementation in South Africa



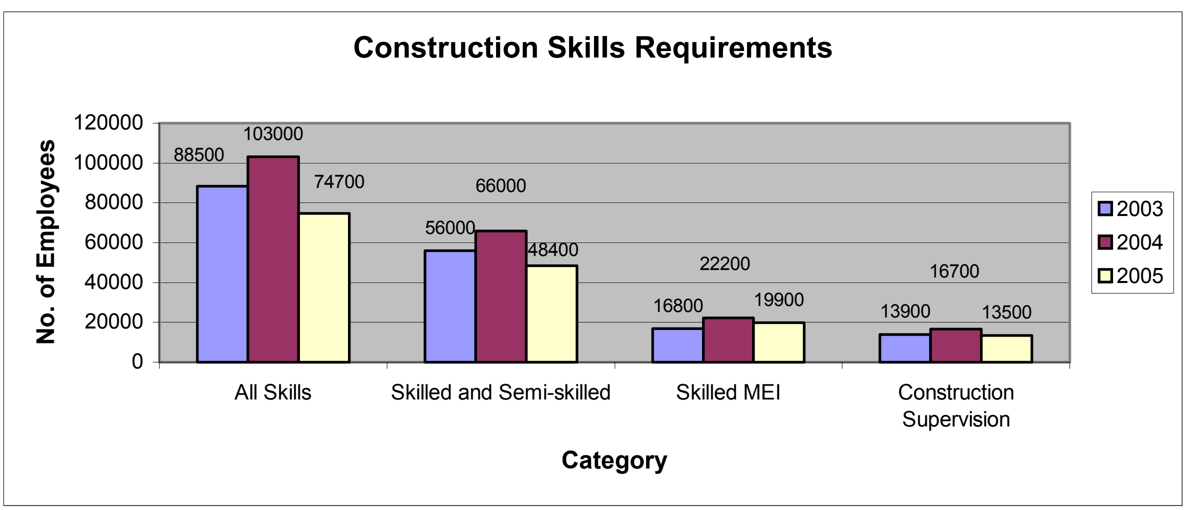
Source: NACI Survey

Figure 2.6: Construction skilled labour requirements



Source: NACI Survey

Figure 2.7: Summary of skills requirements by skills category[6]



Source: NACI Survey

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[6] Unskilled workers are generally regarded by the industry as NQF levels 1 and 2; Semi –skilled as NQF 3 and 4 and skilled workers as NQF level 5.

According to this figure, the peak demand for labour at all skills levels would be 88 500 for 2003, increasing to 103 000 in 2004. This means that 14 500 additional artisans of all skills levels will be required to successfully implement projects in 2004. In the case of mechanical, electrical and instrumentation skilled artisans (MEIs), the figure increases from 16 800 in 2003 to 22 200 in 2004, representing an increase of about 5 400. Finally, the peak requirement for construction supervision increases from 13 900 in 2003 to 16 700 in 2004.

2.3.2 Skills supply survey

Information on the supply of artisans in South Africa is very scarce, but Census 2001 data show that more than one million of the working population of South Africa are employed as crafts and related trades workers. Unfortunately, the census data do not provide a further breakdown by skills category and industry. In order to estimate the number of skilled artisans in the construction industry, NACI commissioned a survey to determine the number of skilled contract artisans employed by the construction industry for the past three years as at June 2003. Organisations were asked not to include artisans employed in maintenance activities. In order to ensure that the data received were representative of the South African construction industry, NACI requested the SNF and CEA to supply a list of major organisations. Table 2.2 lists the total number of artisans used by these companies in the three years under review.

Table 2.2: Artisans[7] contracted by the construction industry (July 2000–June 2003

Category	Artisan	Supervisors
Mechanical skilled artisans	12 500	640
Instrument Fitters	1 000	6
Electricians	1 300	40
Civil Artisans	800	1
Total	15 600	687

Source: NACI Survey

Table 2.2 shows that approximately 15 000 mechanical, electrical and instrumentation (MEI) skilled artisans were active in construction/shutdown related projects for these companies over the past three years. Although this value is used as an indication of the current supply of contract artisans, it may overestimate available supply in the country since:

[7] Mechanical artisans in construction generally include fitters, pipe fitters, boilermakers, welders, riggers and structural steel fitters; civil artisans include bricklayers, concrete finishers, steel fixers and shutter hands

- There is the real possibility of double counting as some artisans may have been employed by more than one construction company over the three-year period
- There could be imported artisans included amongst certain categories

2.3.3 Comparison of supply and demand

The Labour Resource Requirements Survey shows that the demand for skilled MEIs will peak at 16 800 in 2003, increasing to 22 200 additional artisans in 2004. The total increase in the demand between 2003 and 2004 is therefore 5 400. The skills supply survey shows that there are approximately 15 000 artisans in the skills pool, who are normally available for sub-contracting by the construction industry. The shortfall between supply and demand is therefore approximately 2 000 skilled artisans in 2003 and 7 000 in 2004

It was not possible to analyse the supply and demand trends for the semi-skilled and other categories, as no data were available on the supply of these skills levels.

2.3.4 Concluding remarks

- The labour resource study predicts a possible 20% increase in labour requirements by the construction industry.
- Of these, between 2 000 and 7 000 skilled MEIs will be required by the industry between 2003 and 2004.
- Notwithstanding these observations, there was a drastic decrease in the level of apprenticeship contracts between 1982 and 1998; data for 2003 show an increase, however.
- Existing industry-based training facilities, which have the capacity to provide training for 18 000 artisans per annum, are currently being utilised at only 70% of their capacity.
- The FET system should be the largest producer of engineering graduates by far. In 2000, 280 000 learners graduated, but only 34% succeeded in finding employment.
- Courses offered by technical colleges do not seem to be aligned with industry requirements, as graduates from these institutions are purported to have theoretical training but very little practical experience.

SECTION 3
THE UNDERSTANDING OF SCARCE SKILLS ISSUES IN SOUTH AFRICA: A QUALITATIVE ASSESSMENT

3.1 Introduction

Skills are the necessary competencies that can be expertly applied in a particular context for a particular purpose, and skills shortages (or 'scarce skills') occur only when demand for any particular skill outstrips supply. Scarce skills could therefore present as much of an issue for the professional community as in the labourer community, and it stands to reason that a shortage of skills could have a negative impact on the South African economy. The paradox for South Africa is that the labour market is more geared to supplying unskilled and semi-skilled people than skilled people.

In mandating initiatives such as the development of an Advanced Manufacturing Technology Strategy (AMTS) and in supporting the Sasol investigation into construction skills shortages in the petrochemical sector, NACI has raised questions about the availability of skills in South Africa to grow the economy at the required rates. Furthermore, these initiatives have brought into question our understanding of the current situation regarding this important issue.

The available evidence indicates that there is indeed a significant demand for people with skills, which is not matched by their availability, and factors such as economic growth, sectoral levels of labour intensity, projections of net migration, sectoral age profiles, the business cycle, government expenditure decisions, projections of HIV/AIDS morbidity rates, industrial policy and foreign direct investment, all affect this supply and demand dynamic.

Without an understanding of the dynamics of the skills environment, it is not possible to plan appropriately, and the consequences of skills imbalances are undoubtedly negative. NACI therefore requested a rapid assessment of the level of understanding of scarce skills-related issues in the economy.

3.2 Methodology

In assessing the level of understanding of scarce skills in the economy, four key strategic role-players in developing skills were consulted, namely:

- The Skills Development Planning Unit (SDPU) in the Department of Labour, which was established in 1999 in terms of the Skills Development Act (No 97 of 1998). The SDPU researches and analyses the South African labour market in order to determine skills development needs; assists in the formulation of sector skills development plans; and provides information on skills primarily to The Minister, National Skills Authority, the SETA structures and education and training providers.

- The provincial Departments of Labour through an assessment of the Provincial Skills Plans
- Twelve of the 25 SETAs most closely associated with engineering and manufacturing, which are mandated to operationalise the Skills Development Act.
- The HSRC, a national research body that carries out labour market studies for the Department of Labour, among others.

Representatives of the SETAs, HSRC and SDPU were interviewed and asked to identify completed assessments of skills needs and availabilities; initiatives in progress to better understand the skills needs of sectors; and any initiatives that are in place to address skills imbalances (need versus availability). These interviews were supported by appropriate literature reviews of the policy environment and analysis of the SETA Sector Skills Plans (SSPs) and the Provincial Skills Plans.

3.3 Findings and conclusions

The findings of this assessment indicated that the concept of scarce skills was well understood across the economy but that the distinction between scarce skills (for example, insufficiency in chemical engineers) and skills gaps (for example, sufficient chemical engineers but lacking experience in say, catalytic processes) lacked clarity. A skills gap was defined as being different from a scarce skill and occurring where deficiencies in the employed workforce retard the ability of employers to achieve strategic and business objectives. The skills levy is intended to support the increase in all training, but it is not sufficient to solve the current supply of skills. The levy represents only 1% of payroll, and international trends show that companies need to spend between 4% and 7% in order to be successful in addressing the current skills shortages and gaps.

An understanding of this distinction is also important for determining the ways in which the problem is addressed. For example, in the case of an insufficiency in chemical engineers, actions at secondary school level and incentives for matriculants to enter tertiary education may suffice; but for skills gaps, short courses, coaching and advanced tertiary education would be more appropriate. The interchangeable use of the term ‘scarce skills’ with ‘skills gaps’ is likely to cloud remedial decision-making. Furthermore, while the concept is understood and all SETAs have some idea of key scarce skills/skills gaps, the quantification and to some extent, the qualification, of scarce skills is insufficient for accurate decision-making.

3.3.1 Skills supply: a macro-level perspective

The supply of highly skilled workers into the economy is an area of concern. Between 1993 and 1999, enrolments at higher education institutions were relatively static, yet learner/staff ratios have increased and are stretching an already weak academic system. In 2000, only 31% of academics in public institutions had doctoral qualifications – much lower than in comparative countries. Allied to this is that South Africa has a shortage of research and development skills, given that there are only 1.6 researchers per 1000 in the labour force – again much lower than in countries with similar per capita income levels. This is likely to become more problematic as migration and the age profile further reduce the highly qualified pool.

Within the higher education system, and specifically in technical disciplines, it appears (the assertion must still be scientifically validated) that there is an upward movement by students out of the BTech and certificate courses into higher education, thereby reducing student outputs at the NQF 5 level.

This is further compounded by the fact that industry views the further education and training (FET) colleges, which fall under the Department of Education, as being too slow to adapt to their changing needs. This is particularly true of the engineering subjects, which are not well supported at college level, and which have curricula that are insufficient in preparing students with the necessary skills – a source of the skills gap problem.

The same situation applies to the supply of managers, which is sufficient at an aggregate group level, but concerns about the adequacy of skills and experience, as well as the supply of specific management expertise, have been raised.

Within the workplace, skills development is also lacking, with only 17% of the employed population receiving any training in work-relevant skills. It is encouraging that the training profile is fairly equally distributed across occupational categories, such that labourers and professionals are receiving similar amounts of training.

Other factors affecting the supply of skills are migration and the impact of HIV/AIDS. While uncertain in magnitude, both will negatively affect the skills profile at all levels of the workforce.

Given the definition of skills, skills shortages are likely at all levels of the economy, as a result of relatively low levels of education in the workforce and static growth in higher education outputs.

3.3.2 Skills demand: a macro-level perspective

While many of the SETAs are in the process of researching the demand for skills, industry commitment to skills development is questionable, given the low percentage returns of workplace skills plans. This, in part, limits the SETA evaluations of 'scarce skills' or 'skills gaps'[8] and highlights the broader problem of insufficiency in the understanding of the quantitative and qualitative requirements. The SDPU acknowledges that the accuracy, comprehensiveness and reliability of information regarding scarce skills is uncertain and that uncertainty about the labour market, economic change, and their resultant effects on the skills profile, make the identification and quantification of skills shortages problematic.

A high level assessment, which can only 'signal' scarce skills, is presented in Table 3.1.

Table 3.1: Skills in demand

Major skill ccategory	Associated skills
Management	Financial management Production planning Logistics management Business leadership Facility management Training management Human resource management
Professional	Software engineers Industrial engineers
Technical and IT	Water engineering technicians Road engineering technicians Electrical engineering technicians Mechanical engineering technicians Traffic engineering technicians Draughtsmen Computer programming Computer draughting Computer aided design Computer systems analysis

More detailed understanding is derived from other sources such as the National Industrial Training Survey of 2000, in which 88% of the firms interviewed perceived skills shortages to exist in the 'technicians' category, while only 56% and 35% perceived skills shortages to exist respectively in the 'manager' and 'professional' categories.

[8] It could be asked which specific skills gaps and shortages are being focused on – the technical or the soft skills? While the report covered both aspects at a high level, the detailed emphasis was on the technical skills.

The data would again appear to be supported by the fact that 47% of registered learnerships are within the NQF4 and 5 level, where technicians receive 'intermediate level' training.

These studies therefore indicate an understanding at a macro level that there is a surplus of unskilled and semi-skilled people and a shortage of higher-level skills that will facilitate economic growth (for example, executives, managers, technicians). Furthermore, the provision of these higher level-skills, especially technical qualifications, is lacking both in the workplace and in training institutions.

3.3.3 Skills supply and demand : a SETA level perspective

At a more micro level, almost all SETAs lack information on quantitative skills requirements, which is further exacerbated in some SETAs by a qualitative gap in the identification of skills categories. Yet there appears to be reliance at a number of levels in the economy (macro and provincial) on the SETAs as being the responsible bodies for co-ordinating the identification of scarce skills in South Africa. That said, it is encouraging that many of these SETAs acknowledge the importance of rectifying the situation and have studies, either planned or in progress, to do so. Many of these reports will be available by December 2003.

While the completeness of these forthcoming reports will have to be evaluated in due course, the emphasis on future skills needs in current SSPs and research is probably too limited.

The timeframe for training to be effected to meet identified needs, is, in some cases, too long to have a meaningful impact on current requirements, which highlights the urgency with which likely future needs must be identified. Engineering graduates, for example, require four to six years of training (BSc to MSc), and the future focus needs to extend at least that far ahead in order to ensure graduates with the requisite skills.

A number of reports have also indicated that there is a need to develop new curricula and to ensure that the skills sets are aligned with the needs of industry. The involvement of the further education and higher education training institutions is critical in defining a shared vision for future training, based on need.

Through the analysis of the SETA Sector Skills Plans, it is very clear that the most pressing need for skills development to address 'shortages' or 'gaps' is at the technical level.

NQF levels 4 and 5 are the main problem areas, which may support the argument that the apartheid economy encouraged the development of high-level skills, the importation of expatriate skills and the suppression of skills development in the black community. Most notably, this is seen in the development of intermediate skills (NQF levels 4 and 5).

Coupled to this is the view of some respondents that the education system is not providing sufficient numbers of school-leavers with the required competencies for further training, and that this is resulting in skills shortages. The impact of relatively low school matriculation rates on the opportunity for further skills development is cause for great concern. This was highlighted in the Gauteng Provincial Skills Plan, but is probably true for the country as a whole.

Employers also need to contribute to rectifying the skills issues. In many cases, as outlined in confidence by some SETA respondents, the reason for the gap in understanding scarce skills issues is that employers do not co-operate with SETA programmes to address the issues. Employers view the development of the national skills pool as another bureaucratic/regulatory 'have to', and their response is therefore neither complete nor strategic. This point is corroborated by the poor response of companies submitting workplace skills plans (WSPs) – in the Chemical Industry Education and Training Authority SETA, for example, only 7% of registered companies had submitted WSPs by November 2002.

Lack of workplace training leads to a lack of experience, and while South Africa does not have a lack of engineers, it does appear to have a lack of experienced engineers. Furthermore, the lack of workplace training also leads to migration into other occupational categories in areas such as finance and IT.

Another important finding of this study was that there appears to be limited interaction between SETAs. In one case, there was recognition that the skills sets required in a particular industry were covered by another SETA, which introduces the possibility either of double counting (resulting in excess skills training) or inaction by both parties (and further shortages), as each believes the other will develop this skills base.

3.4 Final comment

To date, the impact of scarce skills on the economy has either been mitigated by the relatively low economic growth rate, and/or been a causal contributor to it. Unfortunately, the data set does not allow for a more specific analysis, but any economic upturn is likely to be seriously compromised by skills inadequacy. In addition, the HIV/AIDS pandemic has been cited in many Sector Skills Plans, but the effect of this on future skills supply does not seem to have been seriously investigated.

Without a future focus, detailed information, and better linkages between educational and higher education systems and employers, South Africa seems unlikely to become competitive through the provision of the right skills set an any given point in time.

Finally, it should be realised that the skills levy represents only 1% of payroll, which on its own it is insufficient to address the current skills problems. It is, however, important for industry to augment these training funds in order to achieve the international trends of a 4–7% investment on training.

SECTION 4
ADDRESSING SKILLS SHORTAGES IN THE CONSTRUCTION INDUSTRY: BEST PRACTICES

4.1 Introduction

The construction industry in South Africa is faced with many challenges; many of these are shared with other developing, and even developed, countries. Globalisation, new technologies, more demanding clients and new methods of construction, coupled with lowest-cost drivers, appear to have left the global construction industry lagging.

The discussion that follows outlines some of the actions identified by the United Kingdom, Korea, Australia, Canada and Finland to address the skills shortages in their respective construction industries. (Most of the information included is relevant as of 2000 at the earliest.) In addition, some successful programmes that have operated in South Africa are included as examples of tailor-made approaches adopted in our region.

A possible solution to problems associated with lowest-cost selection of tenders is through 'partnering' or 'alliancing'. This methodology is briefly discussed.

4.2 Australia

The peak–trough nature of the construction industry has a great impact on the available skills pool. Skilled workers are often lost to the residential market or other industries during a slump, leading to severe staffing problems during growth periods. A two-tiered approach to recruitment planning, acknowledging the nature of the industry, is suggested. To attract and retain skills during boom periods, superior employee benefits, strict safety policies and well-defined career progression opportunities should be offered. During a slump, every effort should be made to avoid the redundancy of skilled workers, with due regard for the needs of the next upturn.[9]

The Building and Construction Industry Working Group, under the Australian National Industry Skills Initiative, presented a detailed report on present and future skill needs during August 2001.[10] The working group identified two key training challenges for the industry:

- Training new entrants and ensuring they are rapidly equipped to provide a positive contribution on site
- Broadening and deepening the pool of skills on which the industry draws.

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9 TAD Technical Careers and Contracts, April 2002
10 www.skillsinitiative.gov.au/2nd_round_industries/ working_group_reports/building_report.pdf

Key issues and recommendations arising include the following:

- Skilled occupational outcomes should form part of nationally recognised qualifications.
- Government and industry should develop a targeted marketing campaign to improve community understanding of the range of career and training opportunities within the industry.
- The benefits of training, with the emphasis on training as an investment rather than a cost, should be marketed to the industry.
- Industry and employee organisations should work with government in order to reach agreement on principles to be developed to underpin training wage arrangements and complement training reforms.
- Training systems should focus on developing an intensive industry-specific induction training system to equip apprentices with practical skills to contribute to the productivity of work sites.
- Linkages between industry and training providers (including schools) must be improved.
- Local governments should be encouraged to work with industry in developing employment and training strategies that meet the needs of people in rural and regional locations.
- Industry and government should examine the processes and practices that will encourage public sector clients to contribute further to the investment in training.

4.3 Canada

In Canada, a gap has been identified between apprenticeships and education.[11] Discussions with tutors, apprentices, educators and scholars led to the following recommendations regarding training for young workers entering the construction industry:

- Take a proactive approach to learning assistance
- Create upgrading networks to ensure that learning does not stop when formalised training ends
- Exchange professional skills
- Provide joint professional opportunities for educators and trainers
- Develop self-study and preview materials for technical training
- Educate the education system on apprenticeship.

The Construction Sector Council (CSC) has, as one of its key objectives, the task of improving the image of the trades within the construction industry, both to promote industry in general and to secure the skilled workforce needed. It works on various career awareness campaigns aimed specifically at young people, involving representatives from government, industry and business.[12]
The National Steering Committee for Innovation in Construction (NSCIC) is a transitional organisation with the aim of developing a permanent industry configuration that is able to foster and maintain innovation across the sector. In its June 2002 sector report, it recognises the crisis of the skilled labour

11 www.skillplan.ca/background.htm November 2001
12 http://www.councils.org/1newsroom/pdf/CSCdimensions_oct_2002.pdf October 2002

shortage in the Canadian construction sector. The development and implementation of a national human resources development strategy is highlighted as a priority for action. It is recommended that this strategy include:

- Improving the public image of the sector as an employer with a poor safety record and poor working conditions
- Methods to attract young people to the industry
- A skills development strategy
- Developing recruitment and retention programmes.

4.4 Finland

Training is regarded as the most important means of overcoming the skills shortage, particularly vocational and apprentice-based training leading to vocational diploma qualifications. This customised on-the-job training is targeted to provide the necessary trained labour, and initial indications suggest that it is successful, but it is clear that future success will depend on tripartite co-operation between government, employers and trade unions.[13]

4.5 Korea

The Korean Ministry of Labour's 'Basic Plan to Improve Employment Situation of Construction Workers' aims to help construction workers systematically accumulate relevant skills and facilitate the workforce demand and supply in the sector. The initiative was taken to resolve the problems of skilled workforce shortages and an aging industry, resulting from the multi-layered subcontracting system, employment practices that mainly use daily workers, and the unorganised employment management system.

Strengthening the vocational capability development system will take place through institutional revision and training courses tailored to the demands of the construction market, as well as by expanding training opportunities by financially assisting employers in setting up training facilities and equipment.[14]

4.6 United Kingdom

According to the Institution of Civil Engineers (ICE), competitive tendering for design plays a key role in perpetuating the skills shortage afflicting civil engineering.[15] Lowest-cost design contributes directly to the skills shortage by preventing engineering companies from providing challenging careers. A call

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13 Finnish Ministry of Labour, 1997
14 http://www.koilaf.org/ November 2002
15 www.ice.org.uk November 2002

was made for the adoption of high quality procurement practices and rolling infrastructure plans to eliminate the peak–trough pattern traditionally suffered by the engineering profession.

ICE further advocates a team effort incorporating the professions, employers, training providers and government. The skills shortage is best addressed through promotion of the professions, targeted professional development and the use of the best working and project procurement practices. The following sections describe some actions targeted to achieve these goals.

4.6.1 Promotion of the professions

- Companies and trade unions within geographical areas work together to encourage young local people to consider a career in the engineering and construction industry.
- A National Construction College provides practical training leading to National Vocational Qualifications (NVQs), with the industry levy covering all training of 16–24 year olds.[16]
- The image of the industry is being changed to ensure that school-leavers and their parents view the construction business as a respectable career.
- Schemes are available to encourage contractors to take on new trainees, at adult or apprentice level, through subsidised training costs and wage subsidies.[17]
- The Building Work for Women (BWW)[18] scheme aims to increase opportunities for newly trained tradeswomen in site employment, responds to NVQ requirements for more site work, and lowers the barriers for women wishing to enter the construction industry. The Build Up programme, in particular, was developed to address the skills shortages and skills mismatch in construction. It focuses on increasing workforce diversity, encouraging life-long learning and involving local businesses and people in regeneration work.

4.6.2 Targeted professional development

- Training must be at the top of the agenda.
- The opportunity for career progression within the industry is increased through the NVQ route to professional qualification; skilled workers are able to graduate from manual trades.
- Training providers and industry need to ensure that the courses offered reflect the needs of employers.

4.6.3 Best working and project procurement practices

- Improvements in health and safety to attract more women into the sector.
- Employment of local sub-contractors to help them qualify their workforce.

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16 http://www.citb.co.uk/citb_home.htm July 2002
17 www.objectiveone.com/client/media/media-49.html November 2002
18 www.bww.org.uk

4.7 South Africa

Fluor trained in excess of 20 000 trainees for the Sasol 2 and 3 projects in Secunda during the late 1970s and early 1980s. BHP Billiton focused its training and development initiatives on local communities through its Community Empowerment Strategy[19] on Mozal 2 and Hillside 3 (see Appendix 1). Recognition of prior learning and use of accredited training increased the formal skills base, with the added benefits of improved productivity and labour harmony. SME development initiatives resulted in a workable model and awareness of the need for continued support, post project, to ensure sustainability of the SMEs created during the project.

The South African construction industry recognises the importance of outcomes-based training, overseen by long-term training and skills development plans, and acknowledges that the SETAs are the logical implementation bodies.[20]

4.8 Partnering

Partnering is a structured management approach to facilitating teamwork across contractual boundaries.[21] It requires advanced contracting skills, and all partners share in the risks and reward. An advantage of a partnering contracting process is that all parties meet at the start of the project, and any gaps are identified early in the process.

With respect to skills shortages in particular, these can be addressed through advanced planning and training programmes. Partnering, in itself, cannot solve the skills shortages problem, but it can enforce a joint effort to address the issue along the entire supply chain for a particular project. The lessons learned and data accumulated will be valuable inputs to the national understanding of the skills shortages in the industry. A broader approach is required for the construction industry as a whole, however.

4.9 Conclusions

Unfortunately, no concrete examples of successfully addressing skills shortages in the construction industry over the long term could be found. It does appear, however, that the countries reviewed are adopting similar strategies to solve their particular skills shortage problems.

A common approach is to attract more young people to the construction industry, provide better training that is synergistic with industry needs and provide career opportunities that retain skilled

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19 *Achieving Empowerment Objectives in a Mega Project Environment*, Louis Smidt, BHP Billiton

20 Workshop participant's comments, by e-mail.

21 UK Construction Industry Board, *Partnering in the Team*, Working Group 12, 1997

workers. In most examples, close co-operation between government, industry and training bodies is regarded as a necessity.

In addition to specific skills shortages in the construction industry, economic and social conditions in South Africa draw considerations of poverty alleviation, and race and gender equity, into play. Again, only close co-operation and long-term planning will ensure an able skills base for the industry.

SECTION 5
POLICY FRAMEWORK

5.1 Introduction

The previous sections focused on quantitative and qualitative overviews of the demand, supply and training sides of the construction industry, as well as a selection of best practices to address skills shortages. The provision and deployment of skills, however, does not take place in a policy vacuum. On the contrary, it is sometimes argued that policy is one of the key variables in explaining phenomena such as an under or over supply of certain skills. This section takes a birds' eye look at the policy landscape with regard to skills provision/training in South Africa and addresses the following questions: What does the policy space currently look like? What impact would current legislation and/or policies have on skills development in the construction industry (specifically artisans/tradesmen, engineers, technical staff and project managers)? To what extent, if at all, could problems/possible gaps in current legislation and/or policies impact on skills development in this specific context?

An in-depth analysis of the relevant legislation falls outside the scope of this study, but it is conceivable that, depending on its outcomes, certain legislation and other forms of policy might have to be revisited.

5.2. Skills Development Act (Act No. 97 of 1998*)*

The overall aim of the Skills Development Act is to improve the skills of the South African workforce. According to the Act, the needs of employers, the economy and communities must dictate which skills should be developed. It also aims to provide:

- The best quality training (nationally recognised qualifications on the NQF[22]), and makes provision for the standards of training (e.g. unit standards[23]) to keep improving
- Learnerships that lead to recognised qualifications.[24]

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[22] **NQF:** The NQF is essentially a quality assurance system with the development and registration of standards and qualifications as the first important step in implementing a quality education and training system in South Africa.
[23] **Unit Standard:** A unit standard can be described as a set of registered statements of desired education and training and their associated assessment criteria, together with administrative and other information.
[24] **Qualification:** A qualification can be defined as a planned combination of learning outcomes with a defined purpose or purposes, intended to provide qualifying learners with applied competence and a basis for further learning.

- A set of guidelines and structures to determine and implement national, sector and workplace (strategic) skills development strategies.
- Provisions for employees starting their first jobs (new entrants/unemployed), for those already in work (under-employed), for retrenched employees, and for those who find it difficult to get jobs (e.g. the disabled).

Impact: Organisations must align strategic skills development priorities with sector priorities. Sectors, in turn, must align priorities to national priorities.

Training: The Act covers structured, targeted and generic training – implying that all training interventions should be planned and managed as projects. Training must match unit standards (each worth a certain number of credits), building skills programmes (job-related programmes) that lead to certification. Training is to be conducted by SAQA-accredited service providers.[25] Learnerships consist of hands-on/practical work experience (70%) and a formal learning component (30%) and involve trained assessors, moderators and verifiers, mentoring and coaching. Training is tax-deductible. Skills Programmes must reflect sector and national priorities (in the case of the construction industry, supervisory and project management skills). The Act supports skills building and skills retention in all nine occupational categories[26] (see section 5.12).

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[25] **Provider:** ‘Provider’ means a body that delivers learning programmes focused on the achievement of specified NQF qualifications and standards. A provider also manages the assessment of learning achievements.

[26] The nine occupational categories are:
1. Legislator, senior official or manager (e.g. all managers at all levels, including general managers)
2. Professional (not only academic, also e.g. Consultant, HR practitioner, graphic artists, assessors, librarians, etc)
3. Technician or associate professional (e.g. computer maintenance staff, lab assistants, officers, project co-ordinators)
4. Clerk (e.g. all administrative staff, purchasers, telephone operators, etc)
5. Service or sales worker (e.g. occupational health and safety officers, security staff, supervisors)
6. Skilled agricultural and fishery workers (self-explanatory)
7. Craft or related trade worker (e.g. carpenters, mechanics plumbers, gardeners, etc.)
8. Plant or machine operator or assembler (e.g. drivers, binders, printers)
9. Elementary occupational worker (e.g. cleaners, messengers, maintenance staff, handyman)

5.3 Skills Development Levies Act (Act No. 9 of 1999)[27]

In terms of the Skills Development Levies Act, every employer must pay a skills development levy of 1% of its budgeted payroll to the National Skills Fund (NSF), via the South African Revenue Service (SARS). Of this amount, 70% can be claimed back by the employer, provided that a skills development facilitator (SDF) is employed, a workplace skills plan (WSP) and implementation report (IR) are submitted annually and special training projects are conducted (discretionary grant).

Every employer must pay a skills development levy of 1% of its budgeted payroll to SARS monthly. Of this amount, 70% can be claimed back by the employer, provided that a Workplace Skills Plan (WSP) and Implementation Report (IR) are submitted annually and special training projects are conducted (discretionary grant).

National Skills Fund (NSF): The levies are used as the main source of finance to implement the National Skills Development Strategy (NSDS). The SETAs receive 10% of the skills levies paid by employers for administration costs. The NSF receives 20% of the skills development levies, and 70% is available to be claimed back by the employers. A component of the NSF will be devoted to the provision of practical assistance to unemployed and under-employed people. However, the NSF may be used only for national priority projects in the NSDS. The National Skills Authority (NSA) advises the Minister on these priorities.

Impact Budgeted training costs should be equivalent to at least the amount paid over to SARS, but preferably approximately 7% of payroll.

5.4 South African Qualifications Authority (SAQA) Act (Act No. 58 of 1995)

SAQA registers qualifications on the applicable NQF level and ensures that qualifications are of high quality. Two sets of regulations enable SAQA to oversee the implementation of the NQF, namely National Standards Bodies (NSBs) and Education and Training Quality Assurance Bodies (ETQAs). There are 12 NSBs, one of them being Manufacturing Engineering and Technology. All Sector Education and Training Authorities (SETAs) have been accredited as ETQAs by SAQA. The SETAs therefore have a statutory duty to promote quality and to monitor standards.

[27] This policy only seems to be used by medium and large enterprises; it is not yet clear why most of the SMMEs do not claim the skills levy. Is it because it is not suitable for them (policy gap) or is it because they do not understand it? The Department of Labour is currently reviewing this policy for possible gaps.

Impact: Qualifications include whole/formal qualifications, as well as skills programmes and learnerships. The Manufacturing Engineering and Technology NSB recommends standards and qualifications to SAQA for registration on the NQF. Co-operation between professional bodies and ETQAs is crucial. This project will cut across at least the following five SETAs:

- CETA (Construction Trades)
- MERSETA (Electrical and Electronic Engineering; Mechanical Engineering; Surveying
- MQA (Technology and Construction)
- ISETT (Applied Information Technology)

ESETA (Energy)

5.5 Pan South African Language Board Policy

All employees should have access to training/learning in the language of their choice.

Impact: The majority of primarily unskilled and semi-skilled employees from the designated groups will need literacy training – Adult Basic Education and Training (ABET) opportunities (NQF levels 1–4). The language policy of the organisation should stipulate specific training needs and outcomes.

5.6 Adult Basic Education and Training Bill (*Government Gazette* No. 21461 of 7 August 2002)

The main purpose of the Adult Basic Education and Training Bill is to redress past discrimination and ensure representativeness and equal access, to pursue excellence and to promote the full realisation of the potential of every employee, the tolerance of ideas and an appreciation of diversity.

Impact: This will influence the way that skills are developed and training programmes are designed. Every employee should be trained in basic life skills (including financial, numerical and language literacy). One of the objectives of the National Skills Development Strategy (NSDS), is that all employees should at least have reached NQF level 1 by 2005.

5.7 Occupational Health and Safety Act (Act No. 85 of 1993)

The Occupational Health and Safety Act provides for the health and safety of persons at work and in connection with the use of plant and machinery, as well as the protection of other persons against the hazards of health and safety arising out of, or in connection with, the activities of persons at work.

Impact: The following key regulations are of special importance to the construction industry: Social issues (e.g. HIV/AIDS) have a major effect on planned training and return on investment (ROI). A component of the NSF is devoted to social development and upliftment. A wellness programme (including training of skills in this regard) should be in place. Wellness includes physical, mental and social well-being for improved productivity.

5.8 Labour Relations Act (Act No. 66 of 1995)

The Labour Relations Act has a major impact on the activities of any organisation or workplace. Among other provisions, it “regulates the organisational rights of trade unions”; and ”promotes employee participation in decision-making through the establishment of workplace forums”.

Impact: The training process must be transparent. Employees need to have a say in their training. The skills legislation created expectations. Therefore, all training should be linked to performance assessment, career-pathing and the strategic processes of the organisation.

5.9 Employment Equity Act (Act No. 55 of 1998)

The Employment Equity Act aims to end unfair discrimination at work and to build a workforce that is representative of the country’s population. Organisations must take steps to include women, employees from designated groups and the disabled at all levels (in all occupational categories) in their workforce, using the skills development legislation to achieve a balanced workforce.

Impact: A formal mentoring programme must be in place, its purpose being to retain skilled employees. Such a programme should be linked to performance assessment and should preferably last for the full probation period of any newly appointed employee. Programme co-ordinators, mentors and employees should be trained.

5. 10 Basic Conditions of Employment Act (Act No. 75 of 1997)

The Basic Conditions of Employment Act gives effect to, and regulates the right to, fair labour practices conferred by section 23(1) of the Constitution, by establishing and enforcing basic conditions of employment and by regulating the variation of basic conditions of employment.

Impact: In cases where of employers embark on learnership programmes, there must be a written agreement (contract) between the employee, the employer (or group of employers) and an accredited training provider (or providers). A learnership agreement places obligations on all three parties to the agreement. According to the Regulations published in *Government Gazette* No. 22197 of 3 April 2001: Sectoral Determination No. 5, these obligations briefly amount to the following:

- The employer must employ the employee for the period defined in the agreement; provide practical work experience and allow the employee to attend off-the-job education sessions.
- The employee must work for the employer and attend any specified education and training programmes.
- A written agreement (contract) is required in case where the learner is not employed by the employer at the time of training. Learnerships cater for employed, under-employed, as well as unemployed workers.
- Not all workers qualify to enrol in learnerships, and then need to be trained by means of short courses and workplace certificates.
- Substantial amounts of money are available for training so-called '18(2)' workers. The provider must offer the specified education and training and support the employee as may be specified.
- Procedures for resolving disputes about learnerships are set out in *Regulation Gazette* No. 7091, Vol. 432 Pretoria: 22 June 2001, No. 22398.
- Requirements for Skills Programmes are set out in *Government Gazette* No. 20831 of 26 January 2000.

5.11 Examples of additional policies that may need to be revisited

5.11.1 Government policy and a suite of legislation on six built environment professions

The South African Council for the Built Environment (CBE) Professions Act (Act No. 43 of 2000) is an example of an Act that would have to be revisited. The CBE and each of the professional councils has a role in promoting professional skills, standards, training and competence.

5.11.3 Policy on the construction industry

Such policy is reflected in the White Paper *Creating an Enabling Environment for Reconstruction, Growth and Development in the Construction Industry,* as well as in the Construction Industry

Development Board Act (Act No. 38 of 2000), which establishes a specialist institution with functions and powers to promote and regulate improved practices and relationships within the industry, including those of public and private sector clients.

5.11.3 Immigration policies

Particular note should be taken of how such policies affect the importation of skilled labour.

5.12 Additional notes

5.12.1 Training applicable to various categories of employees

Training is applicable to the following categories of employees (with the relevant type of training indicated in brackets):

- Primarily unskilled/unemployed/18(2) employees: Learnerships (longer-term)
- Semi-skilled/under-employed/18(1) employees: Skills programmes and learnerships
- Skilled/employed: up-skilling or re-skilling: Skills programmes (short term)
- Labour pools: Continuous professional development (short courses).

Within the context of this programme, the skills programme training route should preferably be followed as a short-term target. However, this training route does not ideally cater for unskilled/unemployed employees.

5.12.2 Tax deductions for learneships

The Taxation Laws Amendment Act (Act No. 30 of 2002) makes provision for employers to claim a tax allowance of R17 500 for each employed learner and R25 000 for each unemployed learner, on registration of the Learnership Agreement. A further tax allowance of R25 000 per learner becomes available when the learner completes the learnership. Various learnerships applicable to the construction industry are available at a range of NQF levels from the MQA and ISETT SETAs. One of the national objectives is that there should be 100 000 learners in learnerships by 2005, of whom 85% should be black, 54% female and 4% disabled.

5.12.3 Training for occupational groups covered by this study

Training envisaged for the construction industry will cover four of the nine occupational groups:

- Occupational group 1: Senior officials and managers – project managers
- Occupational group 2: Professionals – engineers
- Occupational group 3: Technicians and associated professionals – technical employees
- Occupational group 7: Craft and related trade workers – artisans, tradesmen

Skills development for the construction industry would be aligned to Objective 4 of the NSDS, namely, to promote opportunities for skills acquisition in development initiatives.

SECTION 6

SIGNIFICANT STRUCTURAL/STRATEGIC ISSUES IMPACTING ON THE CAPACITY TO DELIVER MAJOR CAPITAL ENGINEERING PROJECTS

Previous sections of the document have addressed supply and demand in different ways. During the course of the study, however, the opinion emerged that structural and/or strategic issues might also explain a certain proportion of the variance in the pressure on the skills pool of the country, hence this section, which comprises the following elements: background, key challenges and some guiding principles for resolving the structural strategic issues.

6.1 Background

- South Africa's economic growth depends, firstly, on the physical infrastructure that is delivered by the construction industry, especially for major industrial development, and, secondly, on key participants in the construction economy (including clients and investors).
- Growing demand requires significant growth in the construction industry, and targeted economic growth rates would require the industry to more than double its output and capability over the next ten years. The growing demand for certain skilled labour categories exceeds available resources within South Africa.
- The construction industry is a national asset, the development of which should reflect the development and transformation of our society.
- The industry is fragmented, and its performance, development and transformation are impacted on by the practices of a wide range of stakeholders. These include the academic and training sector, the client bodies owning the projects, and the professionals that conceptualise, develop and implement the projects, as well as public and private sector investors, constructors, suppliers, fabricators and labour specialists.
- The combined leadership and action of all these stakeholder sectors must deliver South Africa's economic infrastructure through a development process that must fundamentally restructure the delivery paradigm.
- South Africa's construction economy is emerging into a period of significant growth and opportunity. The realisation of this opportunity depends on the collective ability of stakeholders to address the entire range of impediments to growth, empowerment, sustainable employment, skills creation, quality, safety, health and the environment.
- The cyclical nature of demand for the construction of major projects in South Africa is a function of macro economic issues such as international markets, political climate, return on investment and tax incentives. These macro economic issues drive the decisions and influence the behaviour of project owners. The cyclical demand has led to a lack of ability in the construction industry to retain people, which in turn has led to declining productivity, which

impacts on competitiveness and results in conflict on pricing between owners and constructors.

6.2 Key challenges

6.2.1 Creating a framework in the national interest

The involvement of the broad spectrum of industry players (including government, industry or project owners, and contractors or project implementers) significantly increases the risk of a fractured debate. This is best overcome by all parties reaching consensus on what would be in the national interest on a short-term and a long-term sustainable basis.

6.2.2 Industry procurement practices and structure

There remain a number of structural issues contributing to a skills shortage. Some constructors would argue that these structural issues manifest themselves largely in the procurement policies of project owners, while project owners would argue that these policies reflect the lack of local competitiveness and declining local productivity. Some examples are a predisposition towards international contractors, placing of contracts into large engineering procurement construction (EPC) contracts, inefficient tendering processes, the passing down of risk to inappropriate levels or entities, a tendency to drive contractor margins down to unsustainable levels, and a strong emphasis on lowest cost bids. The conflict on pricing between project owners and constructors causes time and money to be spent on resolving disputes and further impacts on competitiveness. Some would argue that the time and energy spent on activities such as substantiating claims and rebutting counter claims have the effect of permanently removing capacity, not only for existing projects but also for future projects

6.2.3 Human resources development, skills, capability and performance

Declining demand and the volatility of demand, linked to the procurement practices of major private and public sector clients, has led to a decline of skills and capability within the industry, especially at the level of leadership and management skills.

Certain procurement practices affect the sustainability of enterprises and their ability to develop and retain a skilled workforce, as well as to actively promote safety, health and the environment. In the ‘major project’ market, this has led major participants in the construction economy (including contractors, professions and materials suppliers) to seek the better returns available across South Africa’s borders. For some companies, this market comprises as much as 50% of total turnover and represents a capability potentially available to South Africa.

These factors also underpin unattractive career prospects in the professions, including engineering, as well as employment conditions that, at all levels, are less optimal than in other industries.

6.2.4 Artisans and skills formation

Current procurement and delivery practices have driven the industry into fierce levels of competition, resulting in the shedding of labour and the imperative to rely on labour brokers, who are not part of the skills development equation. Low profit margins mean that even companies that do not pay the skills levy are reluctant to draw down the benefits of the SETA funds, because qualified operatives attract higher wages, and their retention results in reduced competitiveness within the current delivery paradigm.

Skilled labour in specialised categories such as coded welders, boilermakers and instrument technicians for control systems are in particularly short supply for construction in the petrochemical industry.

6.2.5 Professions and engineering

Fee-cutting by clients has reduced the ability of the built environment professions to offer a competitive income. Comparative salary levels in the engineering professions have declined and are significantly lower than those of other professions, such as law and accounting. Qualified engineers are migrating into more attractive opportunities in the ‘lifestyle’ careers such as IT and the financial services sector. An alarming number are taking up better opportunities abroad, and there is huge demand for South African engineers in countries such as the United Kingdom, where enrolment at universities has declined.

Only 12% of South African matriculants have mathematics and science, and these too are gravitating towards the ‘lifestyle’ careers that offer better pay, as well as safe, stable, clean and comfortable working environments.

6.3 Guiding principles

Against the background of the importance of construction for economic growth and the range of key challenges identified in the foregoing discussion, the following principles should be incorporated in any strategy to address current and future skills shortages:

- Promote an industry with a total construction capability to deliver South Africa's economic and social development foundation into the future – to global standards and in concordance with national transformation objectives
- Acknowledge the limitations of resources and ensure that these are utilised so as to build sustainable capability
- Encourage clients to take greater ownership of the challenge
- Recognise that clients are the drivers of positive change and that their delivery and procurement practices shape the development and sustainability of the industry
- Ensure that major projects are planned, scheduled and procured with cognisance of the need to develop and retain capability, and to transform the industry
- Recognise that win–win outcomes are the basis for partnership rather than adversity, and thus ensure that client procurement practices minimise waste and maximise the use of existing capability by:
  - promoting greater uniformity in the procurement process
  - promoting value-based solutions rather than lowest price
  - optimising the potential of the contracting sector to innovate and to participate in the project development from the earliest possible stage
- Maximise the opportunities for skills development utilising recognition of prior learning (RPL) at all possible levels of the identified skills shortage
- Recognise the volatility of specific demand and skills specialisation and address the current skills shortage in a manner that is sustainable and promotes skills portability
- Recognise that productivity in the construction industry needs improvement in order to increase competitiveness
- Support corporate and public sector intervention at school level to promote increasing numbers of mathematics and science matriculants, and at tertiary and research level to enhance the numbers and quality of graduate built environment professionals
- Support the image and attractiveness (and therefore transformed reality) of the construction industry as creator of the infrastructure that underpins economic growth and social development.

SECTION 7

SYNTHESIS WORKSHOP

7.1 Introduction

In response to requests by the construction industry, NACI commissioned a study to investigate skills shortages in the industry. The process involved a number of sub-projects, which were intended to collect a wide spectrum of information on the context, nature and extent of the situation. The following four focus areas were identified, and experts in these fields of study were commissioned to collect and analyse data:

- Demand for and supply of engineers, engineering technologists and skilled artisans
- An overview of the South African skills development policy framework.
- A study of scarce skills in South Africa
- An overview of local and international skills development practices.

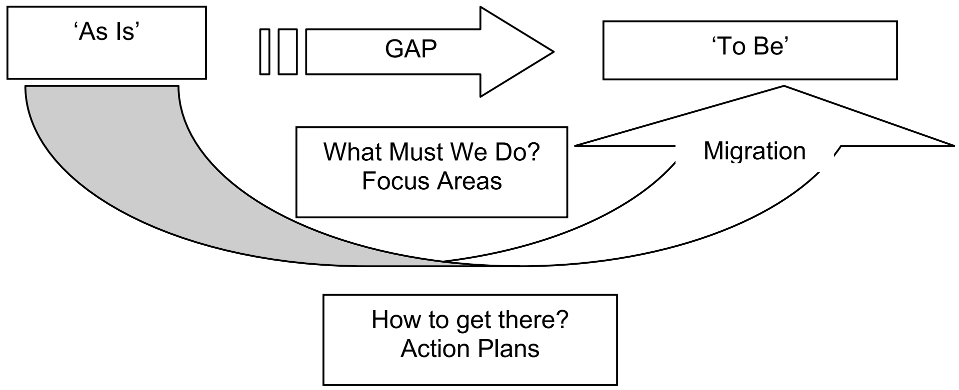
NACI established reference groups to review the reports of each study for quality assurance purposes. The following organisations were represented on these reference groups: Anglo American, AngloPlats, BHP Billiton, Construction Industry Development Board of South Africa (CIDB), Development Bank of Southern Africa (DBSA), Eskom, Grinaker LTA, Group 5, Murray and Roberts, SAISC, SAPPI and Sasol Technology. In keeping with the overall NACI research procedure, the reviewed reports were then synthesised into a draft NACI report, which was presented at a workshop attended by members of the project reference group (see Section 1 for the names) and representatives of the Department of Public Works, HSRC, CSIR, CETA and the Colleges Collaboration Fund (CCF).

This section offers a summary of the workshop (focusing on the outcomes), the overall conclusions and the recommendations of the study.

7.2 Synthesis workshop

7.2.1 Procedure

Figure 7.1: Workshop model



The purpose of the workshop was to:

- Use the key findings of the studies to map the current situation ('As Is').
- Workshop the desired status ('To Be') of skills development in the country.
- Perform a gap analysis to identify the key focus areas.
- Workshop the key action plans needed to migrate to the desired status.

Figure 7.1 shows the process followed during the synthesis workshop.

7.2.2 Current reality ('As Is')

The following key issues were identified as characterising the current situation:

- **Non-alignment between industry and training:** Only 70% of the industry training capacity is actually being utilised, and only 34% of artisans from the FET system are finding employment in their fields of training. Unlike universities and technikons, where there are advisory boards with industry representation, there is no communication between the FET colleges and industry. As a result, these institutions are not aligned with industry needs.

- **Limited communication between the construction industry and project owners:** The business of the construction industry is highly cyclical in nature, making business forecasting very difficult. There is limited communication between project owners and the construction industry, leading to poor co-ordination and fluctuating peak demands. By sharing information on planned projects, it would be possible to smooth out peaks. Government should also be encouraged to use its buying prowess, where possible, to flatten the peaks by shifting its major infrastructural expenditure to spells that have been forecast as lean. As a result of this unpredictable nature of the business, the construction industry is reluctant to train artisans, and also tends to maintain only a small permanent staff complement, opting to sub-contract skilled labour if and when required.

- **An industry unattractive to school-leavers:** The construction industry is currently not attractive to school-leavers, because of poor working conditions, high staff turnover and the current low levels of regard for the artisan profession, among other reasons. In Canada, by contrast, the profession is held in such a high esteem that it is normal for university graduates to train as artisans. South Africa needs a drive to make the industry united, competitive and hence world-class. This would, in turn, serve to make the industry attractive to school-leavers.

7.2.3 Foci for action

The following foci for action in addressing the above critical issues resulted from a synthesis of 34 individual solutions generated by the workshop:

- **Partnership for positive change:** Collaboration and partnering – institutionalised as well as informal – between project owners and constructors, was seen as a key to improving the sustainability of the industry.

- **Training capacity optimisation and development:** In principle, there is sufficient training capacity, albeit not optimally utilised; available capacity should therefore be revived and aligned with industry requirements.

- **Globally competitive and sustainable industry:** The South African construction industry has restructured significantly over the last two decades as a result of the cyclical nature of the business and is currently struggling to be globally competitive and sustainable. Without reliable demand patterns, the industry is reluctant to build human resources capacity and relies on contract labour during peak demands. This results in a very high staff turnover, leading to low skills retention and associated low productivity. Appropriate co-operation and co-ordination between role players has become essential.

- **Attractive industry:** Training policies for artisans should be dovetailed with national needs, ensuring that the qualification is highly recognized and portable. This would allow artisans the opportunity to migrate to alternative industries during periods of low business cycles. The industry must also start perceiving training as an investment rather than a cost.

7.2.4 Action plans

Twenty-one key actions aimed at the above foci were identified and grouped into the following four key areas:

- **Education and training aligned to clear industry needs:** In order to maximise the utilisation of the current training capacity available in the country, the following key actions were recommended:
  - Industry should be encouraged to identify and quantify its key skills requirements
  - A process should be facilitated for the formation of industry advisory boards, that work with the FET colleges to ensure that course content meets industry requirements
  - Industry must start collaborating with FET colleges in providing work placements for staff and learners as part of their training.
- **Decision-making is based on factual information:** It was recommended that a database be created with data on the skills pool, planned major projects and capital expenditure.
- **Stakeholders co-operating to create a transformed world-class industry:** The following key actions were recommended in order to create a transformed world-class industry:
  - Industry role players must collaborate to improve the procurement practices, with a focus on partnering.
  - There should be a drive to form key partnerships between clients, industry and government.
  - The current momentum created by the NACI project, which saw project owners and clients collaborating to find a common solution to the problems, should be maintained.
- **Building a growing, sustainable, less cyclical construction economy:** The following activities were recommended in order to improve the predictability of construction business cycles:
  - A project should be initiated to investigate how fiscal incentives could be used to make the industry sustainable.
  - A public-sector infrastructural development blue-print should be developed and distributed.
  - A public understanding of science, engineering and technology (PUSET) initiative should be launched for the construction industry.

7.3 Summary of key strategies

This section offers a complete set of detailed strategic objectives developed at the workshop and referred to above. The procedure entailed transposing a logic framework on the list of strategic objectives. The framework consisted of the following components: statement of the strategic objectives, identifying the expected outcomes, estimating the priority level and the time frame, identifying the presumed implementation activities, and finally listing the target groups that would be affected by the action. The results of this exercise can be found in section 7.4, where the recommendations are arranged in a logical framework.[28]

Note: The intention of the recommendations included in this section is not to intensify the government regulatory environment for the construction industry, but rather to create an enabling environment for industry to operate within and allow it to be as self-regulating as is practically possible.

[28] Two recent initiatives that took place after the final workshop presentation on 16 September 2003 are included in the addenda to the report as examples of models for best practice:

1. South African Centre for Applied Technology and Innovation (SACATI)
2. Oil, Gas and Chemical Manufacturing industry project charter

7.4 Recommendations arranged in a logical framework

7.4.1 Align education and training to industry needs

Category	Strategic Objectives	Expected Outcomes	Priority	Term	Responsibility	Target Groups
1. Strengthen capacity across all sectors	1. Mobilisation of under-utilised training and development facilities and Practitioners	• Maximum utilisation of available capacity	Medium	Long	DoL(e.g. Sam Morotoba) Industry	Industry Government Training organisations (e.g. BEIFSA, INDLELA)
	2. Encourage industry to identify and quantify future scarce skills needs	• Informed development and funding of key qualifications	High	Short	SETAs Industry Labour Movement	Industry SETAs Labour Movement
	3. Allow industry to import skills on well documented areas of skills shortages	• Short term relief on known areas of shortage	Medium	Medium	SETAs Home Affairs, DoL	Industry
	4. Investigate mechanism to kick-start training in known shortages(e.g. RPL, skills programmes)	• Training aligned to national industry needs • Training aligned to SAQA	High	Long	SETAs, SAQA, FET, Umalozi, Private trainers	FET Industry Trainers, Private trainers
	5. FET engineering courses accredited by ECSA/SETAs	• Portable and highly recognized FET qualification	High	Long	SETAs DoE, FET, Umalozi	FET colleges Private Trainers Industry Trainers
2. Alignment of education	1. Fully equipped FET practical training workshops	• FET graduates with appropriate practical experience	High	Long	DoE, SETAs	FET Colleges

Category	Strategic Objectives	Expected Outcomes	Priority	Term	Responsibility	Target Groups
and training providers to industry needs	2. FET utilises industry workshops for practical training	• Immediate accessibility of training facilities to FET students • Skills transfer from industry experts to student and college staff	High	Medium	Industry Trainers FET DoE	FET
	3. Encourage industry placements for FET learners and staff (e.g. Learnerships)	• Immediate accessibility of training facilities to FET students • Skills transfer from industry experts to student and college staff	High	Medium	FET Industry Industry Trainers	FET
	4. Formation of FET industry advisory boards	• FET course contents informed by industry	High	Long	DoE FET, Industry	FET

7.4.2 Stakeholders collaborating to create a transformed world class industry

Category	Strategic Objectives	Expected Outcomes	Priority	Timing	Responsibility	Target Groups
1. Improvement in procurement practices with focus on partnering	1. Promote partnering within the industry 2. Collaborative planning of projects 3. Focus on global best practice	• Improved profitability • Attractive construction industry • Enhanced relations and trust	Medium	Long	Industry CIDB	Captains of industry
2. Shared vision between government and private sector	4. Identify communities of shared vision 5. Form key partnerships between (clients/ government/industry)	• Improved dialogue between project owners and executors • Encourage partnering through forums	Medium	Long	Industry Government	Industry Government
3. NACI project to continue to maintain current project momentum	6. Formation of a forum to continually assess and address key issues in the industry	• Improved dialogue between project owners and executors • Common understanding of key issues	Medium	Medium	NACI Industry	Industry Government

7.4.3 Decision making is based on factual information

Category	Strategic Objectives	Expected Outcomes	Priority	Timing	Responsibility	Target Groups
1. Data collection	1. Encourage industry to supply accurate skills demand information	• Improved returns of WSP • Informed development and funding of key qualifications	High	Short	SETAs, DoL, NACI project reference group	Captains of industry
	2. Encourage industry to supply data on planned projects	• Alignment of training programmes to national needs • Ability to forecast by the construction industry service providers	Medium	Long	CIDB NACI project reference group	Captains of industry
	3. Collect data on major planned public expenditure projects	• Alignment of training programmes to national needs • Ability to forecast by the construction industry service providers	Medium	Long	Department of Public Works (DPW), National Treasury, Department of Housing, Local governments	Government departments
2. Data availability	4. Create an easily accessible database on planned projects	• Freely accessible data planned projects	High	Medium	CIDB	Industry Government
	5. Create an easily accessible database on skills supply	• Freely accessible data on artisans skills pool	High	Medium	DoE, DoL, FET, SETAs	All artisans

7.4.4 Building a growing sustainable less-cyclical construction industry

Category	Strategic Objectives	Expected Outcomes	Priority	Timing	Responsibility	Target Groups
1. Incentives	1. Investigate fiscal incentives which can be used to encourage private expenditure	• World class incentives schemes for the South African Industry • Less cyclical construction industry • Attractive industry • Sustainable industry	Medium	Long	DST Treasury	Project owners
2. Public understanding of the construction industry	2. Targeted marketing aimed at the Youth	• Construction industry is attractive to school leavers (male and female) • Empowered industry	High	Long	CIDB, DPW, SETAs, DoL	Senior secondary schools FET colleges Tertiary institutions
3. Collaboration on major project timing(public and private secotr)	3. Address cyclical nature of the industry	• Address the cyclical nature of construction industry • Sustainable industry	Medium	Long	Industry Government	Industry Government

7.4.5 Building a growing sustainable less-cyclical construction industry

Category	Strategic Objectives	Expected Outcomes	Priority	Timing	Responsibility	Target Groups
1. Incentives	1. Investigate fiscal incentives which can be used to encourage private expenditure	• World class incentives schemes for the South African Industry • Less cyclical construction industry • Attractive industry • Sustainable industry	Medium	Long	DST Treasury	Project owners
2. Public understanding of the construction industry	2. Targeted marketing aimed at the Youth	• Construction industry is attractive to school leavers (male and female) • Empowered industry	High	Long	CIDB, DPW, SETAs, DoL	Senior Secondary schools FET colleges Tertiary institutions
3. Collaboration on major project timing(public and private secotr)	3. Address cyclical nature of the industry	• Address the cyclical nature of construction industry • Sustainable industry	Medium	Long	Industry Government	Industry Government

7.5 In conclusion

This report is based on interactions between statistical and other information, as well as wide consultation with representatives of some of the major stakeholders. As such, the conclusions and recommendations are representative of a cross-section of informed advice for addressing the potential impact of the skills shortages on the innovative capacity of major capital engineering projects. It is our considered opinion that the challenge is urgent and cannot be left to actions by one party alone. We are of the opinion that if the challenge is not efficiently and effectively addressed, the role of innovation in contributing to economic growth, international competitiveness and improved quality of life could be seriously impaired.

Appendix 1

Capacity Building in a Mega Project Environment

Achieving Empowerment Objectives on the Mozal and Hillside Projects

By

Louis Smidt BHP Billiton

Hillside 3 Expansion Project Manager

September 2003

1. Synopsis

The BHP Billiton aluminium division has implemented four Mega Projects in Southern Africa during the course of the past 12 years. These four projects have not only been a major success in creating shareholder value, but also in building local capacity in the regions where they were implemented.

The approach that was applied achieved benchmark empowerment objectives in the fast-track mega project environments on Mozal 2 and Hillside 3, while still maintaining world class project implementation performances (Table A1). Two main areas of excellence in empowerment objectives are highlighted, firstly the labour 'Skills Assessment and Training Programme' and secondly the 'Small and Medium Enterprise (SME) Development Programme'. Both these programmes contributed successfully to ensuring that the work on these projects was executed with high quality and established a sound foundation for future sustainability. Being able to test the success of these initiatives at both project locations has also proved the transportability of these programmes to other project sites.

Table A1: BHP Billiton aluminium projects in Southern Africa

	Hillside 1&2	Mozal 1	Mozal 2	Hillside 3
Production Capacity (tons)	510 000	250 000	250 000	130 000
Investment Cost (± US$ million)	1 800	1 100	665	449
Construction Start Date (year)	1992	1999	2001	2002
Schedule to First Metal (months)	31	25½	21½	18½
Construction Man-hours (million)	24	26	17	9
Peak Labour on Site	8 300	9 000	5 000	3 000

2. Skills assessment and training programme

The labour Skills Assessment and Training programmes on both Mozal 2 and Hillside 3 proved to be very successful. Not only did it deliver the demand in local construction skills timeously to these projects, but also equipped people with formal skills that they are able to take with them to future projects or other work in the area. By having worked in a world-class construction environment workers also take with them leading health, safety, environmental and other learning's from these projects to other projects. This situation will benefit the construction industry in the long run.

Table A2: Skills assessment and training – actual achievements on Hillside 3 and Mozal 2

	Hillside 3	Mozal 2
Local Employment	79% vs 70%+ target	70% vs 65% target
Skills Assessed & Graded	2 815	687
Local People Trained	1 147	3 992
On-the-job Upgrades	251	455
Supervisors Training	*50 000 man-hours	15 000 man-hours

* Includes training ranging from sensitisation and communications skills training to health, safety and industrial relations

3 SME Development Programme

This program has achieved significantly increased participation during Mozal 2 and is now recognized as a model for the development and sustainability of SME's in developing countries. This process has been very successfully transferred across the border into South Africa to Hillside 3. The IFC and World Bank have also adopted this model for future projects that are funded by them.

Table A3: SME Development Programme: actual achievements on Hillside 3 and Mozal 2

	Hillside 3	Mozal 2
Local Spent	R 565 million (spent to date) vs R490 million target	US$ 95 million vs $ 80 million target
BEE Spent	R 111million (spent to date)	Not defined in Mozambique
SME Spent	R 24 million (spent to date)	US$ 5 million
SME Contracts	25 awarded 4 completed to date	27 completed

In a field of endeavour that is typically littered with failures, the SME development programmes at Hillside and Mozal have been internationally recognised as a sustainable model that can successfully be transferred to other project locations.

Appendix 2

SACATI

AFRICA'S PREMIUM TECHNICAL TRAINING INSTITUTION

THE SOUTH AFRICAN CENTRE FOR APPLIED TECHNOLOGY AND INNOVATION

Eskom and Da Vinci

Executive Summary

The technical skills crisis facing South Africa is starting to have a pervasive impact on the future economic growth of the country. Many South African operations are not immune to this crisis. South Africa's future expansion and business prospects will be severely impacted unless some highly innovative measures are adopted to resolve the shortages of technically skilled people across the spectrum from artisan to engineer.

From an Eskom viewpoint, the crisis is of such a magnitude that the Managing Director of Human Resources has identified a need for extraordinary measures to be undertaken. In consultation with the Managing Directors of Generation and Resources and Strategy, the need to launch a well co-ordinated 'Marshall Plan' that will meet both the Eskom and national needs has been identified. Eskom has also recognised that for such a plan to have a profound impact, there would be a need to establish a dedicated task force with clearly identifiable objectives.

Recently, a ministerial delegation comprising ministerial officials and representatives from Eskom, under the leadership of the Minister of Arts, Culture, Science and Technology, Minister Ben Ngubane, visited the Southern Albertan Institute of Technology (SAIT). The primary objective of the visit was to revisit the Minister's rationale for the creation of a SAIT presence in South Africa.

The findings of this delegation were such that it was recognised that every effort should be made to bring to South Africa, and thereafter to the African continent, the SAIT technical skills training and development methodologies. Furthermore, it was recognised that in order to accelerate the process, representatives from SAIT should visit South Africa with a view to

exploring synergies and identifying how best to incorporate the SAIT methodologies to accelerate technical skills development in South Africa.

The SAIT team visited South Africa from 10 to 17 October 2003, and met with a wide cross-section of government and industry representatives as well as members from the NACI reference group.

This document provides an insight into the current plans for the establishment of the South African Centre for Applied Technology and Innovation (SACATI), through which SAIT and other national and African-based technical skills development programmes will be directed.

Appendix 3

Oil, Gas and Chemical Manufacturing Industry Project Charter

PROJECT CHARTER: PetroChem Contractor Skills Management and Development.

Project Owner: O,G&CM Facility Managers
Project Sponsor: Wayne Hartmann
Project Manager: Neville Eve

Chairman: Project Steering Committee: Sieb Sieberhagen
Committee Members: Arthur Hanslo; Allen Morgan; Bertie Van Baalen

Vision/Destination

Effective management of Skilled PetroChem contract workers

Objectives

- Regional Training Trusts
- A National database of Contract workers
- A Contract workers "smartcard" ID
- GenericHSE and skills training curricula
- Generic training processes & practices
- Alignment with the NSDS

Benefits / KPI's

- Effective PetroChem T&D resources & facilities utilization
- Recoup training costs
- Legal probationary appointments
- Most competent permanent recruits
- Reduced effect of skills attrition to capital construction projects
- PetroChem contribution to national skills pool

Deliverables / Milestones	Date
• Project mandate	1st Oct 03
• Project estimate & Schedule	12th Nov 03
• Database IT setup	24th Dec 03
• Regional training trusts setup	24th Dec 03
• Skills assessment standards	21st Jan 04
• Skills training curricula aligned	21st Jan 04
• Learners contracted	21st Jan 04

Key Dependencies & Interfaces

- Facility T&D functions
- Shutdowns National Forum
- SkillTEC
- Regional training centers
- FLUOR
- Regional project responsibility assignments
- Steering Committee
- Refinery Managers Committee
- NACI
- SETA's
- Engen / Mondi / SAPREF regional alliance

In Scope

- 18/1 & 18/2 learners
- O,G&CM sector NQF Level 2; 3 & 4 qualifications & programs
- HSE Induction training delivery
- IR Induction training delivery
- HSE Skills training delivery
- Maintenance skills training delivery
- Skills development programs delivery
- Supervisory training delivery

Out of Scope

- Construction skills training delivery
- New curricula development
- Production skills training delivery
- Any provision of training
- Abet training delivery
- Level 1 training
- Technician and Engineering training delivery (NQF Level 5 and 6+)
- Eng services skills training delivery

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