Evening meeting

Paper will be presented at an evening meeting held at IStructE, 11 Upper Belgrave Street, London SW1X 8BH on 11 May 2006 at 18.00h

Poverty reduction responses to the Millennium Development Goals

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The Discussion which follows the presentation of this paper will be published in a future issue

Synopsis

Commitment to the Millennium Development Goals (MDGs) relating to poverty reduction demands innovative responses from the engineering community. This paper outlines some of approaches to procurement and appropriate standards and technologies that have been developed in the provision of housing and infrastructure in the post apartheid South Africa. These approaches have provided opportunities to vulnerable and marginalised groups in order to address inequities within a society and in so doing address poverty. This has been accompanied by the development of national standards and best practices to replicate outcomes from pilot projects at scale.

The lessons learned in South Africa are synthesised and contextualised within developing countries. This is done in terms of a 'green' (environmental) agenda and 'brown' (poverty and underdevelopment) agenda and available engineering capacity. The work in South Africa provides a platform for capacity building in developing countries and informs institutional responses to certain MDGs.

Introduction

Sustainable development is defined in the Brundtland report (1987) as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'. The interpretation of this definition has broadened and matured since 1987. The protection of the environment is today recognised as but one element of sustainable development. Sustainable development is now also very much about eradicating poverty. It is rooted in the simple concept of providing a better quality of life for all, now and for generations to come. It is a way of looking at all resources that will lead to a higher quality of life for the current generation, without compromising that of future generations.

In September 2000, 147 heads of State and Government, and 189 nations in total, committed themselves in the United Nations Millennium Development Declaration (MDD) to making the right to development a reality for everyone and to freeing the entire human race from want. They acknowledged that progress is based on sustainable economic growth, which must focus on the poor, with human rights at the centre. The Declaration calls for halving by the year 2015, the number of people who live on less than one US dollar a day.

The eight Millennium Development Goals (MDGs) form a blueprint agreed to by all the world's countries and the entire world's leading development institutions. They have galvanised unprecedented efforts to meet the needs of the world's poorest people and provide time-bound and quantified targets for addressing extreme poverty in its many dimensions.

Recent forecasts for the demand for new infrastructure expressed at the American Society of Civil Engineers' convention in Baltimore, 2004, indicate that approximately 80% of the world's new infrastructure in 15 to 20 years time will be constructed in developing countries. The provision of such infrastructure is expected to be underpinned by poverty reduction objectives such as those relating to the stimulation of economic growth, the creation of jobs, the attainment of social progress and stability, and the promotion of the sustainable utilisation of natural resources as opposed to a strict protectionist stance.

The next few decades for civil and structural engineering will not be 'business as usual'. Civil and structural engineering will need to deliver infrastructure but in a manner that contributes directly to sustainable development objectives that are pertinent to developing countries.

South Africa generates two-thirds of Africa's electricity and possesses 40% of the continent's telephones yet suffers from the scourge of poverty and underdevelopment. In 2004, according to the UNISA Bureau of Market Research, just over one third of households lived on an income of R9 600 and less per year (approximately US$4.3/day) while Statistics South African reported the September 2005 unemployment rate as being 26.7%. President Thabo Mbeki explains this apparent paradox in his 2003 State of the Nation Address – 'with regard to the accomplishment of the task of ensuring a better life for all, we must make the observation that the government is perfectly conscious of the fact that there are many in our society who are unable to benefit directly from whatever our economy is able to offer..... This reflects the structural fault in our economy and society as a result of which we have a dual economy and society. The one is modern and relatively well developed. The other is characterised by underdevelopment and an entrenched crisis of poverty.'

This paper outlines some of approaches to procurement and appropriate standards and technologies that have been developed in South Africa in the provision of housing and infrastructure, synthesises the lessons learned, contextualises poverty and infrastructure within developing countries and outlines some poverty reduction responses to the millennium goals arising from the South African experience.

South African approaches to procurement and appropriate standards and technologies

Background

The South African construction industry is by nature a labour intensive industry with a capacity to absorb relatively unskilled workers. Accordingly, investment in infrastructure projects yields significant work opportunities in its construction and maintenance, apart from the economic and social development benefits that it delivers to a community. The potential to deliver focused employment and business opportunities through infrastructure delivery was explored in the construction and maintenance of infrastructure in the late 1980s.

The system of apartheid left South Africa with highly skewed racial ownership patterns in its economy, great disparities in income along racial lines and large numbers of black people with very little or no education and with no skills. The South African government in 1994 recognised the potential that government procurement had for economic transformation and to address social and development issues. (Public procurement by South Africa departments, public entities and local authorities accounted for between 22 and 24% of GDP during 1996). Public procurement, the disposal of state assets and the issuing of concessions and licenses are the economic levers that government has at its disposal to encourage the private sector to embrace social and economic development. The South African government accordingly embarked upon a programme of procurement reform in 1995 to address good governance concerns and to use procurement as an instrument of social policy.

South Africa's first democratically elected government embarked upon an ambitious housing programme in 1994 to construct 300 000 low income housing units per annum to address the housing backlog and to provide shelter for new family formation. The provision of this quantum of housing units presented many challenges regarding appropriate standards and building controls. Near surface expansive soil horizons with relatively low and fluctuating water table are widely spread across South Africa.

Table 1: Five levels of contractor development (after Watermeyer, 1993 and 1995)

Level of contract	Type of support	Contractor's contractual responsibilities	Degree of developmental support provided
1 (labour only)	Construction and Materials Manager	Provide labour Provide small tools	Offer advice, practical assistance and training Provide and transport materials to site Provide plant other than small tools Arrange for specialist work Arrange for fortnightly wages
2 (labour plus transport of materials to site)	Construction and Materials Manager	Provide labour Provide small tools Transport materials from yard to site Provide certain minor materials	Offer advice, practical assistance and training Provide most materials Provide plant other than small tools Arrange for specialist work Arrange for fortnightly wages
3 (labour plus transport plus materials (assisted)	Construction and Materials Manager	Provide labour Provide small tools Provide site office and certain storage facilities Provide all materials	Offer advice, practical assistance and training Provide plant other than small tools Offer materials for purchase Arrange for monthly wages Arrange for specialist work
4 (labour plus transport plus materials (unassisted))	Mentor	Provide labour, materials and plant Provide 5% surety Engage specialist contractors Finance all contractual obligations	Conduct a tender workshop Advise, coach, counsel, guide, teach, instruct and tutor the Contractor Render assistance in the setting up of proven systems to enhance management and business skills
5 (labour plus transport plus materials plus full surety)	Mentor	As for level 4 Provide 10% surety	As for level 4

Collapsible sand, deposited by wind or resulting from the leaching of granite, is also frequently encountered. Masonry, the material of choice, although being a highly labour intensive form of construction, is susceptible to cracking due to movements within near surface horizons. The Joint Structural Division (JSD) of the South African Institution of Civil Engineering (SAICE) and the Institution of Structural Engineers (IStructE) developed innovative codes of practice in response to these challenges.

Job creation, poverty reduction and broad based black economic empowerment are important issues in the post apartheid South Africa agenda. Emphasis has been placed on the development and nurturing of small, medium and micro enterprises and the increasing of employment opportunities in construction works.

Community based approaches in the provision of infrastructure

During the early 1980s, hundreds of millions of Rand were spent in Soweto on services upgrading projects. From an engineering management point of view, the project was a huge success, as it was completed on time, within budget and to the correct quality standards. However, from a community point of view it was a dismal failure in that unemployment levels were very much the same during construction as they had been before construction and the amount of project expenditure retained within the community was insignificant.

A civil engineering project involving the upgrading of approximately two-thirds of the secondary water reticulation of the city was identified as a project suitable for the implementation of a labour-based Contractor Development Programme (CDP) to address the shortcomings in the previous in the earlier upgrading programme.

At the outset, it was recognised that no Sowetan either owned, or operated, a civil engineering construction company. (At that time, there were no black owned civil engineering contractors in South Africa.) A development team was appointed to provide the professional and third party management support necessary to facilitate the development of local contractors. Consulting firms and large contracting firms, depending upon the expertise required, were appointed as design engineers, engineers, construction managers and materials managers. The team apart from providing conventional consulting services, advised, trained and assisted local community-based contractors in the administration and execution of their contracts, procured and stored materials, issued and delivered materials to the various construction sites, and arranged fortnightly payments. At the same time, the development team employed members of the local community to run stores facilities, monitor progress, assist with administration, etc.

The programme provided for five levels of contract as outlined in Table 1[1]. At each successive level, the contractor's responsibility was increased and the management function of the developmental team diminished. (Levels 1 and 2 relate to community-based projects where the community is involved in the commercial, managerial and administrative aspects of a project in addition to being employed to provide the labour required to execute the works. This enables the amount of funds retained within the community to be maximised and allows the transfer of skills and competencies to the community[2].)

A comprehensive evaluation of the CDP quantified the labour-intensiveness of the programme and the employment opportunities generated in respect of each activity. It also provided statistics on the cost of construction retained by the community (see Table 2)[3] and the expenditure per unit of employment generated and found that the project provided employment opportunities at half the average cost for the civil engineering industry in South Africa.

Several contractors graduated from the programme, purchased plant, obtained access to credit and finances and gained credibility in commercial circles. Today it is rare for a Soweto based company not to win a contract for the upgrading of the water supply. The project was successfully replicated in several other towns, cities and rural areas in South Africa in projects involving civil and electrical engineering works and in mass housing developments.

The approach adopted in Soweto shifted the focus in the project to the means used to achieve the desired end. Modifications to the construction methods and the provision of third party management support facilitated the construction process to the extent that all the barriers to entry faced by local entrepreneurs who wished to participate in the project, were overcome. The programme demonstrated that it is possible to achieve community objectives without compromising the absolutes of project management, namely cost, quality and time.

What is noteworthy about this project is that the systems that were developed by those responsible for the programme were well documented and have recently been incorporated in two national standards, namely SANS 10396 and SANS 1921-4.

Labour-based works

Research in the provision of infrastructure in South Africa since the late 1980s, has indicated that provided there is little or no cost premium, the overall increase in employment opportunities associated with employment intensive practices for an infrastructure project over conventional plant-based practices may reach a factor of two in urban infrastructure and three in rural road construction; increases which are extremely valuable. Choices in technologies, methods of construction and construction materials determine the quantum of employment that is created and where it is generated. The manufacturing of materials on site, e.g. concrete masonry units, can significantly increase the quantum of employment that is created[4].

Appropriate specifications and labour based technologies are required to optimise the engagement of smaller contractors and to increase the quantum of employment opportunities per unit of expenditure. The absence of design information on labour based technologies frequently leads to the situation in which only those

Table 2: Percentage of construction cost retained by the community in Soweto's contractor development programme

Component	Road construction (%)	Secondary water mains (%)	House connections (Plumbing) (%)
Labour contract	26	22	33
Transport	2	8	9
Materials management	2	3	2
Construction management	7	6	6
Total	37	39	50

technologies for which there is adequate design information are considered in the design of a project. Alternatively, labour based technologies are approached circumspectly and conservatively[5].

The Construction Industry Development Board (CIDB) published in 2005 best practice guidelines for *Labour-Based Methods and Technologies for Employment Intensive Works* to enable designers to design works using labour-based techniques and technologies, constructors to embrace such techniques and clients to accept such technologies with confidence. These guidelines cover construction methods for earthworks; methods for the manufacture of precast concrete products, bricks and block making and bitumen emulsion stabilised blocks for single storey buildings; and construction technologies for rubble masonry arch dams and bridges, foamed bitumen gravel, cast *in situ* block pavement, emulsion treated gravel, waterbound Macadam, slurry-bound and composite Macadam construction and methods for unsealed roads.

Earthworks activities relating to trenching, excavation, loading, hauling, spreading and compaction which may be undertaken by hand have recently been published in SANS 1921-5.

Procurement systems

A public procurement system needs to be developed around a set of outcomes or objectives which reflect societal expectations. These objectives in effect establish overarching performance requirements for the system. These high level performance requirements, however, need to be interpreted both qualitatively and quantitatively. At the same time, a means of verifying that the established requirements have been satisfied needs to be put in place. Thus in effect, a procurement system should be designed and implemented around a four level performance framework, (see Fig 1).

Procurement may be regarded as the process that creates, manages and fulfils contracts. Procurement commences once a need for supplies, services, works or disposals has been identified and ends when the supplies are received, the services or works are completed or the asset is disposed of. Accordingly, a procurement system comprises processes which are underpinned by methods and procedures, which are informed and shaped by societal goals and the policy of an organisation. These processes, procedures and methods should at the same time provide a means by which risk relating to corrupt and fraudulent practices, fruitless and wasteful, irregular and unauthorised expenditure, and overspending is minimised.

A recent analysis of the World Bank procurement procedures, WTO's *Government Procurement Agreement*, the UNCITRAL *Model Law on the Procurement of Goods, Construction and Services* complete with a guide to enactment, the current European Union directives and a number of South African procurement procedures have indicated that:

1. there are eight generic procurement procedures associated with procurements other than those relating to disposals and e-procurement;
2. there are four generic evaluation methods; and
3. eligibility criteria can form part of a procurement procedure.

Combinations of the generic procedures and methods, with or without eligibility criteria, can be used to simulate most international and national procurement procedures and methods applicable to supplies, services and engineering and construction works as illustrated in Fig 2. They provide organisations (both public and private sector) with a wide range of procedures and methods in order to attain best value procurement outcomes.

An analysis of the procurement procedures of a number of international organisations and national procurement systems suggest that societal goals are best addressed if the objectives for a procurement system are that the system is fair, equitable, transparent, competitive and cost effective. From a developing country's perspective, the procurement system should also be capable of promoting their national social and development agenda.

Accordingly, the end objectives of a performance based procurement system may be described as follows:

Good governance: The procurement system shall be fair, equitable, transparent, competitive and cost effective;

Socio-economic: The procurement system must promote objectives additional to those associated with the immediate objective of the procurement itself.

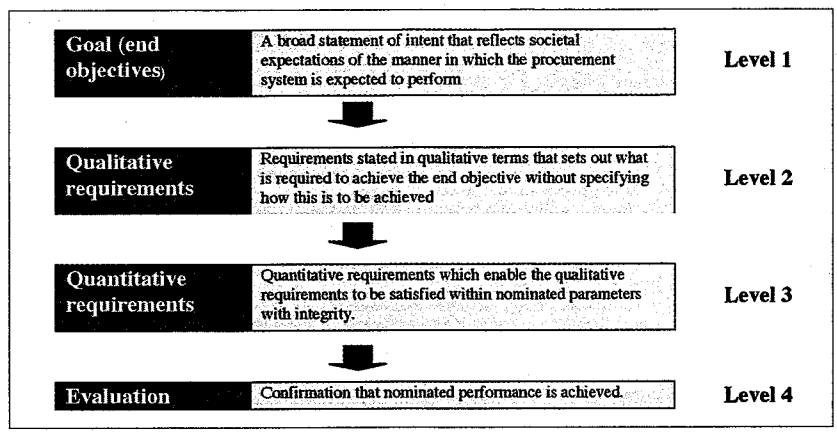


Fig 1. A four level performance framework for the design of procurement systems

These end objectives have recently been interpreted in the CUTS synthesis report (2004) in a qualitative manner, based on current international thinking[6], (see Fig 3).

The risk of the procurement system objectives being breached during implementation needs to be managed. At the same time, measures need to be put in place to curb fraudulent and corrupt practices which inevitably leads to a distortion of fair competition and to the wastage of scarce resources, which in turn contributes to the neglect of basic needs and to an increase in poverty levels.

There are two approaches to the establishment of qualitative procurement system requirements (i.e. standard operating procedures), namely the guidelines approach and the standards approach. These approaches cannot be divorced from the means of evaluation i.e. the manner in which the integrity of the procurement system is managed and maintained, (see Fig 3).

In the guideline approach, guidance and ethical principles are provided to enable users of the procurement system to achieve the end objectives within implied qualitative system requirements. In well-developed systems, standard bidding documents capture some of these procedures in the document that establishes the tenderer's obligations in submitting a tender, and the employer's undertakings in administering the tender process and evaluating tender offers. The system's integrity is invariable maintained by a number of committees which interpret the guidelines, apply the ethical principles and decide on what course of action to take. Put in another way, these committees adjudicate whether or not the process at any particular point satisfies the procurement system objectives and qualitative requirements. This invariably requires senior people in an organisation, who are not necessarily technical experts in a field, to serve on these committees. As a result, technical evaluation sub-committees are required to provide the necessary technical inputs in the evaluation process. This approach consumes scare resources in its application.

In the standards approach, standards, such as that set out in SANS 294, establish minimum requirements for the conduct of employees, agents, board members and office bearers when engag-

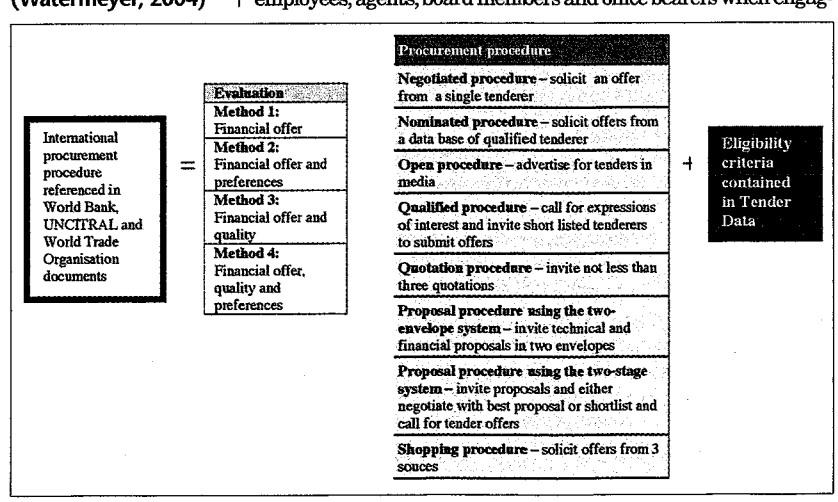


Fig 2. Relationship between international procurement procedures and the generic methods (Watermeyer, 2004)

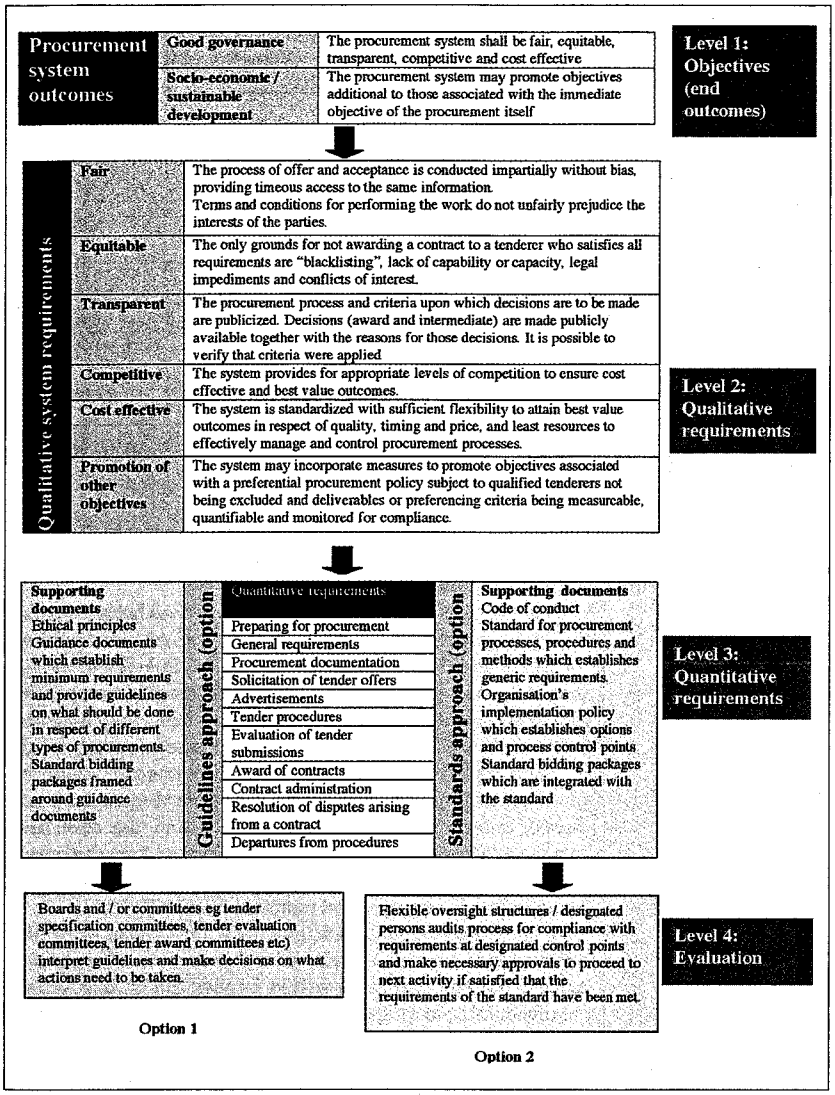


Fig 3. Framework for procurement for the development of a procurement system

ing in procurement, generic methods and procedures for procurements. These include those pertaining to disposals, and standard conditions of tender which place obligations on tenderers and commit employers to certain undertakings in the procurement process, including the manner in which submissions are to be evaluated. Organisations develop their procurement system around the generic processes outlined in SANS 294 and the generic methods presented in Fig 2 and specify in their procurement policies the circumstances under which each procedure and method is to be used. In this manner, a comprehensive and flexible rule-based framework is developed.

Since the standard, when read with an organisation's policy, establishes requirements in the form of a set of rules, the evaluation necessary at each of the control points in the procurement process is limited to confirming compliance with requirements which can be entrusted to suitably qualified technical staff. The standards approach also allows for auditing to take place at any stage in the process, and in particular after the award of a contract. This approach at the same time facilitates the prosecution of offenders relating to corrupt and fraudulent practices as its application does not require interpretation; the system can simply be tested by asking the question 'were the requirements complied with?'.

The CIDB has issued in terms of their governing legislation, a Standard for Uniformity in Construction Procurement. This is based on the provisions of SANS 294, a code of conduct for the parties engaged in construction procurement, a construction procurement best practice library to facilitate implementation, a register of graded contractors and a register of projects. All South Africa national and provincial departments, local authorities and state owned enterprises are required to apply the code of conduct, the standard and registers in procurements relating to the construction industry.

Promoting social and development objectives through the procurement system

Several models for public sector procurement interventions have evolved to promote social and economic development objectives relating to poverty alleviation and job creation, based largely on country specific procurement regimes and requirements. These can be broadly categorised as falling into one of four generic schemes, which in turn can be subdivided into one of the nine implementation methods identified by the Public Procurement Research Group to promote non-commercial objectives as tabulated in Table 3.

Concerns regarding the undermining of primary procurement (good governance) objectives are invariably expressed whenever procurement is used as an instrument of socio-economic policy. Typically the concerns revolve around risks relating to the compromising of a procurement system's good governance objectives. Recently a risk assessment based on AS/NZS 4360 has been conducted on the use of procurement to create a demand for services and supplies from, or to secure the participation of targeted enterprises and targeted labour, using the first eight methods listed in Table 3. This assessment indicated that the methods which relate to preferencing at the short listing stage and award (tender evaluation) stage, whilst not guaranteeing that socio-economic objectives will be met, are the methods that are most likely not to compromise requirements for a system which has fair, equitable, transparent, competitive and cost effective goals, if appropriately managed. The analysis furthermore indicated that method 3 (contractual conditions), method 7 (product / description specification), and method 8 (design of procurement to benefit particular contractors) have the potential under certain circumstances to satisfy primary objectives while method 1 (set asides), method 2 (qualification criteria), and method 4 (offering back) are most likely to compromise such objectives[7].

Targeted procurement procedures were developed in 1996 to facilitate the use of procurement to provide business and employment opportunities to targeted enterprises and labour in a measurable, quantifiable, auditable and verifiable manner, based on the use of a preference at the tender award stage (method 6). In terms of these procedures, preferences may be offered to tenderers who satisfy certain criteria e.g. those relating to the size and ownership of the enterprise on low value contracts. Alternatively, on contracts above a financial threshold, tenderers are required to compete on the basis of both that which is to be constructed or maintained (the product) and the social benefits which target groups (business for targeted enterprises and/or employment for targeted labour) may derive in the execution of the contract (social deliverables).

Performance-based resource specifications were developed to specify and describe contract participation goals at tender stage (see Fig 4). These performance-based standards enable tenderers to tender contract participation goals in the performance of a contract (i.e. offer to spend a nominated expenditure on the engagement of targeted enterprises, targeted labour or a combination thereof) to secure a particular margin of preference. These specifications, upon award of the contract, form the basis for monitoring and verifying that the contractor achieves the contract participation goal in the performance of the contract. Financial penalties or other such sanctions can then be applied should the goal not be achieved. They also measure the flows of money

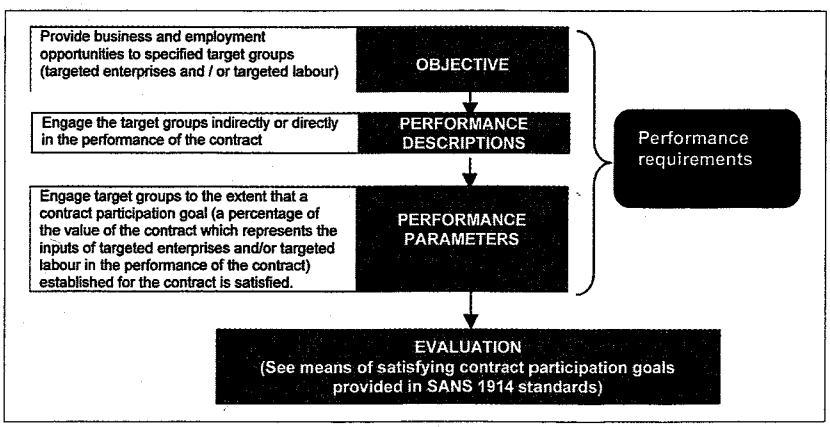


Fig 4. Structure of SANS 1914 performance based resource standards

Table 3: Methods used to implement policies relating to secondary objectives (after Arrowsmith, 2000 and Watermeyer, 2004)

Scheme type	Methods	Actions associated with the method
Reservation (Reserve contracts or portions thereof for contractors who satisfy prescribed criteria)	#1 Set asides	Allow only enterprises that have prescribed characteristics to compete for the contracts or portions thereof, which have been reserved for their exclusive execution.
	#2 Qualification criteria	Exclude firms that cannot meet a specified requirement, or norm, relating to the policy objective from participation in contracts other than those provided for in the law
	#3 Contractual conditions	Make policy objectives a contractual obligation
	#4 Offering back	Offer tenderers that satisfy criteria relating to policy objectives an opportunity to undertake the whole or part of the contract if that tenderer is prepared to match the price and quality of the best tender received
Preferencing (Evaluation points are granted to those who satisfy prescribed criteria or who undertake to attain specific goals in the performance of the contract.)	#5 Preferences at the shortlisting stage	Limit the number of suppliers/service providers who are invited to tender on the basis of qualifications and give a weighting to policy objectives along with the usual commercial criteria, such as quality, at the short listing stage
	#6 Award criteria (tender evaluation criteria)	Give a weighting to policy objectives along with the usual objectives along with the usual commercial criteria, such as price and quality, at the award stage
Indirect (Contractors are constrained in the manner in which they perform the contract to satisfy the policy objectives.)	#7 Product/service specification	State requirements in product or service specifications
	#8 Design of specifications, contract conditions and procurement processes to benefit particular contractors	Formulate specifications and / or set contract terms to facilitate participation by targeted groups of suppliers
Supply side (Measures are put in place to overcome barriers in competing for tenders)	#9 General assistance	Provide support for targeted groups to compete for business, without giving these parties any favourable treatment in the actual procurement

through the target groups and thereby provide a measurable key performance indicator[8].

The aforementioned targeted procurement procedures were implemented on all contracts issued by the National Department of Public Works from August 1996. Businesses owned, managed and controlled by black people, with turnover within prescribed limits (under £1.8M), were targeted. The outcome for the period August 1996 to December 1998 in respect of building contracts is presented in Table 4. (The result for electrical, mechanical and civil works where engineering technical expertise was required was significantly less.) The direct financial premium (difference in price between lowest responsive financial offer received and price of awarded tender) associated with this period was less than 0.67%. The results in Table 4 should be interpreted in the light of a market share of such business prior to the introduction of the policy in 1996 of 0.5% in 1993 and 2.5% in 1995[9,10]. Today some 88% of contractors in all disciplines that are graded on the Construction Industry Development Board's register of contractors having a turnover of £1.8M or less, are black owned.

The practice of breaking down (unbundling) of contracts into smaller contracts to facilitate the participation of small contractors places an additional administrative burden on employers to administer an increased number of contracts. It may result in an inappropriate division of responsibilities, increased contractual risk, duplication of establishment charges and under-utilisation of resources.

Furthermore, projects may lack overall co-ordination and management. Small contractors may not have adequate management skills to deal with the complexities associated with the nature of the works. The use of resources specifications to set targets for granting of price preferences or the payment of incentive bonuses offers a viable and cost effective alternative to unbundling practices as this approach transfers such responsibilities to the main or prime contractor.

Employers may also identify portions of the works that could be subcontracted to smaller contractors and require that these portions of the works be subcontracted in terms of prescribed procedures and contract documentation. Tenders for subcontracts can be called for in terms of the standard conditions of tender contained in SANS 294. The evaluation of tenders can be performed jointly by the contractor and the employer. Once awarded, the subcontract becomes a domestic subcontract. This approach has the added advantage that the subcontracts are tendered for in a controlled environment as opposed to being negotiated by the main contractor.

The choice of technology and construction method/method of manufacture may be specified (method 7) to increase the quantum of employment generated. The cost effectiveness of this approach, however, needs to be determined prior to the calling for tenders. An alternative approach is to allow tenderers the choice of technology and/or methods in order to arrive at an optimum economic mix and to tender a contract participation goal in terms of a resource specification. In this approach, the cost premium will always be within the margin of price preference that is offered.

National standards have been developed for the aforementioned targeted procurement procedures, namely SANS 10396 and the SANS 1914 family of targeted construction standards[11].

Housing standards

South Africa has a very diverse housing stock. According to Census 1996, some 18% of the housing stock comprises traditional dwellings or structures made of traditional materials and 16% informal shacks. (See Table 5). The majority of formal dwelling units are single-storey houses of masonry construction.

The JSD recognised the consequences of ignoring the problems associated with building on problem soil horizons in mass housing projects and that the problem lay not with the technology required, but in the implementation of known technologies. The JSD as a contribution to the government's Reconstruction and Development Programme, published in 1995 a *Code of Practice for Foundations and Superstructures for Single Storey Residential Buildings of Masonry Construction*. It was based on work undertaken by Watermeyer and Tromp in implementing systematic procedures in a rapidly expanding township which facilitated not only effective building control, but also provided a means for the adjustment of subsidies allocated to low cost housing to take account of different founding conditions[12].

The approach classified sites in terms of building practice, based on the expected range of total and differential soil movement to which a single-storey residential type building may be subjected. Sites were classified in terms of an easily understood alphanumeric system which related the expected range of movement to building and construction practices. Standard solutions and engineering design procedures for three serviceability performance levels were also established to enable developers to provide housing from the top to the bottom end of the market. Today, mortgage lending finance cannot be obtained without the presentation of a site class designation certificate and all govern-

Table 4: Market share of expenditure of small black businesses on contracts issued by the National Department of Public Works

Subsector	Period				Weighted average for period August 96 to Dec 98
	Aug 96 to Jun 97	Jul 97 to Dec 97	Jan 98 to Jun 98	Jul 98 to Dec 98	
Target group index (market share) %					
Building	24.9	27.5	31.3	33.3	30.3
Average including engineering contracts	22.3	25.7	28.4	32.4	28.0
Total value of contracts awarded (£ million) Total					
Building	19	32	73	37	161
Total including engineering contracts	22	35	92	38	187

Note: £1 = Rand 11

Table 5: Housing stock in South Africa (Census 1996)

Description	Number (millions)	%
House or brick structure on a separate stand or yard	4.33	48
Traditional dwelling/ hut/ structure made of traditional materials	1.64	18
Flat in a block of flats; town/ cluster/ semi-detached house (simplex, duplex or triplex); unit-in retirement village; house/ flat/ room, in backyard	1.36	15
Informal dwelling/ shack, in backyard or in informal settlement	1.45	16
Other including unspecified dwellings and room/ flatlet not in backyard but on a shared property	0.28	3
Total	9.06	100

Table 6: User performance levels adopted by the Joint Structural Division

User performance level	basic characteristics
1	Focus is on producing basic shelter at the lowest possible initial cost recognising that shorter maintenance cycles than that contemplated in user performance level 2 may be required. Mortgage lending finance is not involved; short term loan finance may be involved*. Limited rain penetration through walls and roofs permitted in abnormal storms
2	Focus is on producing a durable housing unit which requires infrequent maintenance. Mortgage lending finance is usually involved.

*Housing units may be constructed in terms of self help / sweat equity schemes

ment subsidies for the construction of low cost homes are based on this system. The savings to the economy relating to the repair of cracked housing and fraudulent claims for increased subsidies due to geotechnical conditions have not been insignificant.

The Joint Structural Division thereafter turned its attention to the challenge of providing affordable housing for the majority of South Africans. The Division recognised that:

- poor households have limited means at their disposal to access housing which provides adequate protection against the elements;
- the South African regulatory environment was not conducive to the promotion and evaluation of indigenous forms of construction; and
- the interpretation of the South African National Building Regulations were framed around 'first' world parameters, namely; low maintenance, no penetration of water into interiors, deflections which are not discernible, negligible levels of cracking, etc., i.e. around the parameters embodied in international or national codes of practice found in developed countries.

The JSD concluded that housing units fell into one of two categories: formal structures which are constructed in accordance with National Building Regulations and informal structures for which no standards apply or were applied. The JSD found this situation to be unacceptable from a health and safety point of view. It realised that if different user performance levels (i.e. the technical performance criteria applicable for an intended use selected by the user) were defined, it would be possible to regulate the construction of housing units which have comparable safety standards, but have different resistances to rain penetration, behaviour in fire, deflections and deviations from the horizontal and vertical, expected damage in walls and floors, maintenance cycles, and resistance to local damage/soft body impact. End users could then choose the housing solution which lies within their means without compromising safety and basic health requirements[13].

The Division published in 2000 a Code of Practice for the assessment of housing units in South Africa which provided two user performance levels, the basic characteristics of which are set out in Table 6. This code also established technical requirements for both user performance levels and methods for establishing compliance with requirements.

This performance-based code has informed the approach taken in the revised interpretation of national building regulations which are in the process of being finalised. The revised interpretation now makes provision for category 1 buildings which are used for places of instruction, worship, displaying and selling merchandise to the public, offices, dormitories, domestic residence and dwelling houses, that have no basements, a maximum length between intersecting walls or members providing lateral support of 6.0m, and a floor area not exceeding 80m^2. Different performance parameters are provided for category 1 and non-category 1 buildings in respect of a number of attributes.

The revised interpretation of national building regulations will follow a four-level regulatory system outlined in Fig 5. Objectives (level 1) are captured in Section 24 of the Bill of Rights contained in the Constitution of South Africa, while functional requirements in the form of functional regulations (level 2) are provided in the National Building Regulations. The forthcoming third edition of SANS 10400, *The Application of National Building Regulations*, establishes performance (qualitative) requirements (level 3) and deemed-to-satisfy provisions for two categories of buildings and the means by which the functional requirements established in the regulations may be satisfied (level 4).

Procurement documentation

Procurement documents are required to solicit tender offers and to form the basis of a contract. It is imperative that appropriate standards and procurement measures taken to alleviate poverty are captured in such documents. SANS 10403 provides a series of standard headings of component documents based on an 'offer' and 'acceptance' process. The structure provided for in SANS 10403, when used in conjunction with the standard conditions of tender contained in SANS 294, enables preferencing arrangements to be readily documented in a standard and transparent manner. The SANS 1921 family of standards enables requirements relating to issues such as HIV/AIDS awareness, performing certain earthworks activities by hand and the provision of third party management support to be incorporated by reference in the scope of work using most forms of contract, including the NEC and FIDIC families of standard contracts, without having to formulate special conditions of contract[11].

Lessons learned

The lessons learned from the approaches to procurement and appropriate standards and technologies made since the late 1980s may be summarised as follows:

1. The construction and maintenance of infrastructure projects can be used to provide work opportunities to vulnerable groups and business opportunities to the marginalised to address inequities within a society and in so doing address poverty.
2. Innovative procurement arrangements and appropriate technologies and construction methods are required to increase work opportunities. Accepted norms and standards need to be

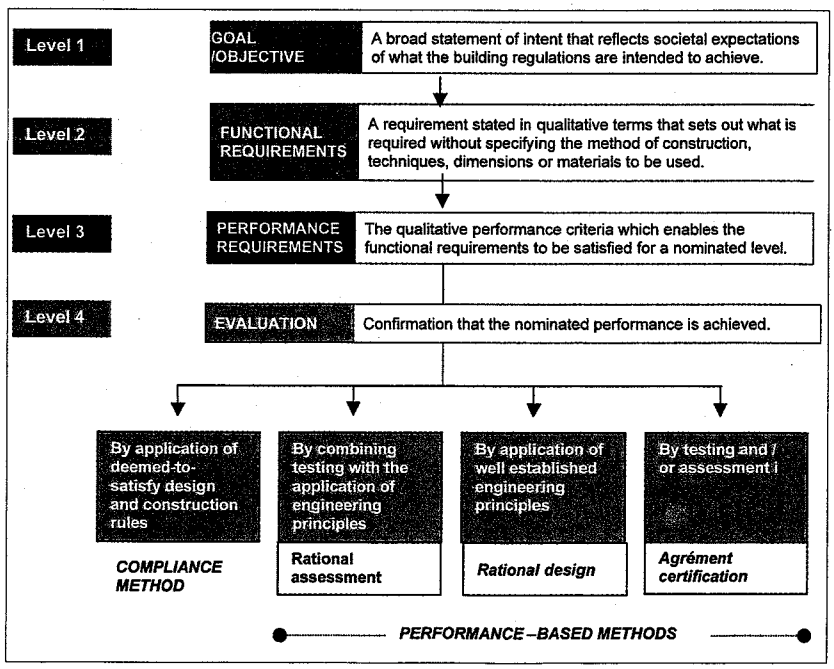


Fig 5. Four level performance based regulatory system

reconsidered and, where appropriate, interrogated using a first principle approach in order to arrive at different outcomes. Certain technologies which have fallen into disuse in developed countries through the high cost of labour may have to be 're-discovered' and implemented. The performance of indigenous technologies needs to be quantified and documented so that it can be applied with confidence.

3. Appropriate standards and comprehensive design guidance and construction standards are needed to replicate outcomes from pilot projects at scale. National standards and best practices have an important part to play in converting research and innovation into mainstream activities and promoting their use.
4. A uniform, flexible, predictable, rule-based procurement system is essential for increased investment in infrastructure, reducing opportunities for corrupt and fraudulent practices and ensuring that allocated budgets are spent timeously.
5. Procurement documents need to be structured in a generic manner so that procurement measures and appropriate standards aimed at reducing poverty can be readily incorporated in such documents and communicated to participants in the procurement process.
6. Capacity building is required to ensure effective and efficient implementation.
7. Supply-side measures need to be in place to enable those targeted to make use of the opportunity presented through the provision of infrastructure.

Understanding the development agenda of developing countries

The 'green' and 'brown' agenda

Sustainable development is rooted in the simple concept of providing a better quality of life for all, now and for generations to come. It is commonly approached from three primary points of view – environmental, economic and social, with the social component relating to the quality of life. The social component in developed countries frequently focuses on social equity, cultural issues, traditions, heritage issues, human health and comfort, social infrastructure and safe and healthy environments. In developing countries the social focus invariably shifts to poverty reduction, job creation and access to safe, affordable and healthy shelter.

Given the disparities in standards of living between the developed and developing countries, the approach in general to the social component is very different. This results in different development priorities between the 'north' (developed nations) and 'south' (developing nations) as illustrated in Fig 6. In countries with dual economies such as South Africa, the priorities differ regionally and within communities, depending upon where the poor and the affluent live.

The so-called 'green' agenda focuses on the reduction of the environmental impact of urban-based production, consumption and water-generation on natural resources and ecosystems, and ultimately on the world's life support system. As such it addresses the issue of affluence and over-consumption and is generally more pertinent to affluent countries. On the other hand, the so called 'brown' agenda focuses on poverty and under development. As such, it addresses the need to reduce the environmental threats to health that arise from inadequate shelter, poor sanitary conditions, crowding, inadequate water provision, hazardous air and water pollution, and accumulations of solid waste. It is generally more pertinent in poor, under-serviced cities or regions[14].

In developing countries like South Africa, both the north and south agendas are relevant.

A balance needs to be found between the needs of people (brown agenda) with the carrying capacity of the earth (green agenda) in such a manner that the needs of future generations can continue to be met. At the same time, a measure of social and economic equity between individuals, as well as between communities, nations and generations must be found. This is necessary to ensure that basic human rights are respected, a fair and just society is created, wealth in the form of access to resources and opportunities is equitably distributed and increased prosperity for all results. Failure to do so will result in a global society in constant conflict with itself. Chrisna du Plessis sums it up by pointing out that sustainable development is 'a continuous process of maintaining a dynamic balance between the demands of people and what is ecologically possible'[15].

The three primary infrastructure project evaluation criteria (triple line reporting), based on the two different agendas, may accordingly be described as:

- the Earth (green agenda);
- people (brown agenda);
- economic prosperity.

Construction is an essential human activity that rivals few in its consumption of resources and its potential to harm the environment. The way in which construction is approached as well as its technologies and practices need to be adapted to cater for the requirements of both the 'green' (environment) and 'brown' (poverty and under development) agendas.

Engineering capacity

Kofi Annan issued a challenge to the engineering community in 2002 'to help mobilise global science and technology to tackle the interlocking crises of hunger, disease, environmental degradation and conflict that are holding back the developing world.' The United Nations Education and Scientific and Cultural Organisation (UNESCO) and the World Federation of Engineering Organisations (WFEO) have responded to this challenge and are mounting major efforts at technical capacity building to developing countries. UNESCO and WFEO recognise that developing countries need a solid base of technology-prepared people, as well as indigenous science and technology capacity, to effectively improve economies and the quality of life[20].

A recent SAICE study has attempted to quantify the technological challenge facing developing countries by providing an indication of the ratio of engineer to population, based on an extensive desk top survey and contacting various institutions and registering bodies[21]. Although the data was compiled from a number of sources of varying detail and reliability, the statistics (some of which are reproduced in Table 7) when linked to *per capita* gross national income, illustrate a linkage between the economy of a country and the number of qualified engineers *per capita*.

The numbers of civil and structural engineers have not kept pace with population growth and have for the last few decades declined, as illustrated in the comparison of the age profile of the membership of SAICE and the IStructE in Fig 7. (In South Africa the average age of a member is 52 and that of a fellow is 58.) Although the skewed age profile may in part be attributed to the introduction of computer technology, the low numbers of young engineers in the face of a growing world population is of concern. This does not bode well for the development of future engineering capacity, unless the approach to the development and capacitation of young professionals changes.

Developed and developing countries have different population growth rates; the population of the world grew by 164% from

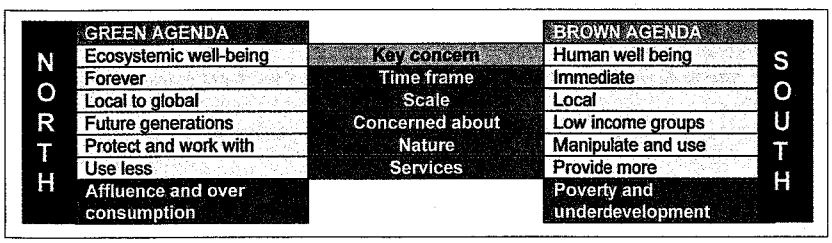


Fig 6. The fundamental differences between the 'green' and 'brown' agenda (after du Plessis, 2003)

Table 7: International registered engineer to population statistics

Country	Population per registered engineer (after Lawless, 2005)	per capita Gross National Income, US$ (World Bank, 2005)
Norway, Finland, Denmark and Canada	≤200	28 390 to 520 303
Sweden, Germany, France and Ireland	201 to 300	30 090 to 35 770
Japan, UK, USA, Australia and Hong Kong	301 to 500	37 120 to 41 400
Malaysia and Chile	501 to 1000	4650 to 4910
Singapore, Korea, Hungary and Romania	1001 to 3000	2920 to 24 220
South Africa	3001 to 5000	3630
Sri Lanka, Tanzania, Namibia	5001 to 7500	330 to 2370
Swaziland, Zambia and Ghana	≥12 000	380 to 1660

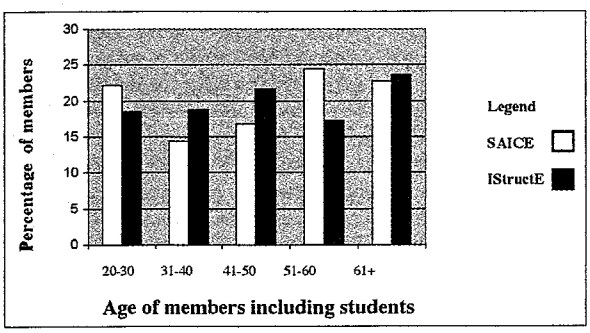


Fig 7.
Age profile of SAICE and IStructE members

1971 to 2001 while the population in the UK and South Africa grew during this period by 5% and 194%, respectively. The shortage of younger engineers is therefore a far more serious problem in developing countries.

Conclusions

Procurement is fundamental to the delivery of buildings and engineering infrastructure. A wide range of tools, techniques, technologies, standards and approaches have been developed in South Africa in response to poverty reduction imperatives, using the procurement of infrastructure to:

- provide work opportunities to vulnerable groups;
- increase the quantum of employment generated per unit of expenditure through the promotion of small scale enterprises and usage of labour-based technologies and methods;
- provide business and/or work opportunities to groups of people who are socially and economically marginalised in order to address inequities within a society.

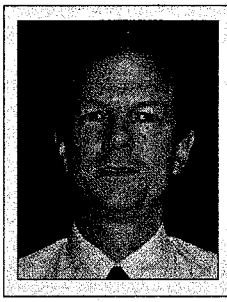
This has been achieved without necessarily compromising international best practice good governance objectives relating to procurement system requirements. They enable aspects of chapter 7 of Agenda 21 to be implemented, namely 'establish and strengthen indigenous building materials industry, based, as much as possible, on inputs of locally available natural resources and to promote the use of labour-intensive construction and maintenance technologies which generate employment in the construction sector for the underemployed labour force found in most large cities, while at the same time promoting the development of skills in the construction sector'. As such they contribute to the reduction of the proportion of people living on less than US$1/day and those that suffer from hunger i.e. MDG No 1 (Eradicate extreme poverty and hunger.)

The standards approach to implementing procurement processes not only provides a practical means to root out corruption which is placing sustainable development at risk, but also contributes to the establishment of rule-based trading systems which improve governance and reduce poverty in support of MDG No 8 (Develop a global partnership for development.)

The challenge in responding to the MDG is to integrate the systems and techniques that have been successfully used in pilot projects in developing countries into the mainstream of public sector infrastructure delivery and to increase the capacity of the public sector to deliver in response to current increasing investment in infrastructure. The standards and best practice approach adopted in South Africa provides a workable model for mainstreaming outcomes of pilot projects and provides an excellent platform for developing capacity. This systematic approach may well be able to address in part the shortage of engineers in developing countries.

The developed countries (the north) have resources and pursue a green agenda, while the developing countries (the south) are without resources and pursue a brown agenda. However, the developing countries with dual economies and limited resources are in a position to bridge this gap. They can offer perspective, understanding, an ability to relate to both agendas, a capability to develop best practices for developing countries and an ability to advise other developing countries on appropriate responses. Accordingly, capacity building within developing countries should be undertaken by other developing countries which understand the 'brown agenda', with support and backing from developed countries. Partnerships between north and south will be needed to do this. Countries such as South Africa, India and Brazil, which are faced with both agendas, need to play a leading role in this regard.

The role of institutions in responding to MDG imperatives relating to poverty are well captured in IStructE's *An Institution for 2010* – 'ensure, as a social responsibility, that appropriate technologies are disseminated in areas where they are most needed, and indigenous construction technologies which constitute best practices in the locality in which they are utilised are given due recognition and are promoted.'



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