The South African Institution of Civil Engineering

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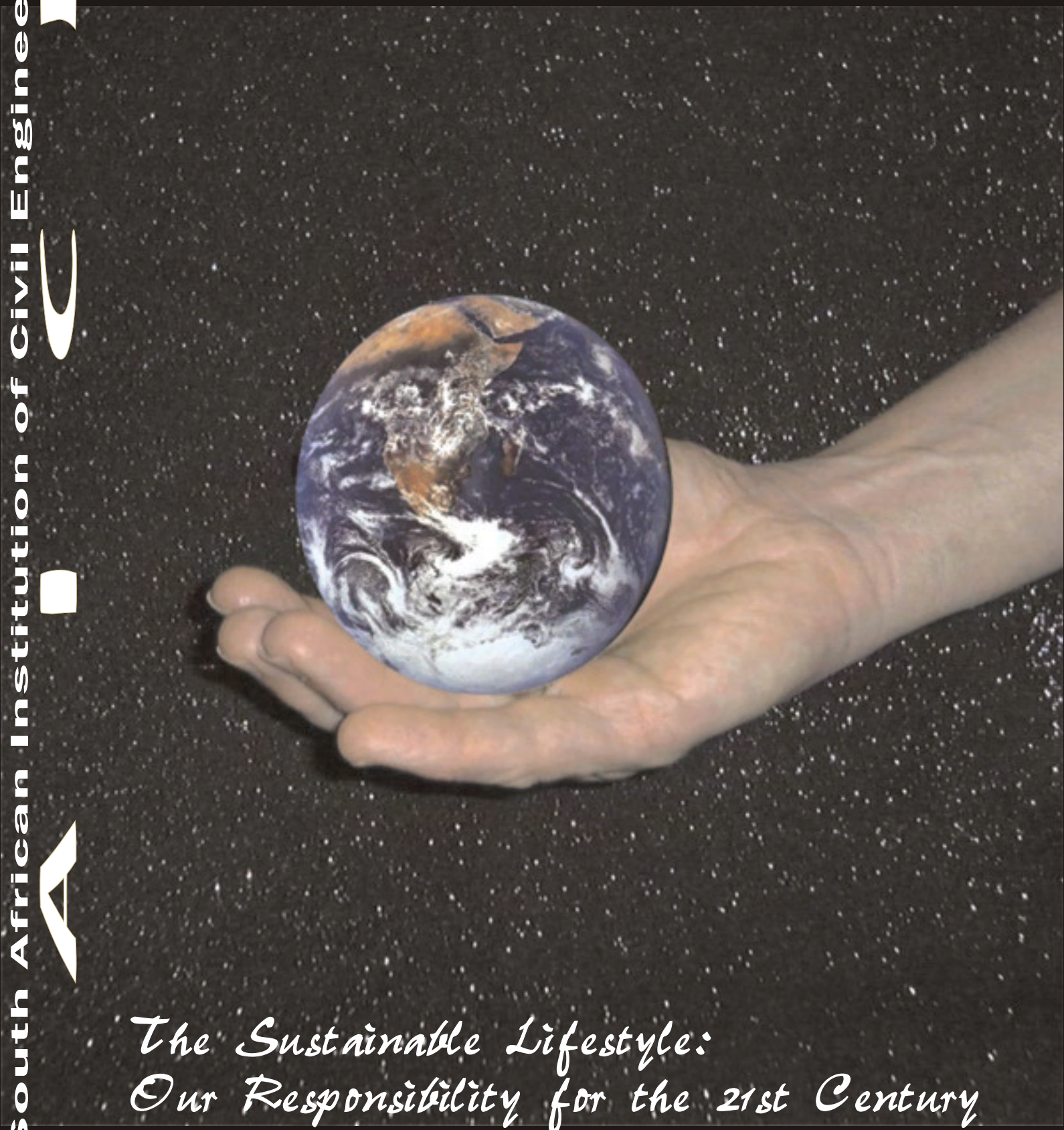
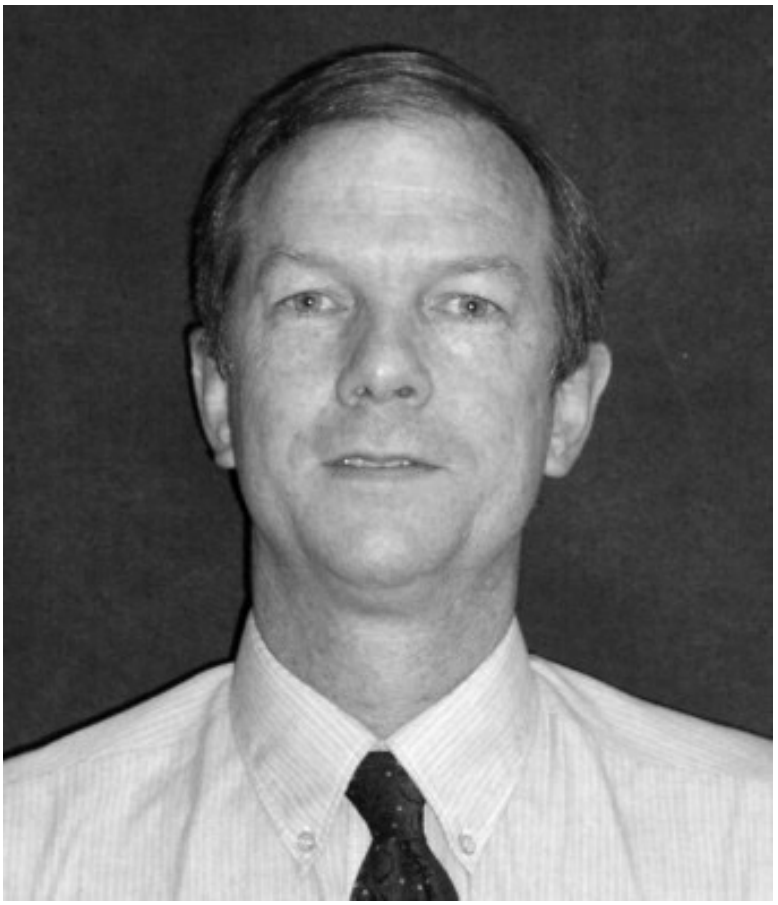


The Sustainable Lifestyle: Our Responsibility for the 21st Century

Ron Watermeyer

A little bit more about Ron Watermeyer

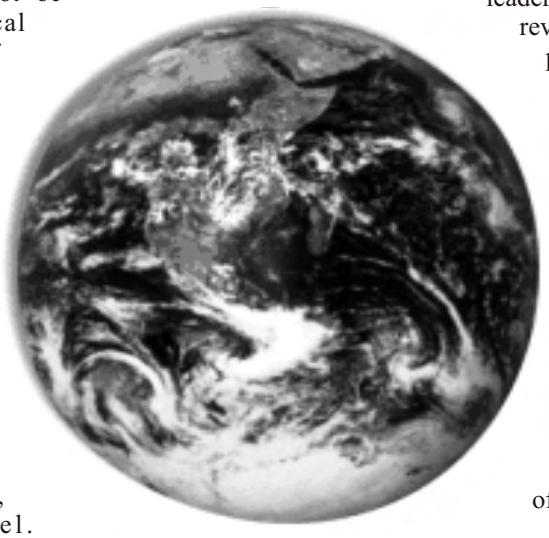
Ron Watermeyer is the 101st president of the South African Institution of Civil Engineering. He holds a civil engineering degree from the University of the Witwatersrand and is both a Professional Engineer and a Chartered Structural Engineer. He is the Chairperson of Standards South Africa's Technical Committee for Construction Standards, an associate of the Construction Industry Development Board and a director of Soderlund and Schutte (Pty) Ltd. He has in the past been the co-ordinator of Soweto's Contractor Development Programme, a member of government's Procurement Forum's Procurement Task Team, a member of the secretariat of the Interministerial Task Team for Construction Industry Development and a vice president of the Institution of Structural Engineers (London). He has published over 60 papers on a wide range of topics and has developed several national standards.



Synopsis

Sustainable development is the biggest challenge of the 21st century. Sustainable development is not about development that is sustainable, i.e. ongoing viable, feasible or continually growing. 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 can lead to a higher quality of life for the current generation, without compromising that of future generations. This may mean that industry needs, in some cases, to stop growing, or to grow in different ways. The next few decades for civil engineering will not be "business as usual".

The challenge facing civil engineering, and indeed mankind, can be found by examining quantitative data relating to natural ecosystems, the impact of human consumption on the environment, greenhouse gas emissions, and poverty. The indications are that if mankind continues its current developments, more than one Earth will be required in the next 50 years. South Africa cannot be complacent - its ecological footprint (measurement of human impact on the Earth) is almost double the world average and it is the largest emitter of greenhouse gases in Africa. In addition global warming is expected to reduce South Africa's rainfall. It also has many poverty challenges.



Societal responses to environmental challenges, including poverty, have taken place at a global, regional, national and local level. Underlying these responses is the notion that it is better to control mankind's destiny than to leave it to nature. Returning to a sustainable development pathway necessitates that changes be made, particularly in terms of consumption patterns and technologies.

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, its technologies and its practices need to systematically tackle both the "green" (environment) and "brown" (poverty and under development) agendas. Accordingly, the focus needs to encompass not only the time, cost and quality aspects of the asset that is created, but also the use of resources, the production of emissions and the impact on biodiversity. Increasingly, projects need to be assessed in terms of a "triple bottom line" which embraces economic, environmental and social considerations.

The construction industry will in future be challenged to utilise renewable and perpetual resources, to reuse, reclaim and recycle construction materials, and to choose those materials with low environmental impact. Reductions in energy consumption will also be required during construction activities. Design and construction requirements will need to expand from immediate safety issues to include global safety issues.

The starting point for SAICE's strategic response to sustainable development is for our members to come to a common understanding as to what is meant by sustainable development and sustainable construction. Once this has taken place, SAICE needs to embark upon an awareness campaign, assume a technical leadership role through its divisions and revise its current code of ethics to provide a framework within which sustainable development decisions may be made. It must also find ways of sharing South African civil engineering responses to sustainable development with other African countries. SAICE also needs to help build capacity within less developed African countries to embrace appropriate technologies and solutions and to promote procurement techniques that encourage aspects of sustainable development.

Civil engineering professionals can turn things around, but they need to adopt a broader view on what constitutes sustainable development and change their mindset to provide solutions that satisfy sustainable development objectives. They need to find ways to provide construction works that do as little harm as possible to the environment while providing a higher quality of life for the current generation, without compromising future generations. This necessitates the adoption of ethical values based on sustainable development imperatives

When all is said and done, sustainable development is a journey and not a destination. It is the responsibility of all the inhabitants on planet earth.

Samevatting

Volhoubare ontwikkeling is die grootste uitdaging van die 21st eeu. Volhoubare ontwikkeling is nie oor ontwikkeling wat volhoubaar is nie, dit is dus nie net oor voortgang, lewensvatbaarheid, haalbaarheid en uitvoerbaarheid of volgehouegroei nie.

Dit is eerder gegrond in die eenvoudige beginsel van 'n beter kwaliteit lewe vir almal, nou en vir die toekomstige geslagte. Dit is 'n manier om na al die hulpbronne te kyk wat kan bydra tot 'n hoër kwaliteit van lewe vir die huidige generasie, sonder om die toekomstige geslagte te benadeel.

Dit mag beteken dat, in sommige gevalle, die bedryf moet ophou groei of op 'n ander manier groei. Vir Siviele Ingenieurswese sal sake vir die volgende paar dekades nie soos gewoonlik verloop nie.

Die uitdaging vir Siviele Ingenieurswese en inderdaad die mensdom, sal gevind word deur ondersoeke ten opsigte van kwantitatiewe data wat verband hou met natuurlike ekosisteme, die invloed van menslike verbruik op die omgewing, kweekhuisgas-vrystelling en armoede.

Daar is aanduidings dat, indien die mensdom volhou op sy huidige ontwikkelingspatroon, meer as een Aarde oor 50 jaar nodig sal wees.

Suid-Afrika kan nie meer gerus wees nie - die land se ekologiese voetspore (die impak van die mens op die aarde) is byna dubbel dié van die wêreld gemiddelde en is ook die grootste produsent van kweekhuisgasse in Afrika.

Boonop word verwag dat die aarde se verwarming Suid-Afrika se reënval gaan verminder. Suid Afrika het ook talle armoede uitdagings.

Die gemeenskapsreaksie op omgewingsuitdagings, insluitende armoede, het op globale, streeks, nasionale en plaaslike vlak uiting gevind.

Onderliggend aan hierdie reaksie is die besef dat dit beter is om die mensdom se bestemming te bestuur as om dit aan die natuur oor te laat. Om na 'n volhoubare ontwikkelingsweg terug te keer, noodsaak verandering, veral ten opsigte van verbruikspatrone en tegnologie.

Konstruksie is 'n noodsaaklike menslike aktiwiteit wat min gelykes het wat betref die verbruik van hulpbronne en potensiële skade aan die omgewing.

Die manier waarop konstruksie bevorder word, die verwante tegnologie en praktyke, moet beide die groen (omgewing) en die bruin (armoede en onderontwikkeling) agendas op 'n sistematiese wyse aanspreek.

Daarvolgens moet daar nie net gefokus word op die tyd-, koste- en kwaliteitsaspekte van die bate wat geskep word nie, maar ook op die gebruik van bronne, die produksie van uitvloeisels en die impak op bioverskeidenheid.

Dit word toenemend nodig om projekte te evalueer in terme van 'n driedubbele somtotaal wat ekonomiese, omgewings en sosiale aspekte omvat.

Die konstruksiebedryf sal in die toekoms uitgedaag word om hernubare en langdurige bronne te gebruik, te herwin en te hersirkuleer en om materiale te kies wat 'n lae omgewingsimpak het.

Energieverbruik tydens konstruksie-bedrywighede sal ook verminder moet word. Ontwerp en konstruksie-vereistes sal moet uigebrei word vanaf onmiddellike veiligheidsaspekte om globale veiligheidsaspekte in ag te neem.

Die beginpunt van SAISI se strategiese reaksie op volhoubare ontwikkeling, is vir ons lede om 'n gemeenskaplike begrip te ontwikkel oor wat bedoel word met volhoubare ontwikkeling en volhoubare konstruksie. Sodra dit gebeur het, moet SAISI met 'n bewusmakingsprogram begin, 'n tegniese leierskapsrol met behulp van die afdelings aanvaar en die huidige etiese kode wysig sodat dit 'n raamwerk kan vorm waarbinne volhoubare ontwikkelingsbesluite geneem kan word. SAISI moet ook maniere vind om die Suid-Afrikaanse siviele ingenieurswese se antwoorde oor volhoubare ontwikkeling met ander Afrika lande te deel.

SAISI moet ook help om kapasiteit te bou in minder ontwikkelende Afrikalande om toepaslike tegnologie en oplossings te aanvaar en om verkrygingstegnieke te bevorder wat aspekte van volhoubare ontwikkeling bevat.

Professionele siviele ingenieurspraktisyns kan dinge omdraai, maar hulle moet 'n wyer uitkyk aanvaar oor wat volhoubare ontwikkeling is en bevat, en hulle moet hulle volhoubare ontwikkelingidees verander om oplossings te vind wat volhoubare ontwikkelingsdoelwitte sal bevredig.

Hulle moet maniere vind wat sal verseker dat konstruksiewerke so min as moontlik skade aan die omgewing aanbring, terwyl dit gelyktydig 'n hoër kwaliteit van lewe vir die huidige geslagte verseker, sonder om die toekomstige geslagte te kompromeer.

Dit is dus noodsaaklik om etiese waardes te aanvaar wat op volhoubare ontwikkelinginstruksies gegrond is.

Aan die einde van die dag is volhoubare ontwikkeling 'n reis en nie 'n bestemming nie. Dit is die verantwoordelikheid van die hele planeet aarde se mense.

Introduction

My immediate predecessor, Faried Allie, the 100th SAICE president, had the privilege in his centennial presidential address of celebrating "*the achievements of the civil engineering profession and the solid foundation that has been laid over the last hundred years*." In order to understand this foundation and how to build upon it in the next few decades, it is necessary to:

- understand the history and nature of civil engineering; and
- identify the single biggest known challenge facing the civil engineering profession in the 21st century.

In my view, sustainable development is the biggest single known challenge of the 21st century. This view has been echoed by several of my predecessors over the last decade. Bingle Kruger, in his presidential address in 1995, made reference to *"...the single greatest challenge for the profession in the 21st century is its contribution in terms of leadership and knowledge to the sustainable development team, including the upliftment process of underprivileged communities."*

Sustainable development is certainly a "buzz" word in the media and in engineering jargon of today. It feels at times as if every second conference has a theme revolving around some aspect of sustainable development. Issues falling under the banner of "sustainable development" appear to be very broad and range from saving the planet to saving the engineering profession and from developments that don't compromise "green" objectives to those that address poverty. Sustainable development appears, to the uninitiated, to be all things to all people; but is it?

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, however, since 1987 broadened and matured. 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. 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 a way of looking at all resources that can lead to a higher quality of life for the current generation, without compromising that of future generations.

In this address, I will highlight some of the sustainable development challenges of the 21st century facing South Africans and the construction industry. This is necessary to promote awareness, to stimulate thinking and to initiate SAICE's strategic response to this important challenge. Sustainable development is now no longer a question of choice. We need to change our approach to projects as well as some of the practices of our chosen profession and our lifestyle, if we are to meet the needs of the present without compromising the ability of future generations to meet their own needs.

The History and Nature of Civil Engineering

Herbert Hoover, the 31st president of the United States (1929-1933) described engineering in his memoirs as "*a great profession. There is the fascination of watching a figment of the imagination emerge through the aid of science to a plan on paper. Then it moves to realization in stone or metal or energy. Then it brings jobs and homes to men. Then it elevates the standards of living and adds to the comforts of life. That is the engineer's high privilege*".

Civil engineering has developed in response to changing societal needs. Rodney Milford illustrated this, in his presidential address in 1999 where he broadly categorized the history of civil engineering in South Africa in terms of Table 1. It is evident from Table 1 that civil engineering is intrinsically linked to the serving of societal needs at both a micro and macro level.

Table1: The history of civil engineering in South Africa (Milford, 1999)

Period	Societal drivers
Pioneering period (1800 to 1940)	This period set the path for the development of South Africa. In particular, the opening up of the transport routes from the Cape, the harbors of Natal and the Cape and the discoveries of diamonds and gold near the end of the 19th century were the starting point for the industrial growth and socio-economic development of South Africa
Growth and expansion period (1940 to 1980)	This period was a multi-faceted era, including growth and expansion in South Africa and the civil engineering industry, increasing self sufficiency and the attainment of world class practices in many areas, but also increasing isolation and inward view
The present (1980 onwards)	This period is characterized by rapid change and complexity, often accompanied by uncertainty and requiring strong leadership at all levels. A key factor during this period has been the change in the political dispensation, and the resulting start of the transformation of our society. Furthermore, this period has seen the reopening in South Africa to the rest of the world, and the initial impact of globalization on South Africa and our industry.

Civil engineering has developed from the construction of roads and railways in response to a societal need to transport goods and people from one area to another and the provision of basic infrastructure and public facilities to serve densely populated settlements to what Brian Bruce referred to in his 1994 presidential address as the "*harnessing of forces of nature for the benefit of mankind*." Today civil engineering is concerned with materials such as steel, concrete, earth and rock, and with their application in the research, design, development, manufacture, construction, operation, maintenance and management of hydraulic, structural, environmental and systems aspects of infrastructure works and services such as water, sewerage, transport, urban development and municipal services, and with building and construction for other infrastructure industries.

Brian Bruce in his 1994 address captured the current nature and intent of civil engineering as "*the application of science and technology in the control and use of forces and materials of nature, for the progressive benefit of all the peoples of our planet Earth*". Civil engineers are truly "*Earth shapers*" and need to respond to global, national, regional and local issues.

The emphasis in South Africa has in the last few years been on transformation to eradicate the legacy of the apartheid system. There is no doubt that much still needs to be done in this regard and this item will remain on the agenda for years to come. The challenge in moving into the 21st century is, however, to integrate transformation issues with global issues.

Environmental Considerations

Background

SAICE's Environmental Division was established in 1994, a mere decade ago. Several of my predecessors since then have devoted significant portions of their presidential addresses to environmental issues. Brian Bruce (1994) stated that "*in the future even more attention will have to be focused on the environment and in addition, on the community being served*". Brian Middleton (1998) pointed out that "*civil engineering professionals conceive, design, manage, build and maintain infrastructure in society. We must therefore ensure that these developments fit in with and are a part of the greater natural and human environment we must engineer with nature*"

In order to understand the challenge facing civil engineering, and indeed mankind, I would like to outline the key problems, present some quantitative data and indicate where South Africa stands in relation to the World with respect to:

- natural ecosystems;
- the impact of human consumption on the environment;
- greenhouse gas emissions; and
- poverty.

The Living Planet Index

The Living Planet Index is an indicator of the state of the world's natural ecosystems. It is calculated as the average of three separate indices which relate to the abundance of forest (mammals, birds and reptiles), freshwater (birds, mammals, reptiles, amphibians and fish), and marine species (birds, mammals, reptiles and fish). The index shows an overall decline of about 37 per cent between 1970 and 2000 (see Figure 1).

South Africa is home to 5.8% of the world's mammal species, 8% of the world's bird species, 4.6% of the world's reptile species and 16% of marine fish species. Currently, 102 species of birds (14%), 72 species of reptiles (24%), 17 species of amphibians (18%) and 90 species of mammals (37%) are listed as threatened in the South African Red Data Books.

Ecological footprints

Ecological footprinting (i.e. the measurement of how much productive land and water an individual, a city, a country, or humanity requires to produce the resources it

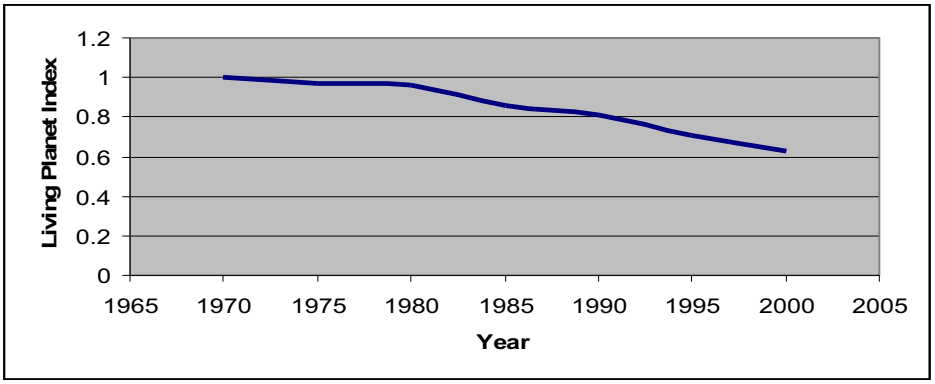


Figure 1: Living Planet Index (Living Planet Report, 2000)

consumes and to absorb the waste it generates, using prevailing technology) is a tool that enables the impact of human pressure on the Earth to be estimated by comparing renewable natural resource consumption with nature's biologically productive capacity. It measures the land area required per person (or population), rather than population per unit area. A country's footprint is the total area required to produce the food and fibres that country consumes to sustain its energy consumption, and to give space for its infrastructure. People consume resources from all over the world, so their footprint can be thought of as the sum of these areas, wherever they are on the planet. (See Table 2)

The global ecological footprint covered 13.7 billion hectares in 1999 or 2.3 global hectares per person. This demand on nature can be compared with the Earth's productive capacity. About 11.4 billion hectares, slightly less than a quarter of the Earth's surface, are biologically productive, harbouring the bulk of the planet's biomass production. The remaining three-quarters, including deserts, ice caps, and deep oceans, support comparatively low concentrations of bioproductivity. The productive quarter of the biosphere corresponded to an average 2.0 global hectares per person in 1999. Therefore human consumption of natural resources that year overshot the Earth's biological capacity by about 20 per cent. The global ecological footprint changes with population size, average consumption per person, and the kinds of production systems, or technologies, in use. The Earth's biological capacity changes with the size of the biologically productive area, and its average productivity per hectare. Hence changes in population, consumption, and technology can narrow or widen the gap between humanity's footprint and the available biological capacity. It is apparent that, since the 1980s, humanity has been running an ecological deficit with the Earth.

The global ecological footprint has grown from about 70% of the planet's biological capacity in 1961 to about 120% of its biological capacity in 1999. (See Figure 2). Furthermore, future projections based on likely scenarios of population growth, economic development and technological change, show that humanity's footprint is likely to grow to about 180% to 220% of the Earth's biological capacity by the year 2050 i.e. three Earths will be required to sustain the world population. Of course, it is very unlikely that the Earth would be able to run an ecological overdraft for another 50 years without some severe ecological backlashes undermining future population and economic growth.

Table 2:Ecological Footprint and Biocapacity (Living Planet Report 2002)

Geographical area*		**Total Ecological Footprint (A)** (global hectares [+] per person)**
World	**average**	**2.28**
	high income countries	6.48
	middle income countries	1.99
	low income countries	0.83
Africa	**average**	1.36
	Botswana	1.48
	Gabon	2.12
	Libya	3.28
	South Africa	**4.02**
Middle East and Central Asia	**average**	**2.07**
	Israel	4.44
	United Arab Emirates	10.13
Asia-pacific	**average**	**1.37**
	Australia	7.58
	Japan	4.77
	New Zealand	8.68
Latin America and Caribbean	**average**	**2.17**
	Chile	3.11
	Uruguay	3.79
North America	**average**	**9.61**
	Canada	8.84
	USA	9.70
Western Europe	**average**	**4.97**
	Finland	8.42
	Norway	7.92
Central and Eastern Europe	**average**	**3.68**
	Estonia	4.94
	Czech Republic	4.82

*Country statistics in each region are for those countries with the highest total ecological footprint
** 1999 data
[+] A global hectare is 1 hectare of average biological productivity

Global warming

The increased concentrations of greenhouse gases in the atmosphere is changing the nature of the Earth's atmosphere and preventing heat from escaping through the atmosphere into space. 60% of the increase in greenhouse gas concentrations is caused by carbon dioxide arising from the burning of fossil fuels. The remaining 40% is caused by deforestation, by methane and nitrous oxide from agriculture, and by chlorofluorocarbons (CFCs) used in refrigerators and aerosol cans.

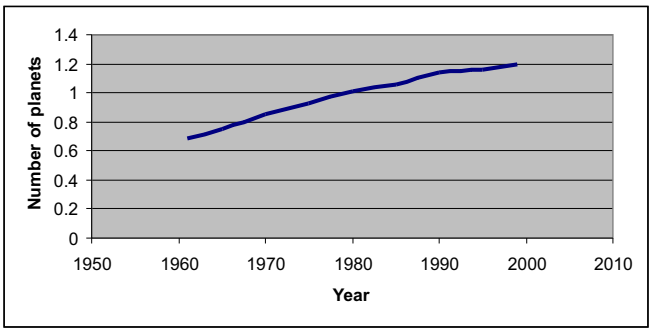


Figure 2: World Ecological Footprint (Living Planet Report, 2000)

The trapping of heat is known as the greenhouse effect and is affecting climates all over the world. The globally averaged temperature of the air at the Earth's surface has warmed between 0.3 and 0.6°C since the late nineteenth century. Further increases in globally averaged surface temperatures of 1 to 3.5°C, based on estimates of future concentrations of greenhouse gases and sulfate particles in the atmosphere, are projected by the year 2100, as compared with 1990. However, specific temperature changes will vary considerably from region to region.

The average rate of warming of the Earth's surface over the next hundred years will probably be greater than any that has occurred in the last 10,000 years, the period over which civilization developed. As a result of the warming, the global sea level is expected to rise by a further 15 to 95 cm by the year 2100. Greater warming is expected to occur over land than over the oceans. The maximum warming is expected to occur in the Arctic in winter. Nighttime temperatures are expected to increase more than daytime temperatures. In general, there will probably be an increase in the number of very hot days at mid-latitude locations in summer, such as in most of North America, Europe, and parts of South America, with a decrease of very cold days in the same locations in winter.

The frequency and duration of extreme events such as heavy rains and droughts is likely to increase as the climate continues to change. Increases in the global averages of both evaporation and precipitation are expected. In winter at mid-latitudes, higher surface temperatures are expected to cause an increased portion of the precipitation to fall in the form of rain rather than snow. This is likely to increase both wintertime soil moisture and runoff, leaving less runoff for summer. In spring, faster snow melt is likely to aggravate flooding. In the summer, increased heating will lead to increased evaporation, which could decrease the availability of soil moisture needed both for natural vegetation and agriculture in many places, and increase the probability of severe drought. Droughts and floods occur naturally around the world, for example in association with El Niño events, but are likely to become more severe, causing water management to become an even more critical problem in the future.

South Africa is a climatically sensitive country. Most crop agriculture in South Africa takes place where it is only just climatically suitable, particularly with respect to rainfall. Water is the resource most limiting to national development. Its availability now and in the future is closely linked to rainfall, temperature, management and land use practices. South Africa will be challenged to satisfy its projected demand for water in the absence of any climate change (See Table 3).

Warmer temperatures in South Africa may lead to:

- Changes in biogeographic distributions and loss of biodiversity.
- More human deaths, especially among the elderly, due directly to heat waves.
- Greater risk of epidemic infectious illnesses, such as malaria (due to an expansion of suitable habitat for mosquitoes which transmit malaria).

The World Watch Institute monitors a selection of north and south industrialized countries that are key to the environment as well as economic players. Table 4 provides some insights into carbon emissions. South Africa is the largest emitter of greenhouse gases in Africa, primarily because of the overall size of its economy and

Table 3: Summary of Sectoral Water Requirements for 1996 and 2030 (DEAT, 1999)

Sector	1996 (million cubic metres per year)	2030 (million cubic metres per year)	Percentage Increase
Urban and domestic	2 171	6 936	219.5
Mining and industrial	1 598	3 380	111
Irrigation and afforestation	12 344	15 874	28.6
Environmental	3 932	4 225	7.5
Total	**20 045**	**30 415**	**51.7**

Table 4:Population GDP, CO_2 comparisons for E9 countries (World Watch Institute, 2001)

Region / country	% of World Population	% Gross domestic product, 1999	% Share of World Carbon Emissions
China	21.0	10.2	13.5
India	16.5	5.4	4.5
European Union	6.3	20.5	14.5
United States	4.6	21.3	25.5
Indonesia	3.5	1.3	0.9
Brazil	2.8	2.9	1.5
Russia	2.4	2.4	4.6
Japan	2.1	8	6.0
South Africa	0.7	0.9	2.0
E-9 total	**59.9**	**72.9**	**73.0**

Table 5 Capacity and gross electricity production by fuel type (SANEA, 1998)

Fuel Type	Electricity production (1998)	
	[GWh]	Percentage
Coal	170 750	90.4
Nuclear	13 601	7.2
Pumped storage	2 626	1.4
Hydro	1 852	1.0
Gas	23	0.0
Bagasse	86	0.0
Total	188 938	100

the coal dependency of its energy economy. (See Table 5).

Poverty

Former Indian Prime Minister Indira Gandhi said almost 30 years ago that poverty was the world's greatest polluter.

20% of the world's population live on less than 1US$ per day while 47% live on less than 2US$ per day (World Bank, 2001); the gap between the rich and poorer nations is widening, and the minority of the global population controls a greater proportion of the world's economic and natural resources. Accordingly, sustainable development for the majority of developing countries becomes meaningful when it is underpinned by objectives which relate to stimulating economic growth, including the creation of jobs, achieving social progress and stability, and promoting the sustainable utilisation of natural resources as opposed to a strict protectionist stance.

The population in South Africa was about 40.6 million in 1996, and is growing at 2% per year. Poverty rates are high, with 20% of households in 1996 having monthly incomes of less than R500.

The "green" and "brown" agenda

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 the 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 parts.

Both the "green" and "brown" agendas are relevant to South Africa.

Societal Responses to Environmental Challenges

Societal responses to the aforementioned environmental challenges have taken place at a global, regional, national and local level. Underlying these responses is the notion that it is better to control mankind's destiny than to leave it to nature. Returning to a sustainable development pathway, means making changes in five fundamental ways, viz:

1) Improving the resource-efficiency with which goods and services are produced.
2) Consuming resources more efficiently, and redressing the disparity in consumption between high and low income countries and the affluent and poor.
3) Controlling population growth.
4) Protecting, managing and restoring natural ecosystems.
5) Eradicating poverty.

At a global level, societal responses have been captured in numerous summits, conferences, protocols and the like, the most important of which are the 1992 United Nations Conference on the Environment and Development Summit (Earth Summit) in Rio de Janeiro and the 2002 World Summit on Sustainable Development in Johannesburg. The Earth Summit established an agenda for sustainable development, which is referred to as Agenda 21, while the World Summit provided

commitments, targets and timetables for global action associated with the international agenda for sustainable development and reinforces the agenda established at the Earth Summit. (See Table 6)

At a regional level, the New Partnership for Africa's Development (NEPAD) has four objectives, namely "*to eradicate poverty; to place African countries, both individually and collectively, on a path of sustainable growth and development; to halt the marginalisation of Africa in the globalisation process and enhance its full and beneficial integration into the global economy; and to accelerate the empowerment of women*". One of its three priorities is to establish the "*conditions for sustainable development by ensuring peace and security;democracy and good, political, economic and corporate governance; regional co-operation and integration; and capacity building*."

At a national level, governments have responded in many different ways. Many nations, including South Africa actively participate in the UN Commission on Sustainable Development and submit national country reports on progress with the implementation of Agenda 21 to this commission. Governments have in addition ratified a number of conventions and protocols addressing a number of issues and have made commitments to achieve the Millennium Declaration Goals and the targets agreed to at the World Summit. Legislation and policy is often used to regulate and promote various aspects of sustainable development. The UK government has, for example, in their White Paper on *Our Energy Future - Creating a Low Carbon Economy* set a goal "*to work towards cutting emissions of carbon dioxide by 60% by 2050*". This policy has focused attention on the problem and has enabled all role players to search for ways in which this can be achieved. The European Union has, on the other hand, issued in 2002 a directive that all buildings, including homes, that are to be sold or rented, must have a valid certificate stating its energy performance and the measures that could be taken to improve upon it.

Agenda 21, which was agreed to at the Earth Summit of 1992, stipulates that "*by 1996, most local authorities in each country should have undertaken a consultative process with their population and achieved a consensus on a local Agenda 21 for their communities*." The

Table 6:Selected Key Commitments, Targets and Timetables from the Johannesburg Plan of Implementation (World Summit on Sustainable Development, 2002)

Area	Key Commitment / Target	Timetable
Poverty eradication	Halve, the proportion of the world's people whose income is less than $1 a day	By 2015
	Achieve a significant improvement in the lives of at least 100 million slum dwellers	By 2020
	Establish a world solidarity fund to eradicate poverty and to promote social and human development in the developing countries.	
Water and Sanitation	Halve the proportion of people without access to safe drinking water	By 2015
	Halve the proportion of people who do not have access to basic sanitation.	By 2015
Sustainable production & consumption	Encourage and promote the development of a 10-year framework of programmes to accelerate the shift towards sustainable consumption and production.	
Energy	**Renewable energy:** Diversify energy supply and substantially increase the global share of renewable energy sources in order to increase its contribution to total energy supply.	
	Access to Energy: Improve access to reliable, affordable, economically viable, socially acceptable and environmentally sound energy services and resources.	
	Energy efficiency: Establish domestic programmes for energy efficiency with the support of the international community. Accelerate the development and dissemination of energy efficiency and energy conservation technologies, including the promotion of research and development.	
Chemicals	Aim to use and produce chemicals in ways that do not lead to significant adverse effects on human health and the environment.	By 2020
	Renew the commitment to the sound management of chemicals and of hazardous wastes throughout their life cycle.	
Management of the natural resource base	**Water:** Develop integrated water resources management and water efficiency plans.	By 2005
	Oceans: Encourage the application of the ecosystem approach for the sustainable utilisation of the oceans	By 2010
	Atmosphere: Improve access by developing countries to alternatives to ozone-depleting substances, and assist them in complying with the phase-out schedule under the Montreal Protocol.	By 2010
	Biodiversity: Achieve a significant reduction in the current rate of loss of biological diversity.	By 2010
Sustainable development for Africa	Improve sustainable agricultural productivity and food security to halve the proportion of people who suffer from hunger.	By 2015
	Support Africa's efforts to implement NEPAD objectives on energy, which seek to secure access for at least 35 per cent of the African population, especially in rural areas	Within 20 years

International Council for Local Environmental Initiatives (ICLEI), an international association of local governments implementing sustainable development, has assisted cities and towns to embrace Agenda 21. Its mission is to build and serve a worldwide movement of local governments to achieve tangible improvements in global environmental and sustainable development conditions through cumulative local actions. Its membership comprises more than 430 cities and towns. Johannesburg, Pretoria (Tshwane), Potchefstroom, Richards Bay (uMhlathuze), Ekurhuleni, Cape Town, and Durban are members of ICLEI. All of these cities have in place a number of programmes to deal with a range of sustainable development issues.

Sustainable Development within the Built Environment

Construction is the broad process or mechanism for the realization of human settlements and the creation of infrastructure that supports development. It is an essential human activity that rivals few in its consumption of resources and its potential to harm the environment.

It is clear to me that the next hundred years of construction must be approached very differently to that of the past 100 years if societal needs and expectations are to be met. Construction approaches, technologies and practices need to systematically tackle both the "green" and "brown" agendas.

In the past the focus has been on time, cost and quality during the physical construction phase of the project cycle and the asset that is created. A shift, particularly in Europe, has already taken place to consider in addition the question of resources, emissions and biodiversity. In South Africa, the question of who benefits from the construction process, in terms of employment and business opportunities, has been introduced into the construction process since the early 1990s. In the future, the approach to construction will increasingly shift to embrace global issues relating to social equity and cultural issues, economic constraints and environmental quality as illustrated in Figure 3. Projects will in the future be increasingly assessed in terms of a "triple bottom line" which embraces economic, environmental and social considerations.

The International Federation of Consulting Engineers (FIDIC) in the Task Force Report (2002) makes the observation that "*Through the actions of our industrial society, we are using up scarce resources and depleting the Earth's ecological carrying capacity faster than they can be replenished or replaced by renewable substitutes. Sustainable development is therefore the single most important criterion for project acceptability.*"

Our project objectives will, at the same time, need to change. Such objectives will need to embrace not only immediate but also sustainable development imperatives.

Let me illustrate this using housing as an example an area that is most familiar to all of us. Housing development objectives need to change from the provision of houses which are habitable and safe to live in to housing that:

- provides adequate shelter whilst satisfying fundamental human needs relating to health, safety and the well being of residents;
- is affordable to access, maintain and live in;
- minimises the harmful effects on the local environment;
- conserves and manages resources including energy and water, in its design, construction, maintenance and functioning; and
- provides significant employment opportunities in its construction, alteration or refurbishment.

The aforementioned objectives necessitate that the following must be considered in the design, construction, alteration and refurbishment of housing units:

- adequacy in terms of accessibility;
- affordability throughout the life cycle;
- health and safety, thermal comfort and vulnerability to natural disasters;
- employment potential, including their potential for poverty relief and employment;
- energy efficiency, i.e. cooking, heating, cooling and hot water consumption energy;
- the biodegradability and non-noxiousness of demolition waste;
- embodied energy, recyclability, and renewability of construction materials;
- sanitation options; and
- water use and savings in terms of appliances and fittings and interventions such as permaculture, rain water harvesting etc.

Furthermore, housing developments should be located on sites with low ecological value which are or can be served by public transport or are within walking distance of places of work. Public transport systems, in turn, need to be energy efficient, particularly as they are a major user of fossil fuels.

The construction industry will be increasingly challenged to:

- utilise renewable resources (i.e. a resource that is grown, naturally replenished, or cleansed, at a rate which exceeds depletion of the useable supply of that resource) and perpetual resources (i.e. a resource that is virtually inexhaustible on a human time scale);
- reuse (reclaim) and recycle construction materials; and
- choose those materials with low environmental impacts

Requirements for reductions in energy consumption will have a significant impact on activities within the built environment as energy is used to:

- manufacture and transport building materials and products ('embodied energy');
- create buildings and structures on site;
- operate the building and structures throughout its lifetime ('in-use energy');
- transport people and goods between the buildings ('transport energy'); and
- demolish buildings and structures and transport demolition waste

The source of energy will also become increasingly important. Energy from renewable sources (wind, hydro, solar etc) does not add to climate change and has the benefit of being infinitely available. South Africa will have to transform its energy sector from its current dependency on coal.

Civil engineering professionals will need to weigh up projects holistically. Tough choices will need to be made between rival goods or the lesser of evils. Often there will be conflicts between objectives, e.g should jobs be created at the expense of the environment? Design and construction requirements for roads, bridges, dams, railways, harbours, water and sanitation systems and buildings will need to expand from immediate safety issues to include global safety issues, i.e. these structures will need to be not only safe to use in the short term over their design life, but should also be safe for planet Earth in the medium to long term.

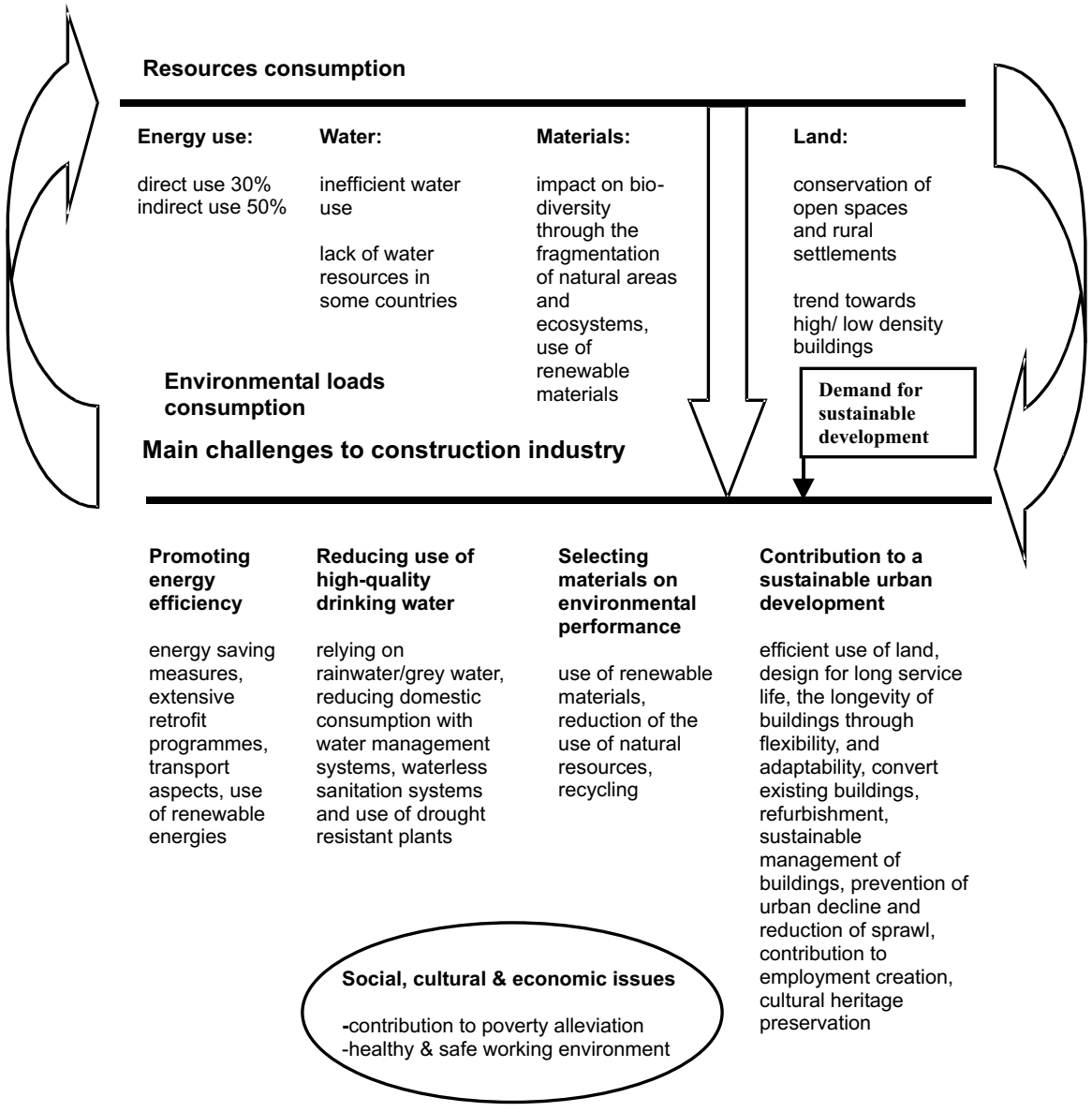


Figure 3: Issues and Challenges of Sustainable Construction (International Council for Research and Innovation (CIB), 1997)

SAICE's strategic response to Sustainable Development

General

Sustainable development is not about development that is sustainable, i.e. development that is ongoing, viable, feasible or continually growing. Du Plessis, a researcher at CSIR's Boutek, points out that "*a sustainable construction industry no longer just means that the industry is able to continue its business and grow, but also that it supports the principles of sustainable development which may mean that in some cases it needs to stop growing or grow in different ways.*" Clearly, the next few decades will not be "business as usual".

The question that then begs asking is what is SAICE's strategic response to sustainable development? In my view, the starting point is to come to a common understanding as to what is meant by sustainable development and sustainable construction. Once this has taken place, SAICE needs to develop a response along the following lines.

Awareness

SAICE established the Environmental Division in 1994 to play a major role in raising technical awareness amongst its members and communities. This Division has made a significant contribution to raising technical awareness. SAICE, however, as an Institution, needs to embark upon a focused sustainable development agenda and to communicate sustainable development realities to not only its members but also to procurers of construction projects (clients) and to those communities that are affected by construction projects.

Technical leadership

SAICE's Strategic and Corporate Plan (2000) presents the goal for technical leadership as being to "*support the attainment of excellence in civil engineering by encouraging innovation in civil engineering and facilitating the development and transfer of information, best practice and standards relating to civil engineering.*"

Rodney Milford, in his 1999 presidential address, made the observation that "*advances in technology will increase rapidly over the next ten years or so, and the pace at which the civil engineering industry adopts new technologies will be greater than it has been in recent history……..sustainable development will become a key principle in all aspects of the construction industry, including sustainable land-use and sustainable cities, life cycle costing and life-cycle assessment, eco-cities, waste reduction, recycling and re-use, materials, conservation and renewable energy resources.*"

All of SAICE's divisions need to start looking at the specialisations that they represent in civil engineering and see where they can begin to make a contribution to sustainable development within South Africa and the African continent. The Divisions have a vital role to play in informing research agendas and increasing the availability of technically sound and appropriate sustainable development options to their members and other built environment professionals which support both the "green" and "brown agendas". They will need to keep abreast of research in their respective fields of specialisation and translate research outputs into best practice and standards for use by their members.

Ethics

When making a decision, an evaluation of alternative courses of action is required. A framework is required against which an "ethical audit" of our activities can be conducted. James Armstrong, a former president of IStructE points out that "*ethical decisions are not just decisions about the best way to meet a given brief or objective. They are concerned with the quality of our decisions with justice, with equity, with the consequences of all affected by the decision, and with the personal and collective responsibilities which lie beyond the contractual obligations into which we enter. They are concerned with the "good" and the "right", with conflicts between rival goods or ills…. Ethical judgment is needed to maintain the stability of our society without the undue imposition of formal regulations for every act. Ethical problems rarely have a single readily deduced solution. They deal with shades of meaning, uncertainty, doubt and complex relationships. They are part of the ethical continuum whose components are inextricably entwined with one another and where a view is needed of the whole."*

Many decisions have environmental and ecological consequences, which may not immediately affect any of the primary actors in a project, but which still require wise ethical judgment. The codes of conduct established by the Built Environment Councils regulate the behaviour of professionals. They do not inculcate a value system within which choices between rival goods or ills can be made. A code of ethics is therefore required to provide a framework within which decisions between alternative courses of action can be made.

SAICE needs to revise its current code of ethics to provide a framework within which sustainable development decisions may be made. Such a code of ethics will not only equip members to make choices but may also provide guidance to corporations and state owned enterprises and agencies in responding to their ethical obligations required in terms of the King Report on Corporate Governance.

Outreach to the region

Alex Visser, in his presidential address of 1997, made the statement that "*for a country of the size and economic power of South Africa, we have made major contributions to the state of knowledge and development*

internationally." South African civil engineering professionals have the potential to make significant contributions from both a developed and developing country's perspective in both the "brown" and "green" agendas. They are also well placed to share their knowledge and experience with other African countries and facilitate the attainment of some of the sustainable development targets agreed to at the World Summit.

SAICE's International Relations Panel has a brief to explore ways in which SAICE can make a contribution to the NEPAD initiatives and to promote the objectives of agreements that SAICE has made with other African institutions. This panel needs to find ways of sharing South African civil engineering responses to sustainable development with fellow African countries and of building capacity within the less developed countries to embrace appropriate technologies and solutions.

Procurement

The International Council for Research and Innovation's (Conseil International du Bâtiment, CIB) Agenda for Sustainable Development in Developing Countries and FIDIC's Task Force Report on Sustainable Development in the Consulting Engineering Industry have both identified a role for procurement to play in attaining sustainable development goals. Procurement and delivery management processes, commencing with the design of the project, can advance or compromise such goals.

Procurement systems must not only be fair, equitable, transparent, competitive and cost effective, but must also promote social and environmental objectives. Standards South Africa has recently developed a unique set of construction procurement standards that do just this. Tools and techniques embodied in the targeted procurement system certainly enable the "brown agenda" to be pursued.

SAICE has established a Procurement and Delivery Management Panel to provide guidance for members on the changes in procurement and management practices being explored by Government and the Construction Industry Development Board. This panel's brief needs to be expanded to educate members and procurers of construction projects in procurement and delivery management techniques that promote aspects of sustainable development..

Conclusions

The statistics that I have presented are somewhat daunting, but I am an optimist rather than a pessimist. I believe that civil engineering professionals can stop the wholesale destruction of the Earth and turn things around, provided that they adopt an informed view on what constitutes sustainable development, change their mindset and rise to the challenge to provide solutions that satisfy long term sustainable development objectives. Consumption patterns within the construction industry can be changed to reduce ecological footprints. Technologies can be developed or adopted to reduce or minimise carbon dioxide emissions.

David Eisenberg of the Development Centre for Appropriate Technology, pointed out that "*the USA was challenged by John F Kennedy in 1961 to put a man on the moon in a decade and responded to that challenge in an extraordinary way and did it in eight years. Our challenge today, is more imperative - can we put nine billion healthy, productive, secure people on the one planet we do have, in a way that works for everyone and for all our descendents?*"

Civil engineering professionals, locally, regionally and globally need to work in concert with each other, consumers, governments and educators to face the challenges presented by sustainable development. If engineers can, with the backing of politicians, put a man on the moon in a relatively short time frame, why can't civil engineers find ways to provide construction works that do as little harm as possible to the environment while providing a higher quality of life for the current generation, without compromising future generations? This will, however, necessitate changes in the approach to construction in terms of choices in technology and procurement practices.

Civil engineering professionals also need to undergo change at a personal level. The adoption of new ethical values based on sustainable development imperatives will not only inform civil engineering decisions, but may also lead to a change in their personal lifestyles and that of their families. When all is said and done, sustainable development is a journey and not a destination. It is the responsibility of all the inhabitants on planet Earth.

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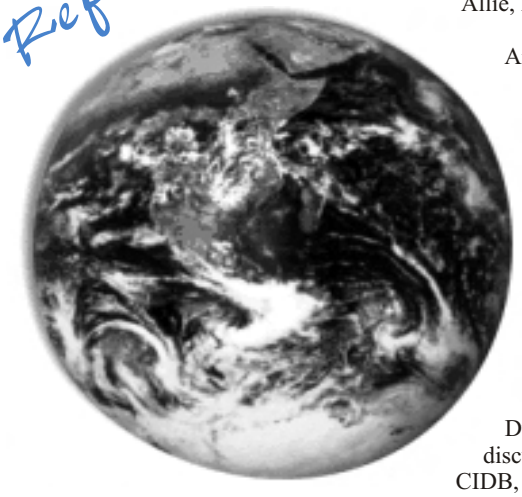

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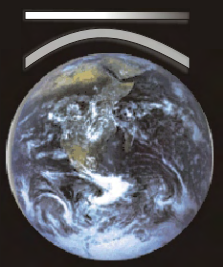

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