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Limitations of Implementing Sustainable Construction Principles in the Conventional South African Design Approach

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ABSTRACT AND KEYWORDS

With the current focus on continuing and improving the systems for measuring or assessing the environmental or sustainability performance of buildings, very little attention has been given to the difficulties encountered by the built environment professionals, particularly by architects, in the implementation of sustainability principles in the development of building projects.

Purpose of this paper
The aim of the paper is to highlight the limitations of introducing sustainability aspects into the existing South African Council of Architectural Professions (SACAP) work plan stages for architects
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Methodology
The paper uses sustainable construction principles defined by Hill et al (1997) to compare the stages of the SACAP work plan, the Ecological Sustainable Development (ESD) Design and the Sustainable Building Life Cycle (SBL), which were studied as part of the literature review. From this, the limitations of implementing sustainability in the SACAP work stages are identified and presented.

Findings
The paper presents the limitations of introducing sustainability aspects into the existing SACAP work plan.

Value of the Research
By identifying the limitations that hamper the implementation of sustainability aspects at various stages of the building project development, the process reducing these limitations begins to become more tangible as more built environment stakeholders are encouraged to engage in the practice of sustainability before the design commences.

Key Words: Sustainable construction, **building life cycle, Sustainable Building Life Cycle**.

Theme of conference: Sustainable Construction

1.1 INTRODUCTION

Environmental protection became a global concern when Meadows *et al* (1972 in du Plessis, 2000) presented a study of the earth's resources, which suggested that the earth had finite resources. Nine years later, the concept of *sustainable development* was formally defined by the Brundtland Commission of the World Commission on the Environment and Development (WCED) as *development that meets the needs of the present without compromising the ability of future generations to meet their own needs* (WCED, 1987). Since then there have been numerous advances within the built environment.

The first of these advances has been the development of building environmental rating systems, including the British Research Establishment Environmental Assessment Methodology (BREEAM) developed in 1990, the Leadership in Energy and Environmental Design (LEED) developed in 1993, the Sustainable Building Tool (SBTool) developed in 2000 and Green Star developed in 2003. These systems provide a way of showing that a building has been successful in meeting an expected level of performance in various declared criteria (Cole, 2003). In addition each of these systems shares a *common goal to stimulate market demands for higher environmental performance levels* and with *the remarkable exception of South Africa's SBAT* (Sustainable Building Assessment Tool), all of the existing rating systems *deal exclusively with the environmental dimension of sustainability* (Da Silva, 2007).

The second advance has been the development of the *Agenda 21 for Sustainable Construction* and later the *Agenda 21 for Sustainable Construction* ***in Developing Countries***. These documents provide global framework for sustainable construction with the latter acknowledging that developing countries require a different approach to sustainable construction than that used in developed countries. In addition the document targeted at developing countries aims to provide a *research and development agenda and strategy for action in developing countries* (CIB *et al*, 2002).

The third advance toward *sustainable development* within the built environment has been the establishment of councils like the World Green Building Council, which (through its various member countries) seek to transform the built environment through the engagement of key stakeholders (http://www.worldgbc.org). The South African Property Owners Association (SAPOA) has established the *Green Building Council of South Africa (GBCSA)*. This has been done to promote environmentally sustainable practices in South Africa's commercial and industrial property industry (van der Merwe, 2007). The Australian Green Star rating system will be customized for use in the South Africa (GBCSA, 2007).

1.1.1 Purpose of this Paper

The paper aims to highlight the limitations of introducing sustainability aspects into the existing South African Council of Architectural Professions (SACAP) work plan stages.

From this research objective, the following research question is derived:

- What are the limitations experienced when introducing sustainability aspects in the stages of SACAP work plan?

1.1.2 Value of the Research

By identifying the limitations that hamper the integration of sustainability aspects at various stages of the building design, the process of reducing these limitations begins to become more tangible as more built environment stakeholders are encouraged to engage in the practice of sustainability before the design commences.

1.1.3 Structure of the Paper

The structure of the paper is outlined below:

- The literature review;
- A comparative analysis of three project / building life cycle stages;
- Current South African architectural practice;
- Findings; and
- Conclusions.

1.2 LITERATURE REVIEW

According to Willis (2000) the connection between the built form and the implementation of sustainability needs *to shift the design focus away from a building as a finished product to a process...rather that a fixed...endpoint.*

The literature reviewed provides firstly a definition and principles of the concept of sustainable construction, which provides the connection between the built environment and the implementation of sustainability.

Secondly, the review presents the objectives of the Ecological Sustainable Development (ESD) Design and Sustainable Building Life Cycle (SBL) stages. The ESD is reviewed, because it is the design process used by the Australian Government in the delivery of their public infrastructure. As part of the ESD design process, the Green Star rating tool (which has been selected for use by the newly formed GBCSA) is used.

The Sustainable Building Life Cycle is reviewed, because it the approach used with the Sustainable Building Assessment Tool, a tool found to be most appropriate for a developing country context (Kaatz et al, 2002).

1.2.1 Sustainable Construction

The term sustainable construction is defined by Kibert (1994 in Hill and Bowen, 1997) refers to the creation of a *healthy built environment using resource-efficient, ecologically-based principles*. Hill and Bowen (1997) add that the term is generally used to describe a process which starts well before construction per se (in the planning and design stages) and continues after the construction team has left the site.

The commencing of sustainable construction at the planning and design stages, suggests that architects have a vital role to play in the development of a sustainable built environment. This is because they predominately have the initial and most frequent contact with a client and have the direct access to all the professional team members, as well as the contractor. They are obliged to provide creative thinking, *be at the cutting edge of technology, exercise strategic management skills, and be skilled craftspeople in order to conceptualise and manage the delivery of the physical infrastructure* (CSIR, 2003).

In addition to the need to continue performing their architectural duties, architects are expected to *familiarise themselves with the issues of sustainable development and to ensure that they are competent at designing infrastructure in a sustainable manner* (CSIR, 2003).

1.2.2 Principles of Sustainable Construction

Hill and Bowen (1997) present four pillars of *sustainable construction* (namely social, economic, biophysical and technical), each with a set of principles for sustainable construction. Each of these four pillars a(and their

related principles) are over-arched by a set of process-orientated principles, including:

- the undertaking of assessments prior to the commencement of proposed activities assists in the integration of information relating to social, economic, biophysical and technical aspects of the decision making process;
- the timeous involvement of key stakeholders in the decision making process (WCED, 1987);
- the promotion of interdisciplinary and multi-stakeholder relations (between the public and private sectors, contractors, consultants, non-governmental) should take place in a participatory, interactive and consensual manner;
- the recognition of the complexity of the sustainability concept in order to make sure that alternative courses of action are compared. This is so that the project objectives and the stakeholders are satisfied with the final action implemented;
- the use of a life cycle framework recognises the need to consider all the principles of sustainable construction at each stage of a project's development (i.e. from the planning to the decommissioning of projects);
- the use of a system's approach acknowledges the interconnections between the economics and environment. A system's approach is also referred to as an integrated (design) process;
- that care should be taken when faced with uncertainty;
- compliance with relevant legislation and regulations;
- the establishment of a voluntary commitment to continual improvement of (sustainable) performance;
- the management of activities through the setting of targets, monitoring, evaluation, feedback and self-regulation of progress. This iterative process can be used to improve implementation in order to support a continuous learning process; and
- the identification of synergies between the environment and development.

These principles

1.2.3 Sustainable Building Design Approach

The abbreviations listed in Table 1.1 have been used in some of the following tables.

Table 1.1 Abbreviations used

A - Architect	**Cl** - Client	**Co** - Contractor
FM - Facility Manager	**Es** - Engineers	**OS** - Other Specialist
OS* - Sustainable Building Consultant	**QS** - Quantity Surveyor	**U** - User

1.2.4 Ecological Sustainable Development (ESD) Design

The Australian Government found in the State of the Environment Report 2006, that the *key issue arising from human settlements is the pressure they impose on the environment*. Following this finding (amongst others), the Australian Government developed *The Ecological Sustainable Development (ESD) Design Guide*, which introduces key environmental issues within office and public buildings and provides an outline of how the issues can be addressed.

ESD is defined as *…using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased*. This definition appears to be in line with both those of the sustainable development and sustainable construction, which suggests that sustainable design can be likened to sustainable construction and that similar processes can be assumed in the processes of developing a building project. Table 1.2 presents the stages and some opportunities for each stage of the ESD design process.

Table 1.2 Ecological Sustainable Development (ESD) design

Stage	Opportunities	Stakeholder
Pre design	**a)** Establish design values of project; **b)** set environmental performance targets; and **c)** consider collaborative design workshop	Cl / A / QS / Es / OS
Design	Assess design against benchmarks and targets	A / QS / Es / OS
Construction Documentation	Specify sustainable materials and components	A / QS / Es / OS / Co
Construction	Develop maintenance and operation manuals	A / QS / Co
Occupancy	Use environmental performance ratings, in-site monitoring and user feedback	Cl / A / Co

Source: DEWR, 2007

1.2.5 The Sustainable Building Life Cycle (SBL)

The Sustainable Building Life Cycle (SBL) was developed to maximise the effect of an assessment framework, like the Sustainable Building Assessment Tool (SBAT), which sets the high-level objectives or targets for a building. The SBL is designed to ensure that at particular stages, targets are set and agreed by key stakeholders and that these targets are used to guide design decisions and the selection of procurement and construction options (see Table 1.3).

Table 1.3 Sustainable Building Life Cycle

Stage	Main Objective / Opportunities	Stakeholders
Briefing	Establish design values of project and client's level of commitment	Cl / A / OS
Site Analysis	Develop project to address local economic, social and environmental issues	A / Cl / OS
Target setting	Establish level of understanding of sustainable development issues among professional team and set environmental performance targets to guide design, procurement and construction	A / QS / Es OS
Concept Design	Select most appropriate design solution for further development	A / QS / Es/ OS
Detailed Design	Develop design further	A / QS / Es/ OS
Construction	Ensure tender documentation addresses sustainability issues and that the contractor is briefed on this regard.	Co / QS / A
Handover	Ensure that users, owners and managers are able to use and maintain building and its systems.	Co / Cl / FM / U / A
Operation	Ensure that performance of the building is maintained.	Cl / FM / U
Refurbish, Reuse, Recycle	Refurbish building or reuse and recycle demolished building components	Cl / A / Es / Co

Source: Gibberd, 2001

1.3 CURRENT SOUTH AFRICAN ARCHITECTURAL PRACTICE

The South African Institute of Architects (SAIA) is a voluntary association of affiliated and regional institutes established in 1996. It has incorporated the previous national Institute of South African Architects (established in 1927) and the regional Institutes of Architects. The Institute *aims to promote excellence in architecture and it seeks to contribute to the enhancement of society and the environment*. (http://www.saia.org.za)

Following a review of activities within the construction industry, the Council for the Built Environment (CBE), was established in accordance to the *Council for the Built Environment Act* (No. 43 of 2000). The CBE is a governing body, which encompasses all the built environment professional councils (including architects, engineers, landscape architects, property valuers, project & construction managers and quantity surveyor). With regard to sustainable development, the CBE aims to *promote and maintain a sustainable built environment and natural environment.*

A regulatory council, South African Council for the Architectural Profession (SACAP), for the architectural disciplines was promulgated by the *Architectural Professions Act* (No. 44 of 2000) in 2000. SAIA is represented on the SACAP committees and has some influence on matters relating to fees, identification of work, categories of registration, continuing professional development (CPD) courses and other matters concerning the architectural professional. (http://www.saia.org.za)

The objectives of the standard services for architects as described in the Board Notice 161 (SACAP, 2001) are outlined in stages in Table 1.4.

Table 1.4 SACAP Work plan stages

	Stage	**Objectives**	**Stakeholders**
1	Appraisal and definition of project	Define client requirements and plan project	Cl / A
2	Design concept	Prepare concept design proposal and advise on appointment of other built environment professionals	A / Cl
3	Design development	Develop design further with assistance of appointed built environment consultants	A / QS / Es / OS
4	Technical documentation and approvals	Prepare technical documentation, advertise and award tender for the project	A / QS / Co / Es / OS
5	Contract administration and supervision	**a)** Administer contract on client's behalf, **b)** supervise construction process, and **c)** provide client with as built drawings and a technical / maintenance manual compiled by contractor and professionals	Co / QS / A / Es / OS / Cl

The only additional (or supplementary) service that may be related to sustainability in the Board Notice includes the *special studies and design* (i.e. environmental and energy conservation).

The Architectural Professions Act does not specifically refer to sustainability, but SACAP's new registration system appears to have accommodated this through the implementation of CPD activities. These ensure that architectural practitioners *remain competent and up to date as professionals, and have opportunities to maintain, develop, enhance and broaden their skills and those of others throughout their working lives* (SAIA, 2007a).

The CPD activities are divided into three categories, namely:

- Category 1, which relates to formal lectures, seminars, workshops, conferences;
- Category 2, which is work based, with points earned for working, teaching and mentoring; and
- Category 3, for which individual activities (e.g. formal study, publication of papers or articles, personal study, community activities, membership of professional bodies) are scored. (SAIA, 2007a)

CPD courses are available from various approved CPD providers and accredited educational institutions for a given number of credits, which in accordance with this new registration system, require a registered professional (in terms of section 13(k) of the Architectural Professions Act) to obtain a minimum of 25 credits (i.e. 5 per year) during a 5 year cycle in order to qualify for the renewal of his registration.

The CPD activities are useful as they ensure that professionals *remain competent and up to date as* professionals, however there unfortunately appears to be no compulsory topics (of which sustainability aspects would be one) from which the professional can select. It can therefore be assumed that where 'sustainable development' specific CPD courses (within either Category 1 or 3) are not offered, the lack of guidance may result in lack of training within the field. This will impact the design of any project undertaken by such a professional as he will not be sensitized to sustainability issues.

In addition to this, since 1997, the undertaking of an Environmental Impact Assessment (EIA) has been compulsory at the planning and design stage. However, this only addresses the environmental impact of the building. It does not address the sustainability performance of the building.

On the World Day of Architecture 2007 (October) SAIA formally launched its Habitat Charter in which it commits its members to striving for sustainability in all their projects undertaken (http://www.saia.org.za). The charter highlights the three sustainability objectives (i.e. economic, social and natural environments/biophysical) and states that these *are interrelated and must not only be interpreted individually, but also holistically, to give effect to the integrative nature of sustainable development* (SAIA, 2007b). A guide, "*An Architect's Guide to Designing for Sustainability*", translates the SAIA policy into practical application. However, the guideline is limited to the clarification of goals and strategies related to sustainability; it does not offer detailed technical solutions (CSIR, 2003).

1.4 COMPARISON OF PROJECT DESIGN APPROACHES

The over-arching process-orientated principles of sustainable construction reviewed above provided a useful framework against which the ESD, SBL and SACAP work plans can be tested (see Table 1.5). From the opportunities/objectives of the SACAP, ESD and SBL reviewed, more principles for ESD (9 – 81%) and SBL (9 – 81%) have been addressed than for SACAP (3 – 27%). This suggests that the SACAP work plan currently does not support sustainability.

SACAP's establishment of the CPD activities should be noted as a commitment to improving (sustainable) performance. In addition to this the South African government is continuously developing legislation and standards that will lead to a more sustainable country. From this, it can be

deduced that some of this legislation will lead to improvements related to sustainable development within the built environment.

In turn the compliance of the ESD and SBL to the *comparison of alternatives* (sustainable construction) principle is assumed; as the design approaches reviewed provide opportunity for "specifying sustainable materials and components" (ESD, see Table 1.2); and for "selecting the most appropriate design solution" (SBL, see Table 1.3). This implies that the specification of an item, for example, underwent a process of comparison of alternative, before the final item was selected.

Table 1.5 Comparison of Building Design Approaches

Principles of Sustainable Construction	**SACAP**	**ESD**	**SBL**
Prior assessment of proposed activities		■	■
Involvement of key stakeholders early in the design process		■	■
Interdisciplinary collaborations		■	■
Comparison of alternatives		■	■
Use of life cycle framework		■	■
Use of systems / integrated approach		■	
Exercise prudence	■	■	■
Compliance with legislation and regulation	■	■	■
Commitment to improving (sustainable) performance	■	■	■
Set targets and monitor progress		■	■
Identify synergies between environment and development			

1.5 FINDINGS

In light of the comparison of the stages of the sustainable building design approaches in Table 1.5 above, the South African architect (who has insufficient training within the sustainable development field) using the SACAP work plan may be limited in the endeavour to providing sustainable infrastructure in the following ways (see Table 1.6).

Table 1.6 Limitations of applying sustainability aspects into the SACAP work plan stages

	Stage	Limitations
1	Appraisal and definition of project	**a)** The professional team and contractor are not part of the project at this stage, therefore common sustainability values are not established; and **b)** the sustainability targets can, therefore, not be set.
2	Design concept	**c)** The professional team and contractor are not part of the project at this stage; therefore the architect develops the concept design.
3	Design development	**d)** With no sustainability project values and targets set, the sustainability performance of the design cannot be assessed; and **e)** the comparison of alternative designs may not be explored. **f)** When the professional team are appointed, the design may undergo major changes as they provide their input.
4	Technical documentation and approvals	**g)** With no sustainability project values, the sustainability aspects may not be captured in the tender documentation; and **h)** the specification documentation. **i)** When the contractor is appointed, the design may undergo further changes as contractor provides input.
5	Contract administration and supervision	**i)** With no integrated design approach, nor sustainability project values in place, the contractor is left to solely make decision on the procurement of materials and components (Ngowi, 1998)

In the advent of a growing demand for more sustainable buildings, architects need be the first professionals to ensure that the principles of sustainability are adopted into design projects (Edén *et al*, 2003). The current involvement of other built environment professionals, particularly engineers, at a stage where the brief has been defined and the design concept developed, demonstrates, according to Willis (2000), that for architects aesthetics plays an important role as their commitment to a particular built form gives the impression that *sustainability is an afterthought*.

In order to ensure that building performance is sustainable, any ambitions to contribute to sustainability should be dealt with in the initial stage. Furthermore, the professional team and the contractor should be involved in the development of the formulation of the client's brief in such a

way that this "locking" process takes advantage of the participators' competence and local prerequisites (Edén *et al*, 2003).

The Australian's Government's Department of the Environment and Water Resources (2007) reports that many of their projects show that the design stage has the biggest opportunity to reduce the environmental impact of a building. The ESD design approach encourages an integrated design in order to minimise silo initiatives and unintended consequences.

1.6 CONCLUSIONS

The architect's role within the built environment is crucial in the implementation of sustainability. This is because the planning and design phases are the most critical as this is where environmental impact of the building is highest as no construction has not occurred and limited project costs spent.

Regarding the introduction of sustainability principles into the current SACAP work plan stages, the paper finds that although the current work plan does not seem to support sustainability. In addition to this, there appear to be a number of limitations with the current SACAP work plan in the delivery of sustainable infrastructure.

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