Integrating Sustainable Development into Briefing and Design Processes of Buildings in Developing Countries: An Assessment Tool

Submitted by Jeremy Gibberd

Promoter
Professor Roger Fisher

Submitted in partial fulfilment of the requirements of the degree of
Philosphiae Doctor in Architecture
In the Faculty of Engineering, Built Environment and Information Technology

University of Pretoria
Department of Architecture

August 2003

AKNOWLEDGEMENTS

I would like to acknowledge the support of the following persons:

Professor Roger Fisher

Amanda

Bashi

My parents and sisters

The CSIR

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS

BRE	Building Research Agency
BREEAM	Building Research Establishment Environmental Assessment Method
CERES	Coalition for the Environmentally Responsible Economies
CSD	Council on Sustainable Development
CSIR	Council for Scientific and Industrial Research
CICA	Confederation of International Contractors' Associations
DFID	Department for International Development
GBC	Green Buildings Challenge
GBTool	Green Building Tool
GDP	Gross Domestic Product
GEAR	Growth, Employment and Redistribution
DEAT	Department of Environment and Tourism
DFID	Department for International Development
EIA	Environmental Impact Assessment
GDI	Gender related development index
GEM	Gender empowerment measure
GRI	Global Reporting Initiative
HDI	Human Development Index
HPI -1	Human Poverty Index 1 (for developing countries)
HPI -2	Human Poverty Index 2 (for industrialized countries)
HSRC	Human Sciences Research Council
ILO	International Labour Organisations
IISD	International Institute for Sustainable Development
ISEW	Index of Sustainable Economic Welfare
LEED	Leadership in Energy and Environmental Design
NGO	Non Governmental Organisation
PPP	Purchasing Power Parity
RDP	Reconstruction and Development Programme
SBAT	Sustainable Building Assessment Tool
SOE	State of the Environment Report
UK	United Kingdom
UN	United Nations
UNCD	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
USGBC	United States Green Building Council
WCED	International Union for the Conservation of Natures
WSSD	World Summit on Sustainable Development

ABSTRACT FOR THE THESIS

Integrating Sustainable Development into Briefing and Design Processes of Buildings in Developing Countries: An Assessment Tool

Submitted by: Jeremy Gibberd
Promoter: Roger Fisher
For the degree of: Philosphiae Doctor in Architecture
University: University of Pretoria
Department: Department of Architecture

This study proposes a specification for an assessment tool that integrates sustainable development into briefing and design processes of buildings in developing countries.

The building and construction industry have a significant role to play in supporting sustainable development in developing countries. However until the implications of sustainable development for the building and construction industry in developing countries are understood and interpreted into a plan of action, little progress can be made.

The research proposal aims to make a contribution to knowledge within the field of sustainable development and building and construction in developing countries. The study suggests that an effective way of beginning to integrate sustainable development into building and construction is to make sustainable development an explicit goal during the briefing and design process of the building. The study develops a specification for assessment tool that enables the goal of sustainable development to be interpreted into building and construction objectives and shows how this can be used in the briefing and design processes of buildings.

The study is based on both a qualitative and quantitative approach. Through critical review of literature and inductive analysis key concepts pertaining to sustainability, sustainable development, developing country contexts, assessment frameworks, and building and construction are defined. These are compared and analysed to formulate a specification for an assessment tool. In order to test and validate findings the specification is compared with an existing building assessment tool, the Sustainable Building Assessment Tool.

All hypothesis developed by the study are successfully demonstrated and the study is successful in proposing a specification for an assessment tool that integrates sustainable development into briefing and design processes of buildings in developing countries.

Key words: Sustainable development, sustainability, developing countries, assessment tools, building, construction, briefing, design.

1. THE PROBLEM AND ITS SETTING

1.1. The Problem

In the developing countries of the South, such whole-system thinking is at a premium, because the new pattern of scarcity….abundant people but scarce nature – has arrived early and with a vengeance. For the developing world, most acutely, the relevant question will be: How many problems can be simultaneously solved or avoided, how many needs can be met, by making the right initial choices? And how can those choices be linked into a web of mutually supporting solutions, creating a healthy economic, social, and ecological system that develops both better people and thriving nature.[1]

The implications of sustainable development for buildings and the construction industry in developing countries are not well understood. However urgent social and economic problems and environmental degradation found in developing countries mean that it is increasingly important that the building and construction industry understands sustainable development and beings to implement and integrate this into mainstream practice.[2]

This study aims to support increased understanding in this area by investigating how the early development stages of buildings in developing countries can be influenced in order to ensure that buildings and construction play a role in supporting sustainable development.

The research proposal argues that an effective way of doing this is through an assessment tool that enables sustainable development to become an explicit goal within the briefing and design processes of buildings. The study proposes a specification for this assessment tool.

It suggests that the assessment tool will enable sustainable development to be interpreted into building and construction objectives. Once defined, these objectives can be used to influence the briefing and design processes of buildings to ensure that sustainable development is integrated into the early stages of the development of buildings. In order to develop a specification for the tool the study uses quantitative and qualitative approaches. A number of steps are used to define the content, structure, and use of the tool.

Definitions of sustainability and sustainable development appropriate to the study are developed. In addition, a list of sustainable development objectives that can be interpreted into building and construction objectives is constituted. These are created through critical review and inductive analysis of the sustainable development and sustainability fields.

---

[1] Hawken, Lovins, Lovins. p. 288
[2] http://www.CICA.net 19/12/02 09:00

The structure and components of the tool are defined through a critical review of assessment frameworks. This provides a description of the essential characteristics of assessment frameworks and defines processes that should be engaged in their use.

The detailed synthesis of proposed structure, content and use of the tool is developed through an analysis, comparison and interpretation of data from sustainability, sustainable development, assessment and development frameworks and building and construction fields.

In order to evaluate the specification and validate findings of the study the specification is compared to an existing assessment tool, the Sustainable Building Assessment Tool.

The study makes a contribution to knowledge within the sustainable development and building and construction fields. In particular, it aims to support improvement in methodologies designed to integrate sustainable development into the briefing and design of buildings in developing countries.

1.2. The Sub problems

1.2.1. Sub problem one and Hypothesis one

Sub problem: What are the key aspects of the international and local contexts of sustainable development useful in understanding how buildings and construction can support sustainable development?

Hypothesis: The international and local context of sustainable development can inform the development of a specification for an assessment tool that aims to integrate sustainable development into building briefing and design processes.

1.2.2. Sub problem two and Hypothesis two

Sub problem: What are key concepts in sustainability that are useful in understanding how buildings and construction can support sustainable development?

Hypothesis: Concepts from sustainability can inform the development of a specification for an assessment tool that aims to integrate sustainable development into building briefing and design processes.

1.2.3. Sub problem three and Hypothesis three

Sub problem: What are the key features of existing sustainable development, sustainability and development assessment systems and frameworks?

Hypothesis: Existing sustainable development, sustainability and development assessment systems and frameworks can inform the development of a specification for an assessment

tool that aims to integrate sustainable development into building briefing and design processes.

1.2.4. Sub problem four and Hypothesis four

Sub problem: Can a specification for an assessment tool which aims to ensure that sustainable development is addressed and incorporated in the briefing and design of buildings in developing countries be developed by drawing on the sustainable development context (problem one), key sustainability concepts (sub problem two) and key features of sustainable development, sustainability and development frameworks (sub problem three)?

Hypothesis: A specification for an assessment tool, which aims to ensure that sustainable development is addressed and incorporated in the briefing and design of buildings in developing countries can be developed.

1.2.5. Sub problem five and Hypothesis five

Sub problem: How does the specification for an assessment tool developed in Sub problem four compare with the Sustainable Building Assessment Tool (SBAT)?

Hypothesis: A comparison between the specification for an assessment tool and the SBAT will assist in validating the specification and identify whether the SBAT is an appropriate tool for integrating sustainable development into the briefing and design of buildings in developing countries.

1.3. The Delimitations

The study will not attempt to design a sustainable building.
The study will not attempt to establish guidelines for the design of sustainable buildings
The study will be limited to the study of buildings and will not address sustainability or sustainable development, at a large urban scale.
The study will not address in detail, the construction, operation, and demolition/reuse stages of the building lifecycle.
The study will not attempt to undertake a detailed study of building performance in terms of sustainability or sustainable development.

1.4. The Assumptions

1.4.1. The First Assumption

The first assumption is that there is inadequate support to ensure that sustainable development is addressed and incorporated in the briefing and design of buildings in developing countries.

1.4.2. The Second Assumption

The need for support and systems to ensure that sustainable development is addressed and incorporated in the briefing and design of buildings in developing countries is likely to increase in importance and there are unlikely to be any major changes that might occur to influence this.

1.5. The Need for the Study

The built environment has a major impact on the environment and plays a major role in the economy and societies of many countries. For instance:

- Construction is the world's largest industrial employer, with 111million employees and approximately 28% of all industrial employment. [3]
- In many countries in the world, the built environment normally constitutes more than half of total national capital investment. [4]
- Construction may constitute as much as 10% of a country's gross national product (GNP). [5]
- The built environment consumes between 40-50% of all energy generated. [6]
- In developed countries the construction industry accounts for half of all the raw materials taken out of the world's crust by weight. [7]
- Three million people a year die of air pollution, with most of this caused by indoor air pollution as result of burning biomass for heating and cooking. [8]

With the increasing emphasis on sustainable development and concern about global environmental damage, many aspects of the construction and building industry need to change in order to support sustainable development. However, the issue is complex and has not been researched thoroughly.

The briefing and design stages of the development of buildings play a key role in establishing the extent to which buildings and construction support sustainable development. There is, however, little support, to ensure that sustainable development is addressed and incorporated in the briefing and design of buildings in developing countries.

This study will argue that influencing briefing and design stages is a valuable way of ensuring that buildings begin to support sustainable development more effectively and efficiently. It will

---

[3] http://www.CICA.net 19/12/02 09:00
[4] http://www.CICA.net 19/12/02 09:00
[5] http://www.CICA.net 19/12/02 09:00
[6] http://www.CICA.net 19/12/02 09:00
[7] http://www.CICA.net 19/12/02 09:00
[8] http://www.johannesburgsummit.org/index.html 11/11/02 10:30

suggest that developing knowledge and systems within this area can make an immediate and cost effective impact.

It will propose that this approach is of particular relevance in developing countries, where through careful design, unsustainable solutions used in developing countries can be avoided, and instead, opportunities taken to ensure that buildings play an active role in addressing sustainable development priorities.

1.6. The Organisation of the Study

The study is divided into the following sections:

Chapter Two, The Sustainable Development Context

This chapter reviews the international and local sustainable development context in order to understand this. It establishes the current international consensus position on sustainable development. To understand the difference in emphasis between developed and developing countries, national responses to the issue of sustainable development in South Africa and the UK, are compared. The chapter captures key international sustainable development issues and important developing country priorities in order to draw on these in the development of a specification in Chapter five.

Chapter Three, Understanding Sustainability

This chapter reviews a range of literature pertinent to sustainability. Through this review the study develops a detailed description of sustainability. In particular there is an attempt to distil the essential social, economic and environmental characteristics of sustainability relevant to buildings in order to draw on these in the development of a specification in Chapter five.

Chapter Four, Review of Sustainability Assessment Systems and Indicators

This chapter reviews a number of existing sustainable development, sustainability and development assessment tools and frameworks in order to establish an understanding of best practice in this field. Building assessment tools are also reviewed in order to review current approaches in this area. The chapter draws together important characteristics of assessment systems in order to use these in the development of a specification in Chapter five.

Chapter Five, Specification for a Building Assessment Tool

The understanding developed in Chapters two, three and four are used in Chapter five to formulate a specification for an assessment tool. The specification describes the structure, content and use of a tool that aims to ensure that sustainable development is addressed and incorporated in to the briefing and design of buildings in developing countries.

Chapter Six, The Sustainable Building Assessment Tool (SBAT)

In Chapter six the Sustainable Building Assessment Tool (SBAT) is introduced. This tool has been developed by the author and evolved through use on projects. This tool will be compared to the specification developed in Chapter five. This will enable validation of the specification and allow the SBAT to be evaluated to discover if it is an appropriate tool to support the integration of sustainable development into building briefing and design processes in developing countries.

Chapter Seven, Conclusions and Recommendations

The final chapter of the study will provide the conclusions of the study and make recommendations for further study.

1.7. The Definition of Terms

Terms used in the study are in Appendix one.

2. THE SUSTAINABLE DEVELOPMENT CONTEXT

My government's commitment to create a people-centred society of liberty binds us to the pursuit of the goals of freedom from want, freedom from hunger, freedom from deprivation, freedom from ignorance, freedom from suppression and freedom from fear….[9]

2.1. Sub Problem One and Hypothesis One

Sub problem: What are the key aspects of the international and local context of sustainable development useful in understanding how buildings and construction can support sustainable development?

Hypothesis: The international and local context of sustainable development can inform the development of a specification for an assessment tool that aims to integrate sustainable development into building briefing and design processes.

2.1.1. Introduction

This chapter reviews the international and local sustainable development context in order to understand this. It establishes the current international consensus position on sustainable development. In order to understand the differences between developed and developing countries national responses to sustainable development and development in South Africa and the UK are compared. The chapter aims to capture key international sustainable development issues and important developing country priorities in order to draw on these in the development of a specification in Chapter five. This chapter does not review the theoretical or academic aspects of sustainability; this is carried out in the Chapter three.

This context is important as this provides a picture of what the international community, within the sustainable development arena, see as the most concerning trends within this area. It also describes agreements on approaches as to how these trends should be addressed. The review enables important aspects and differences in the outlook and approaches of developing countries and developed countries to sustainability and development to be identified.

The chapter will initially review the international position on sustainable development under the heading of International Context. This will be followed by a review of country approaches to sustainable development under the heading Local Contexts. Included in this chapter is an initial description and review of the sustainable development indicator systems used in a national context. This is reviewed in more detail in Chapter four, Review of Existing Sustainability Assessment Systems. The findings provided by these reviews will be discussed

[9] Office of the President. 1994. p 6

in order to develop an outline description of international and local consensus positions and attitudes to sustainable development.

2.1.2. The International Context

In order to describe the current international position on sustainable development, five documents have been reviewed. These are Agenda 21[10], The Rio Declaration on the Environment and Development[11], The Millennium Goals[12], Global Challenges Global Opportunities[13], and World Summit on Sustainable Development, Plan of Implementation[14]. These are reviewed because it is argued that these are the key documents that reflect the recent and the current international position on sustainable development. In addition many of the documents are cross-referenced; it is therefore useful to review the full suite of documents rather than limited selection of these.

2.1.3. The United Nations Conference on Environment and Development (UNCED)

Agenda 21 and the Rio Declaration on Environment and Development were developed for the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil in December 1992. These were developed by the United Nations and have been adopted by 178 governments. It was agreed at the conference to review progress on implementation of these agreements at a 5 yearly interval. Progress was therefore evaluated in 1997 and in 2002 at the World Summit on Sustainable Development (WSSD) held in Johannesburg, South Africa.

Agenda 21[15]

Agenda 21 was developed in response to increasing international concerns about the environment and development. In particular, economic disparities between, and within nations, worsening poverty, hunger, illiteracy and the continuing deterioration of ecosystems are mentioned.[16] The conference suggested that if these concerns are addressed in an integrated fashion a number of outcomes were possible. These outcomes could include fulfilment of basic needs, improved living standards for all, better protected and managed ecosystems and a safer, more prosperous future.

Responsibility for the implementation of Agenda 21 is placed with national governments, which are required to ensure that implementation occurs through national strategies, plans, and policies. Agenda 21 however suggests that implementation should include broad public participation and the involvement of groups such as non-governmental organisations.

---

[10] http://www.un.org/esa/sustdev/indisd/english/worklist.htm 19/12/02 09:00
[11] http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm 02/02/03 10:30
[12] http://www.un.org/millennium/sg/report 19/12/02 09:00
[13] http://www.johannesburgsummit.org/index.html 11/11/02 10:30
[14] http://www.johannesburgsummit.org/index.html 11/11/02 10.32
[15] http://www.un.org/esa/sustdev/agenda21text.htm19/12/02 09:00

Developing countries, it declares, should be given particular attention because of the state of transition that these are in. These suffer particular problems in transforming their economies as a result of social and political tensions.

The preamble of the Agenda states that document is a framework outlining actions, which will be addressed differently, by different countries. It states that actions required of countries, and the Agenda, are likely to change over time:

Agenda 21 is a dynamic programme. It will be carried out by the various actors according to the different situations, capacities and priorities of the regions in full respect of the principles contained in the Rio Declaration on Environment and Development. It could evolve over time in the light of changing needs and circumstances.[17]

The Agenda consists of 40 chapters. A list of these is provided in Appendix two. Each of these chapters has an introduction that provides the reasoning, or 'Basis for Action' behind why change is required. Where relevant, reference is also made to existing UN or other international agreements. This is followed by a description of the objectives of the programme; for instance, the objectives of the programme 'Combating Poverty' are listed as:

- To provide all persons urgently with the opportunity to earn a sustainable livelihood;
- To implement policies and strategies that promote adequate levels of funding and focus on integrated human development policies, including income generation, increased local control of resources, local institution-strengthening and capacity-building and greater involvement of non-governmental organizations and local levels of government as delivery mechanisms;
- To develop for all poverty-stricken areas integrated strategies and programmes of sound and sustainable management of the environment, resource mobilization, poverty eradication and alleviation, employment and income generation;
- To create a focus in national development plans and budgets on investment in human capital, with special policies and programmes directed at rural areas, the urban poor, women and children.

This is followed by a list of activities that, it states, will help achieve the objectives described. In some cases these lists are highly detailed and include suggested actions for a wide range of stakeholders including local government and communities. In order to monitor progress, the UN recommends that programmes be evaluated. To support this Agenda 21 provides a detailed list of indicators. These are reviewed in Chapter four.[18] Finally under the heading

---

[16] Preamble http://www.un.org/esa/sustdev/agenda21chapter1.htm 02/01/03 08:30
[17] Preamble http://www.un.org/esa/sustdev/agenda21chapter1.htm 02/01/03 08:30
[18] http://www.un.org/esa/sustdev/indisd/english/worklist.htm 02/01/03 10:30

'Means of Implementation'; detail is provided of the estimated costs and capacity requirements of implementing the programme.

Agenda 21 provides a useful basis for government to begin to implement sustainable development. It is highly detailed and provides a range of concrete actions that should be implemented. It places clear responsibility for implementation with governments. However it is vague in a number of areas. For instance, in many developing countries, implementation and even the development of new policy is difficult due to lack of capacity. Agenda 21 does not provide an adequate response for this problem. Similarly, while it argues that the responsibility for implementing Agenda 21 lies with government it also states that assistance will be required from other parties. However there is little guidance on how these parties should be involved by government.

The Agenda acknowledges the diversity of countries by suggesting that the implementation of the programme may vary from country to country, depending on local circumstances. It declares however, that implementation should be aligned to a set of principles developed alongside Agenda 21. These are referred to as the Rio Declaration on Environment Development.

Rio Declaration on Environment and Development[19]

The Rio Declaration on Environment and Development provide a set of principles that countries should use in implementing Agenda 21. The declaration consists of 27 broad principles. These are listed below:

Principle 1

Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.

Principle 2

States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

Principle 3

The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations.

[19] http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm 02/01/03 08:30

Principle 4

In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.

Principle 5

All States and all people shall cooperate in the essential task of eradicating poverty as an indispensable requirement for sustainable development, in order to decrease the disparities in standards of living and better meet the needs of the majority of the people of the world.

Principle 6

The special situation and needs of developing countries, particularly the least developed and those most environmentally vulnerable, shall be given special priority. International actions in the field of environment and development should also address the interests and needs of all countries.

Principle 7

States shall cooperate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem. In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.

Principle 8

To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies.

Principle 9

States should cooperate to strengthen endogenous capacity-building for sustainable development by improving scientific understanding through exchanges of scientific and technological knowledge, and by enhancing the development, adaptation, diffusion and transfer of technologies, including new and innovative technologies.

Principle 10

Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and

participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.

Principle 11

States shall enact effective environmental legislation. Environmental standards, management objectives and priorities should reflect the environmental and developmental context to which they apply. Standards applied by some countries may be inappropriate and of unwarranted economic and social cost to other countries, in particular developing countries.

Principle 12

States should cooperate to promote a supportive and open international economic system that would lead to economic growth and sustainable development in all countries, to better address the problems of environmental degradation. Trade policy measures for environmental purposes should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade. Unilateral actions to deal with environmental challenges outside the jurisdiction of the importing country should be avoided. Environmental measures addressing transboundary or global environmental problems should, as far as possible, be based on an international consensus.

Principle 13

States shall develop national law regarding liability and compensation for the victims of pollution and other environmental damage. States shall also cooperate in an expeditious and more determined manner to develop further international law regarding liability and compensation for adverse effects of environmental damage caused by activities within their jurisdiction or control to areas beyond their jurisdiction.

Principle 14

States should effectively cooperate to discourage or prevent the relocation and transfer to other States of any activities and substances that cause severe environmental degradation or are found to be harmful to human health.

Principle 15

In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Principle 16

National authorities should endeavour to promote the internalisation of environmental costs and the use of economic instruments, taking into account the approach that the polluter

should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.

Principle 17

Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.

Principle 18

States shall immediately notify other States of any natural disasters or other emergencies that are likely to produce sudden harmful effects on the environment of those States. Every effort shall be made by the international community to help States so afflicted.

Principle 19

States shall provide prior and timely notification and relevant information to potentially affected States on activities that may have a significant adverse transboundary environmental effect and shall consult with those States at an early stage and in good faith.

Principle 20

Women have a vital role in environmental management and development. Their full participation is therefore essential to achieve sustainable development.

Principle 21

The creativity, ideals and courage of the youth of the world should be mobilized to forge a global partnership in order to achieve sustainable development and ensure a better future for all.

Principle 22

Indigenous people and their communities and other local communities have a vital role in environmental management and development because of their knowledge and traditional practices. States should recognize and duly support their identity, culture and interests and enable their effective participation in the achievement of sustainable development.

Principle 23

The environment and natural resources of people under oppression, domination and occupation shall be protected.

Principle 24

Warfare is inherently destructive of sustainable development. States shall therefore respect international law providing protection for the environment in times of armed conflict and cooperate in its further development, as necessary.

Principle 25

Peace, development and environmental protection are interdependent and indivisible.

Principle 26

States shall resolve all their environmental disputes peacefully and by appropriate means in accordance with the Charter of the United Nations.

Principle 27

States and people shall cooperate in good faith and in a spirit of partnership in the fulfilment of the principles embodied in this Declaration and in the further development of international law in the field of sustainable development.

These principles provide a useful guide for how sustainable development should be implemented. They are however too abstract to be easily applied to the building and construction sector. There is therefore a requirement to translate these into a more directly applicable guide, or set of objectives, for building and construction. This developed in Chapter five.

Millennium Goals[20]

The Millennium Goals were developed and agreed at the United Nations Millennium Summit held in New York on 6-8 September 2000. The Summit reviewed the mission of the United Nations and provided a number of a number of clear goals that member nations were asked to adopt. These are described under a number of headings including: ‘Freedom from Want’, ‘Freedom from Fear’, ‘A Sustainable Future’ and ‘Renewing the United Nations’. The goals listed under ‘Freedom from Want’ and ‘A Sustainable Future’ are relevant to this study and are listed below:

Freedom from Want - the Development Agenda

Poverty: To halve, by 2015, the proportion of the world's people (currently 22 per cent) whose income is less than one dollar a day.

Water: To halve, by 2015, the proportion of people who do not have access to safe drinking water (currently 20 per cent).

[20] http://www.un.org/millennium/sg/report 19/12/02 09:00

Education: To narrow the gender gap in primary and secondary education by 2005; and to ensure that, by 2015, all children complete a full course of primary education.

HIV/AIDS: To halt, and begin to reverse, the spread of HIV/AIDS by 2015 by:

- Adopting as an explicit goal the reduction of HIV infection rates in persons 15 to 24 years of age – by 25 percent within the most affected countries before the year 2005, and by 25 percent globally before 2010.
- Setting explicit prevention targets: by 2005 at least 90 percent, and by 2010 at least 95 percent, of young men and women must have access to the HIV-preventive information and services.
- Urging every seriously affected country to have a national plan of action in place within one year of the Summit.

Clearing the slums: to endorse and act upon the 'Cities Without Slums' plan launched by the World Bank and United Nations to improve the lives of 100 million slum dwellers by 2020.

Youth employment: to develop strategies to reduce joblessness among youth.

Building digital bridges: to review their policies in order to remove regulatory and pricing impediments to Internet access, to make sure people are not denied the opportunities offered by the digital revolution.

Private sector: to develop strong partnerships with the private sector, at both national and international levels, to combat poverty in all its aspects.

Developed countries in particular are urged:

Trade access: to grant free access to their markets for goods produced in poor countries - and, as a first step, to be prepared to adopt a policy of duty-free and quota-free access for essentially all exports from the least-developed countries at the UN Conference on the Least Developed Countries in March 2001.

Debt relief: to implement the expansion of the debt relief program for Heavily Indebted Poor Countries agreed last year without further delay, and to be prepared to cancel all official debts of the heavily indebted poor countries, in return for those countries making demonstrable commitments to poverty reduction.

ODA: to grant more generous development assistance, particularly to those countries that are genuinely applying their resources to poverty reduction.

HIV/AIDS: to work with the pharmaceutical industry and other partners to develop an effective and affordable vaccine against HIV; and to make HIV-related drugs more widely accessible in developing countries.

Africa: to make special provision for the needs of Africa, and to fully support Africans in their struggle to overcome the continent's problems. Specifically, experts and foundations are urged to tackle the problem of low agricultural productivity in Africa.

A Sustainable Future - The Environmental Agenda

Climate change: To adopt and ratify the Kyoto Protocol, so that it can enter into force by 2002, and to ensure that its goals are met, as a step towards reducing emission of greenhouse gases.

Green accounting: To consider incorporating the United Nations system of "green accounting" into their own national accounts, in order to integrate environmental issues into mainstream economic policy.

Ecosystem assessment: To provide financial support for, and become actively engaged in, the Millennium Ecosystem Assessment, a major international collaborative effort to map the health of the planet.

Earth Summit +10: To prepare the ground for the adoption of concrete and meaningful actions by the world's leaders at the ten-year follow-up to the Earth Summit in 2002.

These goals are important as they represent the immediate sustainable development priorities that the UN and many development organisation and funding agencies (such as the Department for International Development (DFID)[21] and the World Bank[22]) have agreed to address. The fact that there are a limited number of goals which have been presented in a very simple way and have an immediacy as a result of their targets and deadlines, may have contributed to their widespread adoption.

2.1.4. The World Summit on Sustainable Development

'Global Challenges, Global Opportunities' and the **'**World Summit on Sustainable Development Plan of Implementation' are reviewed as they are an up-to-date reflection of the current international position on sustainable development. The United Nations World Summit on Sustainable Development was held in Johannesburg between 26 August and 4 September

[21] DFID. 2000. p.12
[22] http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/0,,contentMDK:20040558~menuPK:34559~pagePK:34542~piPK:36600,00.html? 23/04/2003 16:57

2002. It reviewed progress in terms of Agenda 21 (the sustainable development plan agreed in the previous World Summit held in 1992) and aimed to develop, and agree, further plans for international sustainable development policies and programmes.

Global Challenges, Global Opportunities

The report was developed by the United Nations to provide a context for the World Summit on Sustainable Development (WSSD) held in Johannesburg. In particular it provides information on the key trends and projections that should be acknowledged and addressed at the Summit.

The preface of the document suggests that a new development paradigm has emerged since the last Earth Summit held in Rio in 1992. The new model integrates economic growth, social development and environmental protection as interdependent and mutually supportive elements of long–term development. It suggests that sustainable development also has a strong emphasis on:

…*participatory, multi-stakeholder approach to policy making and implementation, mobilising public and private resources for development and making use of the knowledge, skills and energy of all social groups concerned with the future of the planet and its people.*

The preface also refers to the importance of participation from all members of society:

…*mobilising people in their various social roles to promote sustainable development for present and future generations*

The document is divided into the following sections: Population, Poverty and Inequality, Food and Agriculture, Freshwater, Forests, Energy, Climate Change, Health and Water, Health and Air Pollution, with a section at the end which provides reference to documentation where greater detail can be obtained.

Population

The trends highlighted in this section include the increase in the world population, the increasing density of populations, the increase in smaller families and the impact of HIV/AIDS in Africa. It suggests that the World population will grow from its current size of about 6 billion to 8 billion in 2025. This increase will almost entirely occur in developing countries. The increasing population will lead to increasing pressures on agricultural land as this is developed for human settlement. A positive trend, the report suggests, is the reduction in the average size of families. This not only leads to reduced population growth but also to increased investment in education, nutrition and health care for children. The HIV/AIDS epidemic in Africa, however, it is suggested, is undermining sustainable development in Africa. This is negatively affecting families, who have additional health care and funeral expenses and businesses, which experience disruption and reduced productivity.

Poverty and Inequality

The trends highlighted include reduced income poverty, reduced levels of hunger, continuing high levels of inequality, and increased standards of living in Asia. The report suggests that there are about 1.2 billion people living in poverty (defined as living below $1, a day). This number has been declining in all areas of the world except in Sub Saharan Africa. It is suggested that a number of regions including East Asia and Latin America will reach Millennium Development Goals of halving the number of people who suffer from hunger by 2015. This however, will not be achieved in Sub Saharan Africa. High levels of inequality continue to exist in Latin America and Africa. This is a concern, it is suggested, as inequality tends to reduce the effect that economic growth has on poverty reduction. Standards of living have improved in South Asia, however this trend does not exist in sub-Saharan Africa and Latin America.

Food Production and Agriculture

Trends described include increasing production and consumption of food, limitations in further increases in food production and increased agricultural trade. The report suggests that whereas most areas of the world have limited potential for expansion or increased agricultural productivity, this was not the case for Sub-Saharan Africa and Latin America. Increased consumption in developing areas such as North Africa, West Asia and South Asia will lead, it is suggested, to increased food imports from developed countries to these countries.

Freshwater

The trends highlighted include increasing consumption of water and water shortages. Agriculture and industry are major consumers of water and both are increasing consumption. This, it suggests, will result in nearly half of the global population experiencing water shortages by 2025.

Forests

Trends identified include decreases in forest area, decreased bio capacity, as well as improvements in management and protection of forests. Deforestation has been highest in Africa, with forests decreasing at a rate of 7% per decade. Deforestation has been largely due to expansion in agriculture. Loss of forests is leading to many associated services being diminished. These include water and soil conservation, flood control and climate change mitigation. However there have been increases in forest management, with about 2% of forests worldwide now certified as managed for a sustainable yield. In addition, the there have been increases in the area of nature reserves and associated eco-tourism industries.

Energy

Trends described include increased consumption of energy and increases in renewable and biomass as sources of energy. The report particularly draws attention to the links in developing countries between biomass use (for instance the use of wood for cooking) and health problems.

Climate Change

Trends highlighted include increased consumption of fuel and increased CO_2 emissions as well as a range of climate change trends. Global climate change trends include global average surface temperature increasing by 0.6^{o}C since 1900; sea level increases of 1cm a decade and Arctic sea ice thickness declining 40% in the last 40 years. There are increased frequencies of droughts in Asia and Africa and flood and storm damage insurance payouts increasing from $2billion annually in the 1980's to $30billion annually in the early 1990's.

Health and Water

Trends described include causes of mortality and access to safe water. The report suggests that many deaths and illnesses are due to communicable, environment–related diseases, and suggests that many of these diseases can be prevented through simple and inexpensive technologies. A large proportion of the world's population still do not have access to safe drinking water and sanitation. Most of these people are in Africa and Asia. Mortality rates from malaria have been decreasing in most area, except Africa where they have been increasing. This is a result of the decreasing efficacy of the anti-malarial drug chloroquine and the development of dams and irrigation schemes, deforestation, and global warming.

Health and Air Pollution

Trends described include deaths from respiratory diseases, and decreasing urban air pollution in middle and high-income countries. The report suggests that more than three million people a year die of air pollution, with most of this caused by indoor air pollution as result of burning biomass for heating and cooking. Urban air pollution is increasing in developing countries and decreasing in developed countries. With the result that in most large cities in the developing world, air-borne particulate levels are five times higher than in developed countries.

The brief description of the main trends hi-lighted in the report provides a useful context for the study as it provides a list of areas that are seen as priorities. The report was used to provide background for the development of the Plan of Implementation, a plan developed by the Summit to implement Sustainable Development. This is described below.

2.1.5. World Summit on Sustainable Development Plan of Implementation

The Plan of Implementation was developed to provide a plan of action that countries at the World Summit had debated and agreed on. The plan built on commitments developed at the

previous summit, the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992. In addition, it reaffirmed commitments established in other UN conferences and international agreements such as The Programme for Further Implementation of Agenda 21 and the Millennium Declarations.

The plan contains 145 statements describing actions that should be taken by countries to support sustainable development. The plan suggests that the following are the key objectives and essential requirements for sustainable development:

- Poverty eradication
- Changing unsustainable patterns of production and consumption
- Protecting and managing the natural resource base of economic and social development

The WSSD Plan of Implementation appears to contain a comprehensive set of actions to support sustainable development. A detailed review of this plan reveals however that the number and complexity of the statements make it difficult for their relevance and application to buildings and construction to be easily ascertained.

The study therefore proposes to extract the most relevant statements for buildings and construction and summarise these. Statements from the WSSD plan are interpreted into objectives, enabling the implications of these, for buildings and construction to more readily understood. The results of this analysis are in Appendix three. The relationship between these objectives and buildings and construction is explored further in Chapter five, Specification for a Building Assessment System.

2.1.6. Review of International Sustainable Development Context

Through the review of the international and local Sustainable Development context a number of patterns and characteristics can be detected that are relevant to the study. These are described below:

The shift from environmental impact to sustainability: It is argued that there has been a shift in emphasis from the environment to the broader concept of Sustainability during the ten years between the Rio Summit and the Johannesburg. This is reflected in the structure and content of the declarations from these summits. For instance, in Agenda 21, social and economic issues are described separately (under Social, and Economic Dimensions) from environment issues (which are described under Conservation and Management of Resources), whereas in the WSSD Plan of Implementation the distinction between these aspects is not made. Another example is the emphasis placed in the Rio Declaration on the Environment and Development on environmental impact assessment and internalisation of

environmental costs.[23] In the WSSD plan this has changed to suggesting that countries develop and use indicators of sustainable development.[24]

The understanding of social and economic aspects of Sustainable Development however still appears to be developing. For instance, there are detailed descriptions of actions required to address environmental problems whereas these tend to be more vague when it comes to addressing social issues. An example of this is the very limited guidance as to how countries should create employment or deal with HIV/AIDs orphans.[25]

This aspect is reflected in recommendations made to countries in terms of the types of assessment and monitoring carried out. Even with the increasing emphasis on Sustainable Development the WSSD plan suggests that a range of environmental assessments should take place in developing countries without making reference to social or economic impact analysis or modelling.[26]

Both Agenda 21 and the WSSD plan place a strong emphasis on the collection and use of information to support the design and implementation of programmes. They suggest that a difficulty in many developing countries is that relevant, current data is not available. This makes it difficult to plan effectively:

While considerable data already exist, as the various sectoral chapters of Agenda 21 indicate, more and different types of data need to be collected, at the local, provincial, national and international levels, indicating the status and trends of the planet's ecosystem, natural resource, pollution and socio-economic variables. The gap in the availability, quality, coherence, standardization and accessibility of data between the developed and the developing world has been increasing, seriously impairing the capacities of countries to make informed decisions concerning environment and development.

… There is a general lack of capacity, particularly in developing countries, and in many areas at the international level, for the collection and assessment of data, for their transformation into useful information and for their dissemination. There is also need for improved coordination among environmental, demographic, social and developmental data and information activities. [27]

This suggests that an important requirement in developing countries in terms of this study will be capturing and making available information on building performance in relation to

[23] Principle 15 and 16, http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm 02/02/03 10:30
[24] Item 119, http://www.johannesburgsummit.org/index.html 11/11/02 10.32
[25] Item 46, http://www.johannesburgsummit.org/index.html 11/11/02 10.32
[26] Item 104, http://www.johannesburgsummit.org/index.html 11/11/02 10.32
[27] http://www.un.org/esa/sustdev/agenda21chapter40.htm 02/02/03 10:30

sustainable development. This idea is explored further in Chapter five and incorporated as a recommendation in the final chapter of the study.

The science of sustainability: The WSSD report makes reference to the 'science of sustainability' and hints at the characteristics of this. For instance, it suggests that an important aspect of this is the requirement for multi-disciplinary teams. There is however little evidence that a scientific approach has been used in developing the Plan of Implementation. There seems to be no prioritisation in terms of what objectives are most important and which should be implemented first. Is air pollution more, or less important, than soil erosion? These are important questions that developing countries face and need to address with limited budgets. It could be argued that the document may in many ways have been put together in an arbitrary way and may have been influenced more by lobbying than by science. This, it is suggested, weakens the document and makes it more difficult to implement.

The difference between developed and developing countries: Explicit, in documents from both summits, is the realisation that different approaches are required for countries in differing stages of development. This is recognised in the proposed flexible application of Agenda 21 and through the inclusion of separate chapters for Africa and developing small island states.[28] It is also reflected in the principle of differentiated responsibilities.[29]

A concerning aspect that emerges from the review is the trend for Africa, as a continent consisting of developing countries, to perform extremely poorly in terms of sustainable development. According the report 'Global Challenges, Global Opportunities' it has many of the worst health and poverty problems and is unlikely to meet any of the Millennium Development Goals. This suggests that these goals are a particular priority and should be addressed within the building and construction industry where possible. This will be explored further in Chapter five, where the study investigates how sustainable development objectives should be prioritised and incorporated in an assessment tool.

Technology: Both Agenda 21 and the WSSD report recommend that technology from developed countries be transferred to developing countries. The technology referred to generally seems to be of a small scale, alternative type. There is little reference to transferring highly sophisticated, large-scale technology or highly resource and energy efficient technology. There is also little reference to enabling developing countries to develop environmentally sound technology locally. This may implicitly reflect concerns that developing countries may compete in the same technological markets as developed countries. This omission should be addressed as it is argued that new resource efficient, labour intensive and renewable energy technologies are particularly appropriate for developing countries which often have raw materials, plentiful renewable energy (such as sunlight) and a obligation to

[28] Preamble, http://www.un.org/esa/sustdev/indisd/english/worklist.htm 19/12/02 09:00

create as many jobs as possible. There also seems to be no acknowledgement that useful knowledge and technology may also be transferred from developing countries to developed countries. It can be argued that there are a wide range of technologies, processes and approaches to life and work that exist in developing countries that are more sustainable than those in developed countries.

Vulnerable groups: In both documents there is a strong emphasis on ensuring that people are encouraged to participate in the implementation of the programmes. In Agenda 21 this includes farmers and business people as well as women and youth.[30] In the WSSD plan a much stronger reference is made to the poor and ensuring that their needs are addressed with less emphasis on specific roles that individuals and groups of people should play.[31]

Participation and empowerment: It is suggested that there is an increasing awareness that an emphasis on participation is not enough and vulnerable groups, especially the poor, must be more actively empowered by being provided with access to finance, information, information technology, education and infrastructure. For instance, in Agenda 21 participation is described in the following way:

One of the fundamental prerequisites for the achievement of sustainable development is broad public participation in decision-making.[32]

And

Empower community groups, non-governmental organizations and individuals to assume the authority and responsibility for managing and enhancing their immediate environment through participatory tools, techniques and approaches embodied in the concept of environmental care.[33]

This changes to an increasing emphasis on access to infrastructure and information in the WSSD report:

…building rural infrastructure, diversify the economy and improve transportation and access to markets, market information, and credit for the rural poor.[34]

And

---

[29] Principle 7, http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm 02/02/03 10:30
[30] Chapters 25, 26, 27, 28, 29, 30 and 31, http://www.un.org/esa/sustdev/indisd/english/worklist.htm 19/12/02 09:00
[31] Item 6, http://www.johannesburgsummit.org/index.html 11/11/02 10.32
[32] http://www.un.org/esa/sustdev/agenda21chapter23.htm 02/02/03 10:30
[33] http://www.un.org/esa/sustdev/agenda21chapter7.htm 02/02/03 10:30
[34] Item 6 http://www.johannesburgsummit.org/index.html 11/11/02 10.32

These programmes should empower poor people and reflect their priorities and enable them access to productive resources, public services and institutions, and in particular land, water, employment opportunities, credit, education and health.[35]

The WSSD statements are interesting because they depart from conventional environmental and sustainability wisdom by suggesting two things. The first is that infrastructure development is required and should be undertaken. The second is that poor people should dictate the type of development that happens around them. These ideas are relevant for this study and will be explored further in Chapter five.

The WSSD plan also make suggestions on how decisions on global public interest issues should be made. It suggests that these should be discussed in open, transparent and inclusive workshops.[36]

Education: Both Agenda 21 and the WSSD plan emphasize the importance of education. For instance, Agenda 21 states:

Education is critical for promoting sustainable development and improving the capacity of people to address environment and development issues. [37]

Within education there is also a discernable shift between Agenda 21 and the WSSD plan. This changes from an emphasis on 'capacity development' to a broader concept of education including 'education for all', 'lifelong learning' and 'education appropriate to context'.[38] There is also a much stronger emphasis on the right of children to access education, probably as a result of the influence of the Millennium goals.[39] Education, it would appear is an essential component of sustainable development in developing countries. The implications of this for building and construction will be investigated further in Chapter five.

Infrastructure: The attitudes to infrastructure in Agenda 21 and the WSSD report are different. In Agenda 21 there is a begrudging acceptance for the need for infrastructure, with an emphasis on housing and sanitation. This changes in the WSSD report where there is a clear acceptance and understanding of the role that infrastructure can play in development. The WSSD report appears to strongly support infrastructure development in areas that support developing country economies, such as roads and access to markets. An interesting aspect of Agenda 21 is the recommendation that Overseas Development Aid is used for infrastructure development as this generally generates the most impact by drawing in local funding and by creating what is referred as an 'enabling environment':

---

[35] Item 6 http://www.johannesburgsummit.org/index.html 11/11/02 10.32
[36] Item 106 http://www.johannesburgsummit.org/index.html 11/11/02 10.32
[37] Chapter 36 http://www.un.org/esa/sustdev/agenda21chapter36.htm 02/02/03 10:30
[38] Item 115 and 116, http://www.johannesburgsummit.org/index.html 11/11/02 10.32
[39] Item 6 http://www.johannesburgsummit.org/index.html 11/11/02 10.32

……On the other hand, available information indicates that technical cooperation activities in the human settlement sector generate considerable public and private sector investment. For example, every dollar of UNDP technical cooperation expenditure on human settlements in 1988 generated a follow-up investment of $122, the highest of all UNDP sectors of assistance…This is the foundation of the "enabling approach". [40]

The idea that infrastructure can act as a catalyst for beneficial development is useful and will be explored further in Chapter five of the study.

Production and consumption: Both Agenda 21 and the WSSD report make strong statements about changing patterns of consumption and production. There is however a clear lack of will when it comes to implementing and monitoring this. For instance, in 'Global Challenges and Global Opportunities', the document meant to set the context for the WSSD, there is little mention about the continuing wasteful patterns of production and consumption that exist in developing countries. The summit itself appears to have deflected interest and action from this area by concentrating on poverty in developing countries. This is unfortunate because it may be argued that while poverty is a priority that must be addressed, wasteful consumption and production patterns in developed countries have caused, and continue exacerbate many of worst global environmental problems.

Structural changes: Even though the WSSD plan has extremely ambitious goals it seems to have a very piecemeal plan for achieving these. The plan of implementation does not seem to have any scientific basis and is not coherent. There are also many assumptions implicit in the plan that are not questioned. For instance, it can be argued that current economic systems are incompatible with sustainable development. This concern was raised in Agenda 21:

Growing recognition of the importance of addressing consumption has also not yet been matched by an understanding of its implications. Some economists are questioning traditional concepts of economic growth and underlining the importance of pursuing economic objectives that take account of the full value of natural resource capital. More needs to be known about the role of consumption in relation to economic growth and population dynamics in order to formulate coherent international and national policies.[41]

The WSSD plan however does not question any aspects the current economic system other than to express a concern that globalisation does not negatively impact developing countries.[42] It is suggested that structural changes in social, environmental and economic systems may be required in order to support sustainable development and that the WSSD

[40] Chapter 7 http://www.un.org/esa/sustdev/agenda21chapter7.htm 02/02/03 10:30
[41] Chapter 4 http://www.un.org/esa/sustdev/agenda21chapter4.htm 02/02/03 10:30
[42] Item 43, 90, http://www.johannesburgsummit.org/index.html 11/11/02 10.32

plan does not go far enough. This is argued in more detail in the next chapter, Chapter three. This finding, it is suggested, should influence the development of the specification in Chapter five. It is recommended that the while the specification may draw heavily on the WSSD plan, it should not be restricted by this and should go beyond this if thought appropriate especially in relation to economic aspects.

2.1.7. The Local Context

In order to develop an understanding of the difference in national perspectives on sustainable development between a developed country and developing country, government policy and reports from the United Kingdom and South Africa are reviewed.

In both cases policy documents that describe national development priorities and approaches are reviewed. These describe aspects of development that are seen as urgent priorities and provide a framework as to how these priorities should be addressed. In addition, the measures used by these countries to assess progress towards achieving national sustainable development goals are also reviewed in outline. A more detailed review of sustainable development indicators and assessment is carried out in Chapter four.

Policy and indicators from the United Kingdom are reviewed, followed by those from South Africa. These are then contrasted in order to highlight differences in perspective of the different countries. This it is suggested will support a stronger understanding of the dynamic nature of sustainable development and how this can be supported in developing countries.

2.1.8. The United Kingdom

A Better Quality of Life – A Strategy for Sustainable Development for the UK[43]

A Strategy for Sustainable Development for the UK was developed in order to ensure that sustainable development was integrated into government policy and addressed effectively. It is linked to a range of targets and indicators that are assessed in order to measure progress towards sustainable development. The strategy indicates a move away from the conventional assessments of development such as Gross Domestic Product (GDP) to a more holistic, and wider range, of indicators. These indicators have been selected to assess, in particular, quality of life. Tony Blair, the British Prime Minister, describes this shift in the following way:

…Success has been measured by economic growth- GDP- alone. We have failed to see how our economy, our environment, and our society are all one. And that delivering the best possible quality of life for all of us means more that concentrating solely on economic growth. That is why sustainable development is such an important part of this Government's programme. We must ensure that our economy thrives. So we can deliver the schools and hospitals we want , the jobs we need and provide opportunities for all. But we must ensure

that economic growth contributes to our quality of life, rather than degrading it. And that we can all share in the benefits.

The strategy for sustainable development has four main aims. These are:

- **Social progress, which recognises the needs of everyone.** Everyone should share in the benefits of increased prosperity and a clean and safe environment. We have to improve access to services, tackle social exclusion, and reduce the harm to health caused by poverty, poor housing, unemployment and pollution. Our needs must not be met by treating others, including future generations and people elsewhere in the world, unfairly.

- **Effective protection of the environment.** We must act to limit global environmental threats, such as climate change; to protect human health and safety from hazards such as poor air quality and toxic chemicals; and to protect things which people need or value, such as wildlife, landscapes and historic buildings

- **Prudent use of natural resources.** This does not mean denying ourselves the use of non-renewable resources like oil and gas, but we do need to make sure that we use them efficiently and that alternatives are developed to replace them in due course. Renewable resources, such as water should be used in ways that do not endanger the resources or cause serious damage or pollution

- **Maintenance of high and stable levels of economic growth and employment,** so that everyone can share in high living standards and greater job opportunities. The UK is a trading nation in a rapidly changing world. For our country to prosper, our businesses must produce the high quality goods and services that consumers throughout the world want, at prices they are prepared to pay. To achieve that, we need a workforce that is equipped with the education and skills for the 21st century. And we need business ready to invest, and an infrastructure to support them

These aims are guided by ten principles, including:

- **Putting people in the centre.** Sustainable development must enable people to enjoy a better quality of life. In the words of the Rio Declaration, ‘human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature’.

[43] http://www.sustainable-development.gov.uk/uk_strategy/content.htm 17/12/0217 10:00

- **Taking a longer terms perspective.** Sustainable development thinking cannot restrict itself to the life of a Parliament, or the next decade. Radical improvements have to begin now to safeguard the interest of future generations. At the same time we must meet today's needs – for example, people need warm homes, which, at present means using predominantly fossil fuels

- **Taking account of costs and benefits.** Decisions must take into account a wide range of costs and benefits, including those, which cannot easily, be valued in money terms. In pursuing any single objective, we should not impose disproportionate costs elsewhere. Public values, the timing of costs and benefits and risks and uncertainties should be taken into account.

- **Creating and open and supportive economic system.** Sustainable development requires global economic systems, which supports economic growth in all countries. We need to create conditions in which trade can flourish and competitiveness can act as a stimulus to growth and greater resource efficiency.

- **Combating poverty and social exclusion.** Eradicating poverty is indispensable for sustainable development. We must help developing countries to tackle widespread abject poverty. In this country, everyone should have the opportunity to fulfil their potential, through access to high quality public services, education and employment opportunities, decent housing and good local environments.

- **Respecting environmental limits.** Serious or irreversible damage to some aspects of the environment and resources would pose a severe threat the global society. Examples are major climate change, overuse of freshwater resources, or collapse of globally significant fish stocks. In this case, there are likely to be limits which should not be breached. Defining such limits is difficult, so precautionary action needs to be considered.

- **The precautionary principle.** The Rio declaration defines the precautionary principle as 'where there are threats of serious or irreversible damage, lack of scientific certainty shall not be used a reason for postponing cost effective measures to prevent environmental degradation' Precautionary action requires assessment of the costs and benefits of action, and transparency in decision making.

- **Using scientific knowledge.** When taking decision, it is important to anticipate early on where scientific advice ore research is needed, and to identify sources of information of high calibre. Where possible, evidence should be reviewed for wide-ranging set of view points

- **Transparency, information, participation and access to justice.** Opportunities for access to information, participation in decision-making and access to justice should be available to all.

- **Making the polluter pay.** Much environmental pollution, resource depletion and social costs occurs because those that are responsible are not those that bear the consequences. If the polluter, or ultimately the consumer, is made to pay for those costs, that gives incentives to reduce harm, and means that costs do not fall on society at large. At the same time, it may not always be possible for everyone to bear all such costs, particularly for essential good and services.

The strategy has a number of aspects that are relevant to the study. The first is the acknowledgement that developed countries are in a different position to developing countries with respect to sustainable development and therefore may not have the same problems:

….This country does not have problems on such a scale. But we cannot stand aside from these issues…

The second is the use of indicators to measure progress towards sustainable development. These measures are made an integral part of the strategy and the strategy suggests that these should be used to judge the effectiveness of government:

Talking about sustainable development is not enough. We have to know what it is, to see how our policies are working on the ground. We must hold ourselves to account- as a government, but also as a country.[44]

Another aspect is the description of linkages between indicators. This suggests that development must be thought of, and addressed, in a holistic way. It also suggests that there are precursors that must be in place to ensure that development takes place.

There are many links between indicators. For instance, the economy will not grow unless we modernise out education system and our infrastructure. We need to think about the location of our housing, as well as its quality, to reduce the need for car travel and to encourage urban regeneration. The links between transport, health and the environment show how we can all too easily reinforce damaging trends. Such links underline the need for integrated polices, rather than tackling issues individually.[45]

---

[44] Forward, http://www.sustainable-development.gov.uk/uk_strategy/quality/life/09.htm 17/12/0217 10:00
[45] Item 3.8. http://www.sustainable-development.gov.uk/uk_strategy/quality/life/09.htm 17/12/0217 10:00

Progress in terms of the Strategy for Sustainable Development is captured in annually in a report titled 'Quality of Life Counts' issued by the Department of Environment, Transport and the Regions.

Quality of Life Counts[46]

The report reports on 15 'headline' indicators, which give a broad overview of trends and provide detail on 150 detail indicators that focus on specific issues. It builds on a previous report developed in 1996, which mainly documented environmental issues, by including a wide range of new indicators on social, economic and international issues. These are shown below:

Table One: Headline Indicators in the UK Sustainable Development Strategy

Themes, issues and objectives	**Headline indicators**
Maintaining high and stable levels of growth and employment	
Our economy must continue to grow	Total output of the economy (GDP and GDP per head)
Investment (in modern plant and machinery as research and development) is vital to our future prosperity	Total social investment as a percentage of GDP
Maintain high and stable levels of employment so everyone can share greater job opportunities	Proportion of people of working age who are in work
Social progress which recognises the needs of everyone	
Tackling poverty and social exclusion	Indicators of success in tackling poverty and social exclusion (children in low income households, adults without qualifications and in workless households, elderly in fuel poverty)
Equip people with the skills to fulfil their potential	Qualifications at the age of 19
Improve the health of the population overall	Expected years of healthy life
Reduce the proportion of unfit (housing) stock	Homes judged unfit to live in
Reduce crime and people's fear of crime	Level of crime
Effective protection of the environment	
Continue to reduce our emissions of	Emissions of greenhouse gases

[46] Department of the Environment, Transport and the Regions. UK. 1999.

greenhouse gases now and plan for greater reductions in longer term	
Reduce air pollution and ensure air quality continues to improve through the longer term	Days when pollution is moderate of higher
Improve the choice of transport; improve access to education, jobs, leisure and services; reduce the need to travel	Road traffic
Improving river quality	Rivers of good or fair quality
Reverse the long term decline in populations of farmland and woodland birds	Populations of wild birds
Reusing previously developed land in order to protect the countryside and encourage urban renewal	New homes built on previously developed land
Prudent use of natural resources	
Move away from disposal of waste towards waste minimisation, reuses, recycling and recovery	Waste arisings and management

Progress on these indicators is reported in a graphical way allowing trends to be determined easily. These include coloured dots, which indicate progress made towards achieving objectives: green dot – significant change, yellow dot – no significant change and red dot, significant change away from achieving objective.[47]

Since the initial report on indicators published in 1999, a comprehensive website has been developed. This includes an updated indicator framework with a range of additional indicators. This is included in Appendix four.[48]

2.1.9. South Africa

The policies reviewed for South Africa include the Reconstruction and Development Programme (RDP) and the Growth, Employment and Redistribution Strategy (GEAR) and the State of the Environment (SoE) Report. The RDP and GEAR are key programmes that set out the South African government's position on development and are designed to inform all other policy developed by government. Both policies are an attempt to address key developmental priorities in South Africa and the inequity that developed during the Apartheid era. The State of the Environment report, also reviewed in this section, attempts to develop a picture of the sustainable development in South Africa.

[47] Department of the Environment, Transport and the Regions. 1999. p 26 and 27
[48] Department of the Environment, Transport and the Regions. 1999. p 291

The Reconstruction and Development Programme[49]

The Reconstruction and Development Programme was published in 1994 and aimed to support transformation and social and economic progress in South Africa. It had the following aims:

- Developing strong and stable democratic institutions
- Ensuring representation and participation
- Ensuring our country becomes a dully democratic, non-racial, and non-sexist society
- Creating a sustainable and environmentally friendly growth and development path

The role of the RDP is described by President Nelson Mandela in his inaugural address to a joint sitting of parliament on 24 May 1994 in the following way:

My government's commitment to create a people-centre society of liberty binds us to the pursuit of the goals of freedom from want, freedom from hunger, freedom from deprivation, freedom form ignorance, freedom from suppression and freedom from fear. These freedoms are fundamental to the guarantee of human dignity. They will therefore constitute part of the centrepiece of what this government is trying to achieve, the focal point on which our attention must be continuously focused. These things we have said constitute the true meaning, the justification and purpose of the Reconstruction and Development Programme, without which it would lose all legitimacy

The Reconstruction and Development Programme was developed to support transformation and social and economic progress in South Africa.[50]

The RDP places a strong emphasis on participation. It suggests that this is key to the development of South Africa and, in particular, the implementation of the RDP programme:

…*the RPD, which has developed through a process of consultation and joint policy formulation, will continue to encourage organisations within civil society to take responsibility for the effective implementation of the Programme.*[51]

The Principles of the RDP[52]

The RPD lists a number of principles that should inform the design and implementation of the RDP programmes. These are described below:

Integration and sustainability: The RDP programme should be integrated and goals should be achievable and sustainable financially.

[49] Office of the President. 1994.
[50] Office of the President. 1994. p 6
[51] Office of the President .1994. p. 7

People-driven: The implementation of the programme should be inclusive and transparent. It suggests that development is about active involvement of citizens. This is described in the following way:

Development is not about the delivery of goods to a passive citizenry. It is about the involvement and growing empowerment

Peace and security: The programme suggests that is important that there is a peaceful and secure environment, as this will encourage investment and development. This is will be addressed through transformation of the security forces and judiciary to ensure these reflect the gender and racial composition of South Africa and will uphold human rights and the constitution

Nation building: The programme will ensure that there is a framework that enables all parties to be involved in government. This is described as follows:

We are a single country, with a single economy, functioning within a constitutional framework that establishes provincial and local powers, respect and protection for minorities, and a process to accommodate those wishing to retain their cultural identity. It is on the basis of our unity in diversity that will consolidate our national heritage.

Meeting basic need and building infrastructure: The RPD aims to integrate development with redistribution. A key component of this is an infrastructure programme that aims to provide access to services such as electricity, water, telecommunications, transport, health, education and training for everyone. The RDP envisaged not only being able to help meet basic needs but also supporting the opening up of previously suppressed economic and human potential in urban and rural areas.

Democratisation: The RDP states that people must participate in decision-making. This will be done through the restructuring of government and transformation in civil society.

Assessment and accountability: The goals of the RDP must be clearly defined and integrated. This will require organised structures and co-ordinated action, which can be measured in order to assess progress in achieving goals.

The Programmes of the RPD[53]

The RDP consists of five main programmes. These are described below:

---

[52] Office of the President. 1994. p. 8-9
[53] Office of the President. 1994. p. 9-10

Meeting basic needs: The basic needs of people described include job creation, land reform and agrarian reform, water, sanitation, energy supplies, transport, nutrition, health care, the environment, social welfare and security. The RDP suggests that people should be actively involved in the design and management of infrastructure:

In creating the infrastructure to meet these needs the RDP will encourage and support the participation of people in key decisions about where projects should be and how they should be managed.

Developing human resources: The RPD states that people should be involved in the decision-making process and implementing the RPD. It suggests however that this will only succeed if there are appropriate training and education programmes.

Building the economy: The RDP aimed to support the development of the economy through making the government more efficient and through trade and other initiatives.

Implementing the RDP: The procedures for implementing the RDP aim to mobilise the participation of as many social organisations and institutions as possible.

The RDP provides limited information on activities and programmes to be undertaken. It also provides little contextual, quantifiable information on the issues it will address. Its use, therefore, mainly seems to be in the provision of a broad set of guiding principles for development in South Africa. It requires further policy and programmes in order to be implemented. This is acknowledged in the Growth Employment and Redistribution Strategy.

The Growth Employment and Redistribution (GEAR)[54]

The Growth Employment and Redistribution (GEAR) is a macro-economic programme developed by the South African Department of Finance. This aimed to transform the South African economy in order to achieve the following:

- A competitive fast-growing economy, which creates sufficient, jobs for all work seekers;[55]
- A redistribution of income and opportunities in favour of the poor;
- A society in which sound health, education, and other services are available to all; and
- An environment in which homes are secure and places of work are productive.

It was designed to be in line with the Reconstruction and Development Programme and, through a integrated economic strategy, aims to address many of the issues outlined in the

[54] Department of Finance. 1998.

RDP, including meeting basic needs, developing human resources and increasing participation in democratic institutions.

The strategy is designed to integrate many aspects of development and includes the following components relevant to sustainable development:

- A renewed focus on budget reform to strengthen the redistribute thrust of expenditure[56]
- A reduction in tariffs to contain input prices and facilitate industrial restructuring, compensating partially for exchange rate depreciation
- Tax incentives to stimulate new investment in competitive and labour absorbing projects
- An expansionary infrastructure programme to address service deficiencies and backlogs
- A strengthened levy systems to fund training on a scale commensurate with needs

Although both the RDP and GEAR mention monitoring, few detailed indicators are provided. This makes progress in achieving the aims of the RDP and GEAR difficult to measure. There is however a move towards a national monitoring and evaluation system through the State of the Environment Reports developed by the Department of the Environment and Tourism (DEAT).

National State of the Environment Report

The National State of the Environment Report was initiated in 1999 in order to understand the condition of the environment and underlying causes of environmental change in South Africa. The report is consistent with an international move towards State of the Environment reporting. This enables countries that have adopted Agenda 21 to report on sustainable development progress. The report provides detailed information on the current state of the biophysical components of the environment and on the social, economic and political activities that impact on these resources.

The aims of the report are listed as follows:

- Provide access to environmental information that has been integrated, analysed and interpreted for government and other agencies to enhance decision making and sustainable development planning
- Provide information for global environmental monitoring and assessment
- Increase public awareness of environment and development issues

[55] Department of Finance. 1998. p 1
[56] Department of Finance. 1998. p 2.

- Enhance understanding of environmental issues, rights and responsible actions; thereby encouraging individuals, communities and organisations improve their quality of life.

The initial 1999 State of the Environment report provides a summary table of key aspects describing the state of the environment. This is provided below.

Table Two: South Africa State of the Environment Report, 1999 [57]

Ecosystem Component	**State**
Habitats	25% of terrestrial habitats have been transformed for cultivation of crops, forestry and human settlements 50% of wetlands have been transformed for cultivation of crops, forestry and human settlements 5% of terrestrial habitats have been degraded through over-use and poor management 8% of terrestrial and riparian habitats have been heavily infested by alien vegetation
Biological resources	15% of plant species are threatened 14% of bird species are threatened 24% of reptile species are threatened 18% of amphibian species are threatened 37% of mammal species are threatened 22% of butterfly species are threatened
Physical Resources	Only 8.6% of the annual rainfall is available as surface water All major rivers have been dammed or modified to meet the demand Demand for water is projected to increase by 50% in the next 30 years Forestry uses 3% of mean annual run-off Alien vegetation uses 7% of mean annual run-off 17 million ha of cultivated areas are afflicted by erosion Soil is lost 8 times faster than it is being generated
Chemical processes	Carbon dioxide, nitrous oxide and methane levels are increasingly slightly Levels of sulphur dioxide are stable UVB radiation exposure levels are dangerously high for most of the year 2.6 million m^3 of waste domestic and commercial water is treated everyday

[57] http://www.ngo.grida.no/soesa/

	Over 42 million m^3 of solid waste is generated every year A shortage of landfills sites in 5 provinces is predicted in the next 10 years Over 5 million m^3 of hazardous waste is generated every year, most of which never reaches a proper disposal site Most rivers have eutrophication problems Toxic pollutants from sewage and industrial effluents are accumulating in the food chain
People	The total population was 40.6 million in 1996 The populations is growing at 2% a year 50% of South Africans live in towns and cities Nearly 50% live in informal dwelling 45% do not have access to clean water Only 60% have access to electricity 24% of the workforce was unemployed in 1996 Approximately 16% of South Africans are functionally illiterate 20% of households have incomes less than R500 per months Clinic:patient ratios across the country are 1:22,000 Nearly 20% of the workforce is HIV positive Inflation rate is 6% Growth in GDP was 0.5% in 1998

Since the original State of the Environment Report was developed in 1999 a more comprehensive framework has been developed. This has been included in Appendix five.[58]

Review of Local Context

A review of the national policies and indicators is illuminating for a number of reasons. Firstly, this provides an understanding of the different priorities that governments in developing countries have compared with developed countries. Secondly, it provides a picture of the likely trends and changes in priority that may occur as a country becomes more developed. Finally, it provides an understanding of the context, and problems, that interventions designed to support sustainable development in developing countries, will need to address. These aspects are explored in more detail below.

Defining sustainability and the role of government: In the policies reviewed it is useful to note the differences in the way governments see their role and define sustainable development. The UK suggests that a key aspect of sustainable development is quality of life. It then states that it is government's role to improve the quality of life for its citizens. It makes itself accountable for this role by developing indicators and reporting progress in relation to

[58] http://www.environment.gov.za 17/12/0217 15:30

this. The policy also suggests that government should be sending out the right messages by reporting on: the 'greenness' of its own operations, the number of women employed in senior posts, the level of overseas development aid provided, and number of international environmental treaties signed.

This is different in South Africa where there are a range of policies on development and on the environment, but none, as yet on sustainable development. The role that government ascribes for itself in the RDP is as a facilitator of transformation. It aims to restructure many aspects of the society, the economy and government in order to ensure that this is more representative of society and equitable. Government however does not appear to want to take responsibility for development and suggests that this needs to undertaken by civil organisations. There are also limited, publicly available, targets or indicators that can be used to assess the impact or effectiveness of government.

In order to implement sustainable development effectively it therefore appears that South Africa requires a policy on sustainable development that links social, economic and environmental aspects and has a set of indicators. Government should also make themselves accountable, as a whole, for progress in terms of these indicators. Without this it is difficult to see how different sectors of government and the private sectors will work together to implement effective and integrated programmes that support sustainable development.

The economy: The policies of both the UK and South Africa consider the economy as a vehicle for improving people's lives. They both suggest that economies and approaches should become more people centred. They however differ in approach. The UK has an emphasis on making business more sustainable through encouraging business to adopt ethical trading codes and environmental management systems. This aspect seems to be largely absent in South Africa where the emphasis is strongly on growth and employment. For instance, an objective of GEAR is to provide:

Tax incentives to ensure stimulate new investment and in competitive and labour absorbing projects.[59]

There seems to be openness in the UK policy to questioning economic models. For instance, the policy suggests that GDP is a poor indicator of progress and that changes in economic systems could encourage resource efficiency:

Sustainable Development requires global economic systems, which supports economic growth in all countries. We need to create conditions in which trade can flourish and competitiveness can act as a stimulus to growth and greater resource efficiency. [60]

[59] Department of Finance. 1998. p 2

This is different in South Africa where the main concern appears to be developing correct survival techniques with which to the weather the negative consequences of the international economic systems. For instance, an objective of GEAR is to reduce the impact of exchange rate depreciation.[61]

Indicators: There are strong differences in the approaches developed by South Africa and the UK to using indicators**.** In the UK the overarching aim of the Sustainable Development Policy 'To improve quality of life" is broken down into a number of objectives such as "Doing more with less" and "Economic stability" and "Competitiveness". Attached to each of these objectives are indicators that can be used to measure the rate of progress towards the achievement of objectives. The indicators in the South African State of the Environment report generally appear to be designed to capture existing states, rather than to measure progress in a particular direction. They also appear to assess negative aspects of the environment, the economy, and society. For instance, many of the society indicators are organised under the heading of 'Vulnerability'. This reinforces the perspective that developing countries have many problems and needs rather than suggesting that there are opportunities, which can, and should be, used to move South Africa to a more sustainable state.

The UK indicators are also closely linked to a policy on sustainable development. This is not the case, in South Africa where the State of the Environment report does not appear to relate to any particular South African policies and is only loosely related to Agenda 21. It is particularly odd that these indicators do not align with the RPD and GEAR as these are meant to inform all aspects of development in South Africa. For instance, both the RDP and GEAR list employment and the support of small businesses as a priority. The State of the Environment report includes only one indicator for this area. This compares to the UK report, which provides a wide range of indicators, including the following:

- New business start-ups net of closures
- Labour productivity
- Proportion of people of working age who are in work
- Proportion of people of a working age in workless households
- Proportion of people of a working age out of work for more than two years
- Proportion of lone parents
- Long-term-ill and disabled people who are economically active
- People in employment working long hours
- Low pay
- Work fatalities and injury rates

---

[60] http://www.sustainable-development.gov.uk/uk_strategy/quality/life/09.htm 17/11/0217 15:30
[61] Department of Finance. 1998. P. 1

- Working days lost through illness
- Ethnic minority employment and unemployment.

The emphasis in the selection of indicators for the South African State of the Environment report appears to be heavily in favour of environmental indicators, some of which appear to be of little value. For instance, of the 19 sets of indicators listed, only 2 sets appear to be directly related to social aspects and none to economic aspects. Another example is the inclusion of an indicator of the contribution to job creation of conservation areas. The value of this indicator, given its significance in terms of a proportion of the total employment market, is questionable. A number of the indicators also appear to be difficult to measure, for instance there is an indicator of government capacity for environmental management. It is unclear how this is measured.

The type of the society: Both UK and South African policy make statements about the type of society that they aim to develop. The UK policy aims to have no social exclusion, poverty, poor housing and unemployment. In addition, it aims to protect aspects that are seen to improve the quality of life such as wildlife, landscapes, historic buildings and access to culture and sport.[62]

South African policy paints a picture of a democratic, non-racial and non-sexist society that is actively involved in the development of the country. A fundamental aspect of picture is that there is freedom, and that people's essential needs are met.

An interesting aspect of the UK policy is the consideration given to all citizens. This states that access should be given to a range of facilities in order for people fulfil their potential:

Everyone should have the opportunity to fulfil their potential through access to high quality public services, education and employment opportunities, decent housing and good local environments[63]

There is also an indicator on the consumer information, which aims to empower people in encouraging change in the market. In addition there are indicators for access to services in rural areas, and by disabled people. Communities and social interaction are assessed through indicators on voluntary activities and community spirit.

Education: Both the UK and South Africa policy regards education as important. In the UK this is seen as key to maintaining a competitive edge:

---

[62] http://www.sustainable-development.gov.uk/uk_strategy/quality/life/09.htm forward 17/11/0217 15:30
[63] http://www.sustainable-development.gov.uk/uk_strategy/quality/life/09.htm forward 17/11/0217 15:30

….. we need a workforce that is equipped with the education and skills for the 21st century [64]

The UK encourages businesses to support education through its 'Investors in People' award and have developed a number of indicators that reflect levels of awareness of sustainable development within the general public. South Africa places a strong emphasis on enabling access to education and through a levy, aims to support increased levels of training and education in the workforce.

Role of infrastructure & technology: There are different perspectives in relation to the human environment. In the UK there is an emphasis on the quality of the environment. There are, for instance, indicators for the quality of the environment and energy efficiency in housing. In South Africa the emphasis is on security and productivity:

An environment in which homes are secure and places of work are productive [65]

Both countries view infrastructure as a mechanism for supporting development. There are differences, however, in emphasis. In the UK, infrastructure is seen as part of a productive machine that supports the economy. It is therefore important that the right type of infrastructure is developed to support competitive industries:

…*we need businesses ready to invest and an infrastructure to support them* [66]

It is also important that this infrastructure is of good quality and efficient. For instance, there are indicators on the thermal efficiency of housing stock, household water usage and municipal water wastage. This extends to the technology used in infrastructure; for instance, there are indicators for the efficiency of appliances and motor vehicles.

In the UK policy there also appears to be growing awareness of the long-term impact of infrastructure. This has lead to an increased interest in urban design and planning and an increasing requirement for denser more efficient development. There are, for instance, indicators on new homes built on previously developed land, and new retail floor space in town centres and out of town. There is also a wish to ensure that existing infrastructure is managed well and used efficiently. This has lead to indicators being developed for vacant land and properties, for derelict land, and for working days lost through illness.

In South Africa the development of infrastructure is seen as necessary in order to address inequitable distribution of services. The RDP aims to provide everyone with access to electricity, water, telecommunications, transport, health, education and training. Infrastructure

[64] http://www.sustainable-development.gov.uk/uk_strategy/quality/life/09.htm forward 17/11/0217 15:30
[65] Department of Finance. 1998. p 1
[66] http://www.sustainable-development.gov.uk/uk_strategy/quality/life/09.htm forward 17/11/0217 15:30

is also seen as a means of growing and shaping the economy by opening up previously suppressed economic and human potential and by providing jobs.

There is little reference to the quality of the infrastructure to be developed other than this should be 'secure' and 'productive'. However there are guidelines about how this should be developed. Infrastructure programmes should actively involve citizens who will participate in making the key decisions:

..the RDP will encourage and support the participation of people in key decisions about where projects should be and how they should be managed [67]

This aspect is in line with UN recommendations.[68] However it is concerning to note that there is no mention of complementary scientific and rational planning processes. The sole use of participatory process is likely, it is suggested, to lead to the development of poorly planned, and managed, infrastructure.

The selection of the indicators for South African State of the Environment report is biased heavily towards environmental issues. For instance, there are indicators for green space in settlements, contaminated land, and housing density. The indicators however do not appear to take into account the quality and safety of the environment from the user perspective. For instance there are no indicators on safety and security in settlements or for the affordability of energy and transport.

The science of sustainability: In the UK it appears that there is a growing awareness of the science behind sustainable development. This science recommends that design of interventions and development should be carefully considered because of the importance of the order, and of the many interlinked aspects, of sustainable development:

…For instance, the economy will not grow unless we modernise our education system and our infrastructure. We need to think about the location of our housing, as well as its quality, to reduce the need for car travel and to encourage urban regeneration. The links between transport, health and the environment show how we can all too easily reinforce damaging trends. Such links underline the need for integrated polices, rather than tackling issues individually[69]

In South African policy the emphasis seems to be on addressing immediate needs as quickly as possible and there does not appear to be a strong attempt made to develop highly interlinked and coordinated programmes. There also does not seem to be much consideration

[67] Office of the President. 1994. P. 6
[68] http://www.johannesburgsummit.org/index.html 11/11/02 10.32 (see also appendix three)
[69] http://www.sustainable-development.gov.uk/uk_strategy/quality/life/09.htm

given to the long-term impact of development. Thus although the policy may provide immediate remedies to some of the existing problems, it may also result in infrastructure that is, in the long term difficult, to sustain.

2.2. Addressing Hypothesis One

An initial review of the context of sustainable development vindicates Hypothesis one, by indicating that there are important and useful concepts within this field for the study. These concepts are discussed below and summarised in the conclusion section that follows this.

The structure of policy: In order to support sustainable development it appears that policy needs to be structured in a particular way. There appears to be a requirement for two components namely, a policy document, and a system of indicators. The policy document should include a definition of sustainable development, which informs the development of a clear overarching aim. This aim should then be broken down into a set of objectives. Each of these objectives can then have programmes with specific timelines, deliverables and responsibilities linked to them. These objectives should also have linked indicators, which can be used to measure progress in the achievement of objectives.

It is important that the policy has a clear vision of what a ‘state of sustainability’ is and expresses this clearly. This should also be used to inform the development of indicators that assesses progress down this path to this state of sustainability. For example the vision for the ‘state of sustainability’ may be that all farming is to be organic – this requires an indicator that assesses progress towards achieving this objective. It is important to realise that current knowledge does not allow this ‘state of sustainability’ to be fully described given the complexity of interactions between human and biophysical systems. However it is important to ensure that this is described in adequate detail to ensure that development moves in broadly the right direction.

In order to implement policy, a clear strategy with roles, responsibility and accountability must be provided. Within this there must be an iterative mechanism that monitors progress towards particular objectives and enables changes to be made where progress is not being achieved. Where a wide range of stakeholders are expected to support and participate in implementing a policy it is particularly important that policy is easy to understand and provides clear direction as to what actions are to be taken. For instance, if adult literacy is seen as important, there could be an indicator that assesses the accessibility of adult education classes. This would enable progress towards achieving accessible adult education to be measured. Expressing the objective and the indicators clearly can help in drawing other parties in and encourage them to contributing to objectives set.

Placing people at centre: Both the sustainable development policies reviewed refer to the concept of placing people at the centre. This means seeing development, the environment, the economy and society from the perspective of citizens and understanding the needs of people. It requires an understanding of what is seen as ‘fulfilment’ by people. This must be understood from the perspective of a wide range of people including old people, youth and disabled and uneducated people. In addition to understanding these perspectives, research must be taken to understand the obstacles that should be overcome in order to address needs and enable fulfilment. When these obstacles are understood programmes and policy should be developed to ensure that these obstacles are removed where they currently exist and are considered and addressed in new developments. This aspect is important to note in the study because it suggests that ‘placing people at the centre’ may be an important concept to address in ensuring that buildings and construction support sustainable development. It also provides some guidance on how this concept could be included in building and construction processes.

The science of sustainability and infrastructure: It is clear that a science of sustainability is emerging. This is providing the flesh to the vision of a ‘state of sustainability’ mentioned above and includes recommendations about how we should live and work. It is especially relevant for the design and management of infrastructure and can increasingly guide this. However there may be conflicts between scientific recommendations and what people may desire. For instance people may want to live in low-density suburbs whereas high-density apartment living may be scientifically shown to be more sustainable. How this conflict be addressed, especially, if having ‘people at the centre’ is acknowledged as a key tenet of sustainable development becomes important.

There are a range of implications for infrastructure beginning to emanate from the science of sustainability. This suggests that infrastructure is an integral component of the economy. If designed and managed correctly, infrastructure can, not only make the economy more competitive by reducing costs, but also more resource efficient. In a similar way towns. if designed correctly, can not only reduce commuting costs, but also improve the quality of life by, for instance, enabling adults and children to walk safely to work and schools.

From the science of sustainability it emerges that not only should interventions to support sustainable development be of a certain type, but that the sequence of these interventions is also important. This has strong implications for how development programmes should be designed and implemented. It may mean that development and interventions should take into account the perspective of a wide range of stakeholders including people that will be directly affected and surrounding communities. It also suggests that the needs and opportunities within the area need to be properly understood. Once this has achieved, a likely response is the development of a multi-strand programme that has the strong support of the people that it

will be addressing. This programme will consist of a range of integrated interventions designed to support the development of an intricate network of mutually supportive elements, which ultimately lead to sustainable state.

A scientific approach to sustainability suggests that a holistic approach is important. For instance, not only must the design performance of new developments be addressed. It is also important to ensure that the eventual management and maintenance processes of infrastructure are also considered at an early stage of a development. Existing developments must also be efficiently used. This is reflected in the UK indicators for derelict land and unused buildings.

The stages of sustainability: Sustainable development can be described as the path towards a state of sustainability. Moving along this path is a dynamic process, which passes through a range of different stages. Each of these stages requires issues to be addressed before progress can be made to the next stage. Different countries are at different stages in terms of progressing towards a sustainable state. More developed countries are not necessarily at a more advanced stage than developing countries in terms of this progression. Developed countries have addressed their population's basic needs but may have developed infrastructure and processes that are unsustainable in the long term because they are highly wasteful or reliant on non-renewable resources. This must be addressed through redesign and reconstruction, technological interventions and organisational change before the country can progress to a more advanced staged in the path towards sustainability. Developing countries may on the other hand be at a very similar 'distance' away from a sustainable state as developed countries but are moving towards this from a different location. Developing countries may not have developed highly wasteful infrastructure yet but they also are likely not to have addressed the basic needs of their populations. Therefore in order for these countries to move to a more advanced stage of sustainability the basic needs of their resident populations must be addressed as a priority.

There are a number of implications from this for the study. Firstly, different countries need to address different aspects of their context and stage of development before they can move along a path towards a state of sustainability. A second aspect is that the path towards a state of sustainability is not the same for all countries; developing countries do not have follow the same developmental route as developed countries, they can take a different, more direct, route towards achieving a state of sustainability. Thus, it is important for developing countries to begin to chart a different developmental route so as not to make the same mistakes as have been made by developed countries. The challenge for developing countries is that charting this route, and progressing along this, will require different processes and tools than those used by developed countries.

The implication for this study is that the priorities that construction and buildings need to address in order to support sustainable development in developing countries are different from those in developed countries. This implies that the type of tools, processes, indicators and emphasis in application may also be different.

2.3. Concluding Hypothesis One

The hypothesis that the international and local context of sustainable development can inform study is demonstrated through the development of a number of key concepts which will be used in Chapter five to develop the specification of an assessment tool. These concepts are listed below:

Policy context: An understanding of the policy context is important. This is required for the study because any interventions suggested by the study will have to take into account government and international policy and work with this. This may mean supporting the implementation of policy that supports sustainable development or addressing gaps in existing policy and implementation. In many cases sustainable development policy is not easily applied to buildings and construction, work therefore needs to be done in order to understand the implications of policy for buildings and translate these into practical, and easily implemented, actions. It is important however that interventions designed to support sustainable development are not constrained by existing policy. For instance, if sustainability within a current economic system is deemed impossible, interventions should be made to support a move towards more sustainable models, even if this is not acknowledged, or supported by, current policy.

Interpretation and application of policy: Existing UN policy on sustainable development is generic and complex. In order to apply this to the building and construction field it needs to be simplified and interpreted. The World Summit on Sustainable Development Plan of Action can be interpreted and simplified in to a set of social, economic and environmental sustainable development objectives. These are:

Social Sustainable Development Objectives[70]

- **Access:** Ensure that development supports increased access to land, adequate shelter, finance, information, public services, technology and communications, where this is needed.
- **Education**: Ensure that development improves levels of education and awareness, including awareness of sustainable development.
- **Inclusive:** Ensure that development processes and benefits are inclusive.

[70] A table showing the development of these objectives from the WSSD Plan of Implementation is provided in Appendix three.

- **Health, safety and security:** Ensure that development considers human rights and supports improved health, safety and security.
- **Participation:** Ensure that development supports partnerships, social interaction and involves, and is influenced by, the people that it affects.

Economic Sustainable Development Objectives

- **Employment and self employment:** Ensure that development supports increased access to employment and supports self employment and the development of small enterprises.
- **Efficiency and effectiveness:** Ensure that development (including technology specified) is designed and managed to be highly efficient and effective, achieving high productivity levels with few resources and limited waste and pollution.
- **Indigenous knowledge and technology:** Ensure that development takes into account and draws on, where appropriate, indigenous knowledge and technology.
- **Sustainable development accounting:** Ensure that development is based on a scientific approach which measures and monitors social, environmental and economic impacts and this is used to guide development.
- **An enabling environment:** Develop an enabling environment for sustainable development through the development of transparent, equitable and supportive policies, processes, and forward planning.
- **Small-scale, local and diverse economies:** Ensure that development supports the development of small scale, local and diverse economies.

Environmental Sustainable Development Objectives

- **Size, productivity and biodiversity:** Ensure that development conserves or increases the size, biodiversity, and productivity of the biophysical environment.
- **Resource management:** Ensure that development supports the management of the biophysical environment to ensure that this is not adversely affected.
- **Resource extraction and processing:** Ensure that development minimises the use/support of environmentally damaging resource extraction and processing practices.
- **Waste & pollution:** Ensure that development manages the production of waste to ensure that this does not adversely affect the biophysical environment.
- **Water:** Ensure that development manages the extraction, consumption and disposal of water in order not to adversely affect the bio-physical environment
- **Energy:** Ensure that development manages the production and consumption of energy in order not to adversely affect the biophysical environment.

Interventions: There appears to be a particular set of components and structure required for intervention frameworks or plans of action designed to support sustainable development. These includes a simple overarching goal that is cascaded into a set of integrated objectives. These in turn are linked to a set of indicators that are used to monitor on progress towards the achievement of the objectives. Intervention frameworks must be carefully designed in order to ensure that interventions planned occur in the right order and are mutually supportive. This is because sustainable development is incremental and holistic.

Developed countries and developing countries: There appears to be clear difference in the context, priorities and policies of sustainable development between developed countries and developing countries. The implications of this are that interventions to support sustainable development in developing countries should be different from those used in developed countries. It also appears that there is an opportunity to avoid making the same mistakes as developed countries by developing a sustainable development path that 'short cuts' many of the problems (in relation to sustainability) of conventional development paths. This sustainable development path for developing countries however has not been clearly defined and developed.

Developing country sustainable development priorities: A key sustainable development priority in developing countries is to ensure that the basic needs of its citizens such as food, safety and employment, are met. It is also important that development designed to meet these needs involve, educate, and empower, people in order to ensure that impact can be multiplied, and is sustainable.

3. UNDERSTANDING SUSTAINABILITY

The problem we face is not so much a management problem as a design problem. In order to develop a sustainable society we need to describe a system of consumption and production in which each and every action is inherently sustainable and restorative.[71]

3.1. Sub Problem Two and Hypothesis Two

Sub problem: What are key concepts in sustainability that are useful in understanding how buildings and construction can support sustainable development?

Hypothesis: Concepts from sustainability can inform the development of a specification for an assessment tool that aims to integrate sustainable development into building briefing and design processes.

3.1.1. Introduction

There are numerous definitions of sustainability.[72] In this chapter a number of these definitions are reviewed in order to understand the concept of sustainability. It is suggested that these definitions can be grouped in to sets. These groupings are used to explore the idea of sustainability in some detail and enable the study to develop a description of the characteristics of sustainability.

A review of sustainability enables the study to be informed by theory in this field. It also helps locate buildings and construction within the sustainability discourse. An exploration of sustainability is valuable as it assists in the defining of the goal of sustainability that buildings and construction should aim for. It also offers models and approaches that can be drawn on to support the achievement of this goal.

A review of the definitions of sustainability reveals a number of patterns. The first pattern is that many definitions that attempt to describe *what* sustainability is, share a concern about ensuring that the *environment, development or systems need to be designed and maintained to provide for existing human populations as well as for future populations*. The second pattern, is that definitions that tackle *how* sustainability can be achieved, generally agree that this will have to be *pursued simultaneously, and in an integrated way across social, economic and environmental arenas.*

Studies in sustainability often investigate how different systems interact and interrelate. In order to understand this, systems are broken down, and studied, in their individual

[71] Elkington. 1997. p. 38
[72] Bell and Morse.1993. p.10

components. This can be called a ‘bottoms up’ approach. However when one looks at the overall characteristics of these interacting systems or components, properties appear that could not have been predicted from only a study of the isolated parts. These properties, defined as emergent properties, also need to be understood. This requires a ‘top-down’ approach. Therefore, the study of sustainability could be said to require both a top-down as well as a bottom-up approach.

To reflect these patterns the literature review on sustainability will have two main sections. The first will be concerned with developing a broad definition and understanding of sustainability. This will be done by reviewing a range of general definitions of sustainability, such as those developed by the United Nations. This establishes the top-down view of sustainability The second part of the review will develop a more detailed understanding by exploring definitions of sustainability within the social, environmental and economic arenas. This will develop a bottom-up view.

3.1.2. Sustainability: A General Definition

Sustainability

The Oxford English Dictionary defines ‘to sustain’ as ’to keep a (person or community, the mind, spirit etc) from failing or giving way ‘ or ‘ to keep in a state of being; to cause to continue in a certain state; to keep or maintain a proper level or standard’.[73]

Using this definition two questions can be explored. The first asks what is the entity that needs sustaining? The second asks what should its requisite state be? We can use these questions as a way of reviewing definitions of sustainability, so as to extract characteristics of sustainability from these definitions.

General definitions of sustainability appear to fall into two camps. One set has an emphasis on systems and how these can, and should be, maintained and developed. These can be referred to as Systems definitions. A second set has an emphasis on humans and their existing and future needs. These can be referred to as Human Development definitions.

Systems Definitions

Sustainability can be understood very simply, at a practical level, as ways and systems that are ongoing. For example, Pearce uses an example of fisher people or foresters who understand that yields are sustainable so long as they harvest fish and trees at a rate equal to the growth of biomass.[74] Using our general definition questions, the entity in this definition would be the environment and desired state would be one in which the consumption of fish or trees match the ability of the environment to provide these.

---

[73] Little, Fowler and Coulson. 1998.
[74] Pearce.. 1993. p.3

Another systems definition is by Lynam and Herdt:

…The capacity of system to maintain output at a level approximately equal or greater than its historical average, with the approximation determined by the historical level of variability[75]

The entity in this case is the system and its required state is to maintain output at equal or greater than it has in the past. This definition brings in the concept of time and productivity. It suggests that it is important to have an output, and that this output must be fairly steady over time.

Pearce and Turner, in their definition place a strong emphasis on outputs. Here they state that productivity must be optimised within limits that relate to natural resources:

…maximising the net benefits of economic development, subject to maintaining the services and quality of natural resources over time.[76]

The entity in this case is a system, and the required state is one in which optimal economic benefits are provided. These benefits however, he maintains, must be achieved without affecting the quality and services of natural resources. This definition indicates that limits are important and that these must be defined, if a sustainable system is to be created.

Fresco and Kroonenberg suggest that sustainable systems are variable and can be affected by change such as climate change:

The sustainability of natural ecosystems can be defined as the dynamic equilibrium between natural inputs and outputs, modified by external events such as climatic change and natural disasters.[77]

In this description the entity is an ecosystem and its required state is that the ecosystem maintains a steady state. This definition shows that an important characteristic of a sustainable system is the ability to maintain a steady state. This state however, may be redefined by changes such a climate change or natural disaster.

It is clear that a review of these patterns reveal a number of characteristics of sustainability. These are summarised at the end of the chapter. It is also apparent that ecosystems, in their natural state are sustainable and that it is important to understand these better in order to

[75] Lynam and Herdt. 1989. p 381-398
[76] Pearce and Turner.1990
[77] Fresco. and Kroonenberg. 1992. p. 161-170

create sustainable systems. This will be done in the review of environmental sustainability later in this chapter.

Human Development

In the human development set of definitions, the concept of sustainable development is often referred to. For instance:

Sustainability reminds us that there are future generations, ..and that we can very easily shift unacceptable burdens on to them. Sustainable development, as opposed to sustainability, reminds us of other social objectives, most notably the plight of the poorest in the world.[78]

The entity in this case is development, and its required state should be one that ensures that the poorest people and future generations should be considered. Development is normally defined as a process of evolving, or the production of a new form. This definition therefore suggests that man, in evolving or designing all new forms and processes, must take into account certain considerations, which include the poor, and future generations. This definition is extremely broad and has significant implications. It suggests that there should be a fundamental change in the way in which development occurs.

This also reflected in other definitions. Probably the most well known definition comes from the World Commission on the Environment (WCED). Here sustainable development is described as:

…development that meets the needs of current generations without compromising the ability of future generations to meet their needs and aspirations.[79]

The entity in this case, is again, development. However the required state for development is that it meets the needs of current generations. The definition also suggests limits, in this case, that needs should be provided for in a way that also enables future generations to meet their own needs and aspirations. This definition raises the question as to what is defined as 'needs', and 'aspirations'. These clearly will be defined differently by different societies, and will differ widely between developing countries and developed countries. The concept of 'needs' and 'wants' will be explored further in the section of sustainable economics, later in this chapter.

The WCED definition is qualified by suggesting that needs should be *essential* and that our ability to meet these needs is limited by *technology* and *social organisation*:

[sustainable development] *contains within it two key concepts:*

---

[78] Pearce. 1993

[79] World Commission on the Environment and Development. 1987. p. 43

The concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority must be given
And
The idea of limitations imposed by the state of technology and social organisation on the environment's ability to meet present and future needs.[80]

This definition dwells at some length on limits and seems to imply that if we can change our social structures and develop different technology we will be able to meet our own as well as the future needs of others. This idea is particularly relevant to this study as there is a close relationship between technology, social structure and building and construction. This aspect will be explored further later in the chapter.

The International Union for the Conservation of Nature (IUCN) provides a similar definition to that of the WCED:

…. development that improves the quality of human life while living within the carrying capacity of supporting ecosystems.[81]

However in this definition the required state for sustainability is to improve the quality of human life. This must happen within limits, in this case the carrying capacity of the supporting ecosystem. This definition raises the question of how quality of life is defined. This will be explored further in the sections on social and economic sustainability later in this chapter. This definition introduces the concept of carrying capacity. It suggests that in sustainable systems it is important to define the carrying capacity and ensure that this is not exceeded. Having reviewed these definitions it is useful to summarise the definitions in the form of a table (Table One).

Table Three: Sustainability Definitions

Source	Entity	Required State	Limits
Pearce	Fisherman and Foresters and their Environment	Provision of fish and trees for man	Ability of environment to provide biomass
Lynam & Herdt	System	To provide output	Output must be same or greater than in the past
Pearce & Turner	System	Maximise economic benefit	Maintain quality and services of natural

[80] World Commission on the Environment and Development. 1987. p43
[81] International Union for Conservation of Nature. 1991.

			resources
Fresco & Kroonenberg	Ecosystem	Dynamic equilibrium between inputs and outputs	Balance could be altered climate change / natural disasters
Pearce	Development	Avoid placing burdens of future generations, addressing the poor	
WCED	Development	Meets need of current generations and needs and aspirations of future generations	Environmental ability Technological state Social organisation
IUCN	Development	Improve quality of life	Carrying capacity of ecosystem

3.1.3. Environmental, Social and Economic Sustainability

A review of the main current definitions of sustainability indicates that there are a range of different emphases. In particular there seems to be split between an emphasis on human issues and development and system or ecosystem issues. As buildings have both human and environmental aspects it is important to develop an understanding and definition of sustainability that encapsulates both of these. This will be done through an investigation of environmental, social and economic aspects of sustainability.

3.1.4. Environmental Sustainability

In order to review environmental sustainability it is useful to describe this in terms of the original questions that were applied to definitions of sustainability. We therefore need to define the entity that is to be sustained and the required nature of this entity. In environmental sustainability two entities can be explored. At a very large scale the entity explored could be the planet. Here the state required is the healthy operation of the systems that maintain this. At a much smaller scale the entity explored could be an ecosystem. The state required in this case is the healthy and ongoing operation of all of the aspects that sustain this.

Exploring these entities in this study is appropriate for a number of reasons. The first is that by developing an understanding of planetary systems, the study can begin to understand the relationship between building and construction and planetary systems and begin to establish how the building and construction has an impact on these. This understanding will inform the

study, as it will help establish how buildings and construction can minimise or avoid negative impacts on planetary systems.

The second reason is that buildings are part of ecosystems and have an impact on them. Developing an understanding of ecosystems will begin to define the requirements that buildings and construction will have to meet, to limit or avoid negative impacts on ecosystems. It may even suggest ways that building and construction could enhance the healthy operation of ecosystems.

Thirdly, buildings and man together, can be described as a system. Clues for making this system more sustainable may be found from a study of natural sustainable systems, such as ecosystems.

Planetary Systems

The Earth has been described as a living organism.[82] Although this idea has been controversial it may provide useful insight for developing an understanding of the impact of human activities, and in particular, the built environment, on the Earth. In the Gaia hypothesis, Lovelock illustrates the validity of this view through listing a wide variety of similarities between planetary systems and living organisms. An example given is how the Earth is able to maintain temperature and chemical balances in the face of perturbations, in the same way as living organisms.[83]

Lovelock uses his definition of the Earth as a living organism not only to help understand this but also to suggest a role for man in ensuring its continuing health. He suggests that it is vital to understand more about the earth and to ensure that we begin to understand, and act on, any signs of ill health. This he describes in the following way:

I insist that Gaia theory itself is a proper science and no mere metaphor. My use of the term alive is that of an engineer who calls a mechanical system alive to distinguish its behaviour from when switched off, or dead. Engines on whose proper function many lives depend have health monitors; devices that ensure that signs of failure are detected early enough to avoid a tragedy.[84]

Lovelock is quick however to explain that, unlike man-made engines, man still has a very poor grasp of the mechanics of the Earth as a whole, a field that he refers to as planetary science. He attributes this to the way knowledge has developed in this area. This he calls the ‘bottoms-up’ approach, in which detailed knowledge in specific fields has been developed by specialised disciplines such as meteorology and geology. He suggests that there has been

[82] Lovelock. 1991. p.6
[83] Lovelock. 1991. p. 29
[84] Lovelock. 1991

very little interaction between these highly specialised disciplines preventing the development of a clear understanding of how the planet, as a whole, works. Lovelock indicates that alongside this bottoms-up approach, it is important to have a top-down approach:

This top-down view of the Earth as a single system, one that I call Gaia, is essentially physiological. It is concerned with the working of the whole system, not with the separate parts of a planet divided arbitrarily into the biosphere, the atmosphere, the lithosphere, and the hyposphere. These are not real divisions of the Earth; they are spheres of influence inhabited by academic scientists.[85]

Lovelock asserts that the planet is in a serious state of ill health and that there is insufficient time to develop a full understanding of planetary science before acting to address ill health. He proposes that, as with early medicine, we use empiricism as a method of progressing. The example Lovelock provides is that of the Romans who thought that marshes had 'bad odours' that caused disease, and so drained marshes. This actually got rid of the real problem as well: malaria.[86]

He states that is important to move away from our current way of thinking that tends to be self-centred and short term. This thinking has failed to enable man to see, as part of a much larger system, the real value of aspects of the environment such as the Amazon rainforest or marine algae. For instance, he describes how a popular reason given for not cutting down Amazon rainforest is a fear that a particular cancer curing species of plant will be lost.

Dwelling on these issues, although important, he maintains, often obscures far more important issues. A very important contribution that rain forests make is its global contribution as: "A self regulating system that keeps the climate in the region comfortable for life". A planetary physician, it is proposed, would regard the great forests of the earth as part of the skin of the earth, which like human skin sweats, to keep us cool. If a value was to be obtained for this natural air conditioning, using costs attributable to mechanical systems, Lovelock calculates that this would be within the region of $150 trillion.[87]

True sustainability, Lovelock states, can only occur when we realise our level of ignorance about the Earth and instead of seeing ourselves as masters, and in control of the Earth, we see ourselves as stewards. He describes this in the following way:

I would suggest that our real role as stewards of the Earth is more like that of proud trade union functionary, the shop steward. We are not managers or masters of the earth; we are just stewards, workers chosen, because of our intelligence as representatives for others, the

---

[85] Lovelock. 1991. p.11
[86] Lovelock. 1991. p. 14
[87] Lovelock. 1991. p. 183

rest of life on our planet. …. Indeed all living things are members of our union and they are angry at the diabolical liberties taken with their planet and their lives by people. People should live in harmony with the other members, not exploiting them and their habitat.[88]

There are aspects of Lovelock's work that are relevant to the study. These include the following ideas. Man must become more attuned to the biophysical systems that support life and steward these to ensure they are healthy. A useful way of indicating the value of biophysical systems is to calculate the costs required for a mechanical system to do the same work. To achieve sustainability, action must be taken now, even if full knowledge and understanding within area has not been achieved.

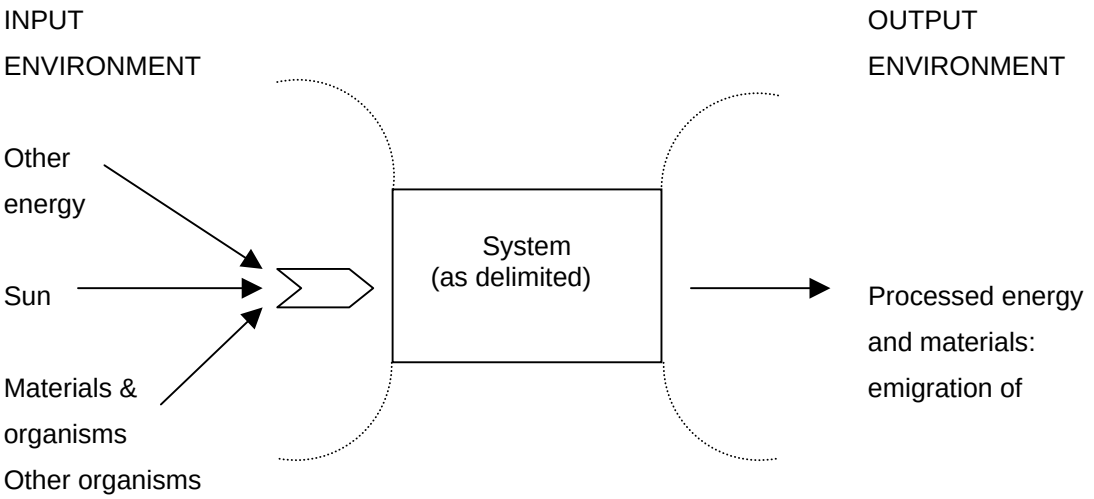
Ecosystems

A number of the definitions reviewed early in this chapter refer to ecosystems. The definition of ecosystems is attributed to Sir Arthur Tansley who described this an organised unit consisting of biotic (living) components and abiotic (non-living) components. This unit is organised in such a way, that although there may be change, and organisms and material may pass through it, it essentially remains constant.

Odum describes ecosystems as an open system in which there inputs (which come from an input environment) and outputs (which come into an output environment).[89] Examples of ecosystems that he provides include a section of beach and a block of forest. An essential component of the input environment is energy, which drives the system. This usually comes from the sun but can come from other sources such as wind, rain or water flow. The input environment may also include water and nutrients as well organisms that enter the system. Out of the system flow emigrating organisms and processed energy and organic matter such as food and waste products. Odum's model of an ecosystem is shown in Figure One.

[88] Lovelock. 1991. p. 186
[89] Odum. 1989. p. 39

Figure One: Ecosystem Components[90]



IE + S + OE = Ecosystem

Odum describes this model in the following way:

Model of an ecosystem as an open, thermodynamic non-equilibrium system, with emphasis on the external environment, which must be considered an integral component of the ecosystem concept.[91]

Odum describes a number of properties of ecosystems. These are reviewed in order to develop a better understanding of systems and extract characteristics of ecosystems that may be useful for guiding the development of more sustainable systems. Where appropriate this will be used to provide an input to the specification developed in Chapter five. Odum describes ecosystems as having the following characteristics:[92]

Ecosystems are emergent. Ecosystems have properties that result from the functional interaction of their components and therefore cannot be predicted from the study of these components separately or decoupled from the whole system. It is interesting to note that an understanding of this property requires the top-down approach suggested by Lovelock.

Ecosystems tend to be governed by homeostatic mechanisms. Odum describes these as 'checks and balances' and gives a number of examples. At a physiological level homeostasis ensures that our body temperature keeps constant despite fluctuations of the external environmental temperatures. At a larger scale, homeostatic integration of biotic and abiotic

[90] Odum. 1989. p. 39
Odum. 1989. p.
[91] Odum. 1989. p. 39

processes of the biosphere keep carbon dioxide and other gas concentrations relatively constant despite large volumes of gases leaving and entering the atmosphere.

Energy - the currency of ecosystems: An understanding of ecosystems, Odum indicates, is aided by models. A model he defines as a simplified formulation that mimics a real-world phenomenon so that complex situations can be comprehended and predictions made. He proposes that the easiest way to model an ecosystem is to chart the flows of a currency that is common to all of its components. He suggests that this currency should be energy. Using this currency he defines different aspects of an ecosystem. There are energy sources like the sun. There are producers that convert and concentrate solar energy, such as plants. There are also consumers (like herbivores) who them use this converted energy to produce higher quality energy.

Ecological niches: Ecosystems exist within a biosphere, which is differentiated, through gradients in its physical factors. For instance, there are temperature gradients from the Arctic to the Tropics. There are also moisture gradients from deserts to the tropical rainforests of the world. Species have developed to occupy specific habitats along these gradients. The particular way that the organism has developed (the way it lives and interacts with other organisms) is called the ecological niche. From this one can see that a range of organisms can occupy the same niche. For instance kangaroos, bison and cattle all occupy the same niche when found in grassland. Organisms with these same ecological niches are termed ‘ecological equivalents’.

Coevolution: A characteristic of communities of organisms that have existed together for a very long time is the way they tend to evolve together. This coevolution often enables them as .a whole, to adapt better to change and enable them to inhabit more extreme ecological niches.

The structure of natural communities in ecosystems: Natural communities also have particular community structures. They tend to have few species that are very common (have large numbers) and a large number of species that are relatively rare. These common species are called ecological dominants. Species that have strong controlling influence, whether dominant or not are called keystone species. The rarer species on the sidelines add greatly to the robustness of the system. This is because if the major species fails as a result of, for instance, physical changes, often a rarer species, more tolerant of change can take its place as the keystone species. This ability to ‘swop players’ is termed redundancy and contributes greatly to the resilience of an ecosystem.

---

[92] Odum. 1989

Carrying capacity: The size of populations within an area will be limited by the ability of the environment to support it. This is termed the carrying capacity of the environment. In biology this is usually defined in terms of the number or biomass of organism that a given habitat can support. It also can be applied to humans. However there are difficulties with this as different populations consume vastly different quantities of resources and energy.

The initial review of planetary systems and ecosystems indicates that there are useful concepts that can be applied to develop a definition of environmental sustainability. This will be discussed and developed in further in Section 3.2, Addressing Hypothesis Two – Environmental, Economic and Social Sustainability

3.1.5. Economic Sustainability

A review of economic theory related to sustainability, sometimes referred to as 'green economics', indicates that there are numerous problems with the current economic system which make it incompatible with the development, and implementation, of more sustainable practices. This section reviews relevant literature in order to develop an understanding of green economics. The review has two sections. The first part reviews the arguments against the current economic systems. The second part attempts to extract a list of characteristics of the green economics in order to understand the implications of this for buildings and construction.

The role of economics can be described as the creation, distribution and consumption of wealth.[93] Conventional economic science asserts that this role is carried out in a neutral value-free way. Green economists suggest that this is not only untrue, but also wrong - if we are to develop more sustainable practices, economics must guide and expose underlying values and assumptions:

The role of economists is as *much to expose the values and assumptions underlying economic choices, as it is to give guidance about the choices themselves*[94]

Green economists argue that economics is a means and not an end and it should be developed to provide for needs of man. They point out that the current economic system only addresses a limited number of people's needs and has a wide range of problems associated with it. They argue that it is highly inefficient, produces large amounts of waste and causes avoidable social and environmental problems. Numerous examples of waste are provided. These include speculation:

Making money independently of productive activity or real wealth creation has become a debilitating virus in the economic system.[95]

[93] Ekins, Hillman and Hutchinson. 1992. p. 30

And the high levels of solid waste and pollution in America:

The solid waste produced by each American is nearly one million pounds of material per person per year.[96]

They argue that the system is not only wasteful of resources it is also wasteful of people. Figures quoted from the International Labour Organisation (ILO) suggest that there are nearly a billion people (about 40% of the world's population) who are unemployed or underemployed.

Many manufacturing systems are also highly inefficient. In the agro-forestry business, often only about 5% of a crop is actually used, with 95% being discarded.[97] In conventional cars, only about 5% of the energy produced by the engine actually is delivered to the wheels and used to propel the car.[98]

Green economists argue that it is increasingly important to move towards a system of economics that improves resource efficiency and values the environment and people. The key priorities for economics should be to ensure that the needs of every person are addressed. The elimination of poverty, it is argued, not only makes sense from a moral point of view, but also from an economic point of view:

Poverty destroys motivation and potential and fosters anger and alienation. Poverty tends to perpetuate itself. The elimination of poverty can be justified on the grounds of both economic efficiency and social justice.[99]

Conventional economics, it is argued, often does not value the most important things, such as people and the environment, probably because these are hard to quantify. Green economists point out that most indexes do not have environmental or social indicators and yet, the World Bank, in a study in 1995 calculated the value of human capital to be three times greater than all existing financial and manufactured capital. They also point to many aspects of life and work, which, by not being quantified and reflected in costs, have perpetuated the involuntary subsidization by everyone of highly inefficient and damaging practices. Hawkins et al provides an example of this from car usage in the United States of America:

---

[94] Ekins, Hillman and Hutchinson. 1992. p. 31
[95] Ekins, Hillman and Hutchinson. 1992. p. 24
[96] Hawken, Lovins and Lovins. 1999. p. 52
[97] Pauli. 1998. p. 23
[98] Hawken, P., Lovins, A., Lovins, L.H. 1999. p. 24
[99] Hawken, Lovins and Lovins. 1999. p. 33

The social costs of driving – related both to the conversion of fuel into smog and congestion, lost time, accidents, roadway damage, land use and other side-effects of driving itself- are largely socialized. 'External' costs approaching 1 trillion dollars a year, perhaps a seventh of the American GDP, are borne by everyone, but not reflected in driver's direct costs.[100]

In conventional economics the environment is often taken for granted and is of little concern. Green economists argue that this will change, as the environment rapidly becomes the limiting factor for future development. Drawing on history, they illustrate how changes in limiting factors in economies cause fundamental paradigm shift because "behaviour that used to be economic becomes uneconomic".[101]

Many Green economists argue that this paradigm shift is beginning to happen. They suggest that increasingly, business and governments are becoming concerned about environmental and social issues, and that this being reflected in the evolution of a new economic system. Terms for this new form of economics differ with Hawkins et al calling this 'Natural Capitalism', Ekins et al, 'Green Economics' and Elkington, 'Triple Bottom Line Accounting'.

Ekins et al suggests that the fundamental priorities for this new system will be the alleviation of poverty and the matching and maintenance of economic systems with optimal ecological size and performance.[102] Key characteristics of a green or sustainable economy are summarised in Section 3.2 Addressing Hypothesis Two – Environmental, Economic and Social Sustainability

3.1.6. Social Sustainability

It is difficult, initially, to see the relationship between social systems and sustainability. However this relationship is vital. As already described, economics for sustainability has a strong emphasis on people. We need to understand which forms of society are more supportive of sustainability and understand what mechanism are required in these to encourage the development and implementation of more sustainable practices. This is important because, without a concerted effort that integrates social and economic systems, more sustainable practices are unlikely to be adopted.

This section reviews literature that describes the role of society in sustainable systems. It has three parts. The first part reviews definitions of human and social capital; concepts widely considered important in establishing how society can support sustainability. This leads to a review of examples, which help describe the role society has to play. Finally, the review extracts a number of characteristics of society that need to be cultivated in order for societies to become more sustainable.

---

[100] Elkington. 1997. p. 349
[101] Hawken, Lovins and Lovins. 1999. p.156 -159
[102] Ekins, Hillman and Hutchinson. 1992. p. 33

Behind economic activity, Elkington argues, there is an invisible structure of beliefs.[103] These guide economics and are often responsible for the particular strengths or weaknesses of a system. Green economists argue that instead of this being invisible, this structure should become explicit and must have as objectives, the restoration and assignation of value to people and the environment. People and characteristics of society, they argue, play a key role in wealth creation. To describe these roles they use the terms 'Human Capital' and 'Social Capital'.

Human Capital

Human capital is a concept, which describes the contribution of health, knowledge, skill and motivation of people to wealth creation.[104] It describes the potential for efficient and directed productivity within people themselves. A person who is healthy, motivated and happy will be more productive than one who is not. In a similar way, a person who is provided with skills and knowledge is likely to be more productive than someone without these attributes.

Social Capital

Social capital describes the contribution of social relationships, trust and cooperation to wealth creation. While human capital emphasizes the productivity of the individual, social capital emphasizes the productivity of the group. Putnam defines social capital and describes its leveraging effect on other forms of capital in the following way:

Social capital refers to the features of social organization, such as networks, norms and trust that facilitate coordination and cooperation for mutual benefit. Social capital enhances the benefits in physical and human capital.[105]

Green economists suggest that investing in social capital has a wide range of benefits including increased capability, reduced friction, and an increased ability to innovate. All of these support the development of more sustainable systems as they enable increased resource productivity, reduced consumption, and more equitable distribution of resources. Fukuyama describes these benefits:

If people who have to work together in an enterprise trust one another because they are all operating according to a common set of ethical norms, doing business costs less. Such a society will be better able to innovate organizationally, since a high degree of trust will enable a wide range of social relationships to emerge.[106]

---

[103] Elkington. 1997. p.139
[104] Ekins, Hillman and Hutchinson. 1992. p. 49
[105] Putnam. 1993. p. 2
[106] Fukuyama. 1995

It is argued that social and human capital are important initial ingredients required in order to begin to move towards sustainability. Societies where there are high levels of social capital and trust are be able to innovate and organize more rapidly in developing and implementing sustainability. Elkington describes this in the following way:

Sustainable development is most likely – and will be achieved at lowest cost to the economy – in those societies where there are the highest levels of trust and other forms of social capital.[107]

Areas where social capital is low however are likely to lag and to continue to suffer from low productivity and waste. Elkington points out that distrust can be equated with tax:

Widespread distrust in society imposes a kind of tax on all forms of economic activity.[108]

Hawkins et al provides a range of examples of how a lack of investment in social and human capital leads to high costs in unproductive areas. As examples, they refer to the security and private police, which is currently the fastest growing industry in the world, and the five million Americans currently in prison.[109]

It is argued, that social and human capital, instead of being ignored, should be central to economics. Elkington points out that if these aspects were quantified, in many instances these are actually likely to be more valuable than economic and manufactured capital. He gives the example of the company Skandia, where intellectual capital is regarded as at least as valuable as financial capital, in providing substantial earnings.[110] This point is argued strongly by Jolly who suggests:

Human capital is a more important factor for achieving economic growth than physical capital.[111]

Having established that human and social capital are important considerations in sustainability, it is useful to review how these concepts can be developed and supported. Green economists argue that there are a number of mutually reinforcing components that contribute to strengthening social and human capital. A number of these are outlined below.

Health and Education

It is argued that people are an important productive resource that should receive continuous investment and attention in order to ensure that they are maintained and enhanced. This

[107] Elkington. 1997. p. 85
[108] Elkington. 1997. page 85
[109] Hawken, Lovins and Lovins. 1999. p.8, 54
[110] Elkington. 1997. p. 88
[111] Ekins, Hillman and Hutchinson. 1992. p. 54

investment should be made into health and education. Ekins et al describe the value of this investment to a productive economy in the following way:

Enhancing human capital becomes an objective of, as well as a measure to, a productive economy through investment in education and training and stimulating work experience.[112]

Morley suggests that investment in social aspects is as important in development as investment in physical facilities:

Motivating, mobilizing, education and training is as important as the accompanying physical investments.[113]

To be fully productive people need to be healthy motivated and appropriately skilled; qualities that need to be constantly renewed. This renewal …should be an integrated part of working life.[114]

Capability and Opportunity

It is argued that everyone needs to be able participate fully in economic development and that this should be not be limited to a few people. As well as being able to have needs addressed it is important that people are empowered and fulfilled by being able to do this themselves:

Power…can yield power over oneself, the ability to fashion and achieve one's own fulfilment. This is the power expressed by the word capability. In Green economics the whole notion of economic "development" boils down to an increase in the capability of the least well off people in society, and thus their ability to satisfy an ever-increasing number of needs.[115]

Ekins et al suggest that there are three requirements for this increase in capability

First, political power must be isolated from economic power. Second, because this will not be entirely possible, the concentration of economic power must be avoided. Third, everybody must have effective access to each of the 4 capitals necessary for production: environmental resources including land: human capital through education and health rights: social and organizational capital, through freedom to organize and agitate, and to live in communities free from disruption: and tools and machines, through cooperative ownership structures and the creation of public infrastructure.[116]

Resource Productivity and Efficiency

---

[112] Ekins, Hillman and Hutchinson. 1992. p. 55
[113] Ekins, Hillman and Hutchinson. 1992. p.125
[114] Ekins, Hillman and Hutchinson. 1992. p. 54
[115] Ekins, Hillman and Hutchinson. 1992. p. 74
[116] Ekins, Hillman and Hutchinson. 1992. p. 74

Many of current systems of production and consumption are highly inefficient. Often they have also been developed to minimize employment. These systems, it is argued, will have to change as natural resources become increasingly scarce and access to employment becomes more important. Hawkins et al and Pauli argue that radically increased resource productivity is possible and that implementing this will solve both environmental and social problems. Pauli suggests that companies, instead of 'downsizing' and looking at ways of minimizing employment should upsize and create additional employment by developing useful by-products and services from areas previously considered waste.[117] Hawkins et al suggest that there are a number of environmental benefits as well as social ones that could be achieved from this approach:

Radical resource productivity slows down resource depletion at one end of the value chain, lowers pollution at the other end and provides a basis to increase worldwide employment and meaningful jobs.[118]

Measurement and Taxation

If changes in society are an important part of moving towards sustainability, tools for measuring and implementing this need developing. A range of measurement systems have been developed which take into social aspects. These include the Human Development Indicator (HDI) and the Index of Sustainable Economic Welfare (ISEW). Useful tools for encouraging change are taxes and subsidies. Hawkins et al point out that many current taxes and subsidies are vestigial, and reduce sustainability, by promoting inequity, inefficient practices and high levels of unemployment. They suggest that it is important for governments to revisit these and change them in order to promote more sustainable practices. This is already happening in Europe where it is suggested:

tax reforms aimed at increasing employment by shifting taxes away from people to the use of resources have started to be instituted.[119]

Creativity

Achieving sustainability with the limited resource and time available will require a high degree of creativity and ingenuity. It will also require motivation and willingness to change. Sustainability will require a radical rethink and redesign of our current systems. Paul Hawkins describes the problem in the following way:

The problem we face is not so much a management problem as a design problem. In order to develop a sustainable society we need to describe a system of consumption and production in which each and every action is inherently sustainable and restorative.[120]

---

[117] Pauli, G. 1998.
[118] Hawken, Lovins and Lovins. 1999. p. 10
[119] Hawken, Lovins and Lovins. 1999. p.14

The problem of sustainability, Hawkins et al suggests, is most acute in developing countries. They suggest however, that through careful design and 'whole-system thinking', it may be possible to develop solutions, which solve many of the existing problems and are sustainable.

In the developing countries of the South, such whole-system thinking is at a premium, because the new pattern of scarcity….abundant people but scarce nature – has arrived early and with a vengeance. For the developing world, most acutely, the relevant question will be: How many problems can be simultaneously solved or avoided, how many needs can be met, by making the right initial choices? And how can those choices be linked into a web of mutually supporting solutions, creating a healthy economic, social, and ecological system that develops both better people and thriving nature.[121]

3.2. Addressing Hypothesis Two

The initial review shows that the hypotheses that literature on sustainability can inform the development of a specification for an assessment tool to be correct as this enables a detailed understanding of sustainability to be developed. It also provides characteristics of sustainable systems. These are discussed below:

Environmental Sustainability

A healthy, diverse, productive environment is vital in sustaining human life. The environment carries out a wide range of functions that support and enable human life. Many of these we do not fully understand. These functions include the following:

- Production of oxygen and absorption of carbon dioxide
- Absorption of waste products and pollution
- Temperature regulation
- Humidity regulation
- Production of renewable natural resources such as food, fuel, building materials etc

For the environment to be effective at carrying out these functions it must to have a range of attributes. These include the following:

Size: Environments and ecosystems have a carrying capacity. This limits the size of the human population it can support on a sustainable basis. It is therefore important that the size and productivity of biophysical systems are matched to, or are preferably larger, than the sizes of the human population they are required to support. The human population has been growing rapidly and levels of consumption have been increasing. The size of the biophysical

[120] Elkington. 1997. p. 38
[121] Hawken, Lovins and Lovins. 1999. p. 288

environment, on the other hand, has been decreasing.[122] This has meant that we have moved from a point at which we were within the earth's carrying capacity to one in which we are now living beyond this. This point according to the World Wildlife Fund occurred in the 1970's.[123] It is therefore becoming increasingly urgent to balance this equation. This will require significant economic and social change in order to reduce the required carrying capacity. Increasing, or at least maintaining, the current size of biophysical environment on the environmental side of the equation is essential, if this balance is to be achieved.

Diversity and complexity: Healthy, highly productive, resilient ecosystems are usually complex and consist of a diverse range of species. There are also a wide range of ecosystems, which have evolved to occupy a wide range of different environments. This complexity and diversity has been vital to enabling ecosystems to accommodate change (such as climatic change). This characteristic is also described as resilience. This ability is extremely important to retain, and enhance, in order to cope with the current climatic changes. Retaining, or even improving, the levels of biodiversity will help increase the chances that ecosystems adapt to changing climate conditions and can continue to support life. This complexity and diversity of ecosystems have also enabled harsh environments (such as deserts) to support ecosystems. With increasing human populations it is likely that there will be increasing pressure on these marginal environments to support human life. It is therefore important to retain and develop ecosystems in these areas.

Productivity: Humans consume large quantities of resources and energy. This can be produced naturally and in a sustainable way by the biophysical environment. With an increasing population it is important to ensure that biophysical environments are as productive as possible. It is therefore important to understand how productivity in terms of the different requirements for human life support can be maintained, and enhanced, in the biophysical environment.

Location: As far as possible the location of life support ecosystems should be close to where they are needed. This is for a number of reasons. Locating natural resources consumed by man close to where these are used reduces the requirement for transportation and the associated negative impact of this on the environment such as the consumption of non-renewable resources and pollution. Ecosystems also absorb and recycle human waste such as carbon dioxide, sewage and organic waste. Locating ecosystems that absorbs this waste close to its production, avoids the need for transportation and reduces possible negative impacts on human health of these products, as they are not allowed to accumulate. Finally, it is useful to have the environmental control function that ecosystems provide interspersed with human habitation as this enables better regulation. This reduces for the likelihood of

[122] World Wild Life Fund. 2000. p. 2
[123] World Wild Life Fund. 2000. p. 1

uncomfortable or unhealthy conditions developing, for instance as a result of the urban heat island effect or high concentrations of pollution in large cities.

Economic Sustainability

Economic systems have implications for sustainability. In many ways economic systems structure the relationships between people, machinery, buildings and the environment. It also provides a value system that drives, and controls, productivity. Increasingly, it appears that existing economic systems are partly responsible for social problems and environmental damage. To become more sustainable it is therefore important that our economic system needs to change. These changes and the characteristics of more sustainable economic systems are discussed below:

Equitable: Economic systems will have to become more equitable. The current structure of the economy provides a number of societies, such as those in developed countries, with a surfeit of wealth while barely providing for the basic needs of other societies. Societies that have a surfeit often are very wasteful. Relative to the number of their members, they consume large amounts of resources and produce high levels of pollution. Societies who do not have enough for their basic needs often rapidly damage the fabric of their society (through, for instance, crime and ill health) and their environments (by, for instance, over grazing, soil erosion and pollution) in their attempts to sustain themselves. This reduces both the carrying capacity of the natural environment and social and human capital within that society. In the long term, this can lead to war and famine, which wealthy countries then have to address through peace-keeping forces and aid, both of which are highly inefficient as they require large quantities of resources and often only have a short term effect. A more equitable system would therefore help reduce the negative environmental impacts of both wealthy and poor societies by reducing waste and avoiding the need to damage the environment by ensuring that everyone was able to provide for their basic needs in a fulfilling and sustainable way.

Local economy: Emphasizing the local economy supports sustainability in a number of ways. It supports sustainability in a very simple way by reducing the need for transportation. This limits the consumption of non-renewable resources and pollution. A more subtle aspect of this is the way it draws on the connections between people and their environments. The local emphasis encourages people to adopt more sustainable practices by ensuring that people experience directly both the negative and positive consequences of their actions.[124]

Complexity and diversity: Economic systems that are sustainable are likely to be complex. This is because they are likely to evolve, like ecosystems, a range of characteristics that enable them to make highly efficient use of resources and to accommodate change. Examples of these characteristics can be seen in the growing field of industrial ecology.

[124] Ekins, Hillman and Hutchinson. 1992. p. 35

Industrial ecology is the science of linking different industries for mutual benefit. This leads to increased efficiencies and reduced waste. For instance a by-product of one industry, such as the ash from a power station can be the input into another industry and used in the manufacture of Gyproc building boards.[125] This increased efficiency has economic benefits as the cost of disposing of waste is reduced. It also has environmental benefits, as there is increased resource efficiency as well as reduced waste and pollution. There can also be social benefits such as increased levels of employment.

Value society: Economic systems can generate wealth in a wide variety of ways. To be sustainable it is important that wealth is generated in a way that values people and encourages and enables them to develop more sustainable practices and habits. This means a priority is ensuring that the basic needs of everyone are met. It also means considering the social impact of different practices as well as developing practices that support a more sustainable society.

Value the environment: The biophysical environment plays a crucial part of supporting human life. However this role is not recognized in our current system and the value of this is not accounted for. In order for the environment to be a part of an economic system its value must be quantified in economic terms. This value must be recognized formally, for instance, through accounting systems, legislation and taxation.

Productivity: Natural resources are limited and ecosystems and environments have a finite carrying capacity. With increasing populations it is therefore important to make the best use of these resources. This means that the economic system must encourage and maintain high levels of efficiency and are effective in providing for human needs while being resource efficient as well as minimizing waste and pollution

Social Sustainability

Human activity is beginning to have a significant impact on the environment. This is resulting in damage to the biophysical environment, which if allowed to continue, will reduce the earth's ability to support human life. It is therefore important that we not only try and preserve existing natural environments and their ability to support life but that we change how we behave. We need to ensure that society that develops activities and habits, which value and maintain the environment. An important first step in this process is ensuring that the essential needs of people are catered for. This helps ensure that there is a balance in society, which will enable and support the development of a balanced relationship between society and the environment. The attributes of this type of society can be described as follows:

[125] Carley and Spapens. 1998. p. 125

Access to capital: Sustainable societies will enable their members to have adequate access to different forms of capital in order to enable them to fulfil their own needs. For example this may mean enabling people to have sufficient access to land (natural capital), start-up capital (economic capital), equipment (manufactured capital), knowledge (human capital) and markets with agreed systems of trading (social capital).

Inclusiveness: Sustainable societies are likely to strive to be more inclusive. This means making sure that people such as disabled people, old people, people with different cultural and educational backgrounds are not marginalized but are included and encouraged to be productive members of society. This supports sustainability through increased social capital and reduced need for additional special facilities and services.

Health: Sustainable societies are likely to strive for high levels of health and wellbeing amongst their members. This supports sustainability by avoiding the negative effects of ill health. Ill health has a negative effect on the environment as treatment of illness can consume large quantities of resources and produce large amounts of waste. Another negative impact is the productivity of the person that is lost.

Education: Sustainable societies are likely to strive for high levels of education and awareness. This will support them in becoming more resourceful and innovative in developing more sustainable practices. It will also increase the awareness of sustainability and it's implications amongst all members and encourages them to adopt more sustainable practices and habits.

Social interaction: Sustainable societies are likely to value social interaction. This encourages increased levels of understanding between members, enabling them to organise themselves more easily. This ability to develop trust and to organize enables societies to become more sustainable as they can tackle problems in a coordinated and integrated manner and are more able to share.

3.3. Concluding Hypothesis Two

The hypothesis that concepts from sustainability can inform the development of a specification for an assessment tool that aims to integrate sustainable development into building briefing and design processes is shown to be true. The review of literature on sustainability has proved to be highly useful.

The review enables a clear understanding of sustainability to be developed. It also enabled detailed descriptions of environmental, economic and social sustainability to be developed. This is valuable for the development of the specification for an assessment tool as it provides a detailed description of sustainability, the goal that the tool aims to support.

The review also provides many concepts about the structure and characteristics of sustainable systems as found in environmental, economic and social systems. As aspect of buildings and construction are found in each of these areas, useful clues as to the nature of more sustainable building and construction systems are provided.

Having discussed the characteristics of sustainable environmental, social systems definitions of sustainability appropriate to the study can be described.

Defining Sustainability

Sustainability may be seen as the science and the art of understanding, developing and implementing systems that enable man and future generations to live within the earth's carrying capacity. Given, that man has already exceeded the earth's carrying capacity the task is an increasingly urgent one.[126] This is not only urgent but also large-scale and will require a concerted, integrated effort across social, economic and environmental systems to be tackled effectively.

Environmental Sustainability

Damage to existing ecosystems must be halted and where possible, damage should be repaired and new ecosystems developed to replace the ones that have been lost. By retaining and developing productive ecosystems it may be possible, over time, to be able increase the earth's carrying capacity and thus make it easier to balance this with human activities. Bio physical environments that support sustainability will include thriving, productive, resilient and adequately sized ecosystems that are well able to provide life support functions for man.

Economic Sustainability

Economic systems have to be developed which enable societies to live within the carrying capacity of the earth. This will mean *doing more with less*. Economic systems will need to be more equitable, more resource efficient and value people and the environment.

Social Sustainability

Societies will need to be more trusting, cooperative and share more. This will avoid wasting scarce resources on crime and defence. They will also need to become increasingly innovative and resourceful – in order to be able to maximise the benefit of limited resources for as many people as possible. Society will require organisation and capacity that enables, and ensures, that it's current and future members' needs are met and are able to live fulfilling lives within the carrying capacity of the environment.

[126] World Wild Life Fund. 2000. p. 1

For buildings and construction to support sustainability it is therefore important to understand the relationship between buildings and construction and Environmental, Economic and Social Sustainability. This understanding must be used to inform and implement changes in order to ensure that buildings and construction actively address and support the development of *Environmental, Economic and Social Sustainability.*

4. A REVIEW OF EXISTING SUSTAINABILITY ASSESSMENT SYSTEMS AND INDICATORS

Behind the formulation of any system of indicators lies some implicit or explicit model of (1) what matters, and (2) the way the world works[127]

4.1. Sub Problem Three and Hypothesis Three

Sub problem: What are the key features of existing sustainable development, sustainability and development assessment systems and frameworks?

Hypothesis: Existing sustainable development, sustainability and development assessment systems and frameworks can inform the development of a specification for an assessment tool that aims to integrate sustainable development into building briefing and design processes.

4.1.1. Introduction

As there is still no precise definition for sustainable development it is difficult to develop a comprehensive and complete assessment system. There is however general agreement on the broad path (sustainable development) that leads towards sustainability and a wide range of indicators have been developed to assess progress down this path.

This chapter will critically review a range of different assessment systems and indicators that have been developed to measure sustainable development progress. This critical review will be undertaken in three parts. An initial section will review international initiatives to develop sustainable development indicator systems. This will be followed by a review of national, local and project indicators systems. This will review initiatives by the United Kingdom and South Africa to develop national sustainable development indicator systems. It will also describe systems developed by non-governmental organisations to assess progress within particular areas, such as the contribution of community to sustainable development. In addition it will review a widely used procedure called the Log frame for development projects. This will be followed by a review of a number of established building environmental impact assessment systems.

The review of assessment systems is carried out to provide an understanding of how these work and inform how an assessment tool should be developed. This will provide a useful input for developing a specification for an assessment tool in the Chapter five. It is also important to review existing building assessment systems in the light of the understanding about the sustainability and sustainable development developed by the study.

4.1.2. International Indicator Systems

There has been a shift in emphasis internationally in the way development is measured. In the past this has had a strong emphasis on economics and used measures such as gross national income, gross national income per capita and gross domestic product.[128] Increasingly, this is moving to systems that include a wider range of measurements and include social and environmental indicators. The UN and a number of non-governmental organisations have identified this type of reporting as crucial to implementing sustainable development effectively.

Agenda 21 Working Indicators[129]

An early initiative on sustainable development reporting is the Agenda 21 set of working indicators. These include three sets of indicators (driving force, state and response) that describe different aspects of the theme described in each of the Agenda 21 chapters. The driving force indicator describes factors that make an impact on sustainable development; the state indicators reflects the current status of aspects within the theme and the response indicators provides a description of the level of response being developed by the country to address this.[130] A table showing these indicators is included in Appendix six.

These indicators have been developed, and their implementation supported, through the Commission on Sustainable Development (CSD), a body set up by the UN to support monitoring of progress on Agenda 21 issues.[131] One of the objectives of this body is to assist countries develop their own 'country reports' which report on progress towards achieving the objectives listed in Agenda 21.[132] These country reports are provided at five yearly intervals, with the last one due in time for the World Summit on Sustainable Development held in 2002.

CSD Theme Indicator Framework[133]

In addition to the working list of indicators the CSD has also developed an indicator framework organised by theme. The organization of these indicators is similar to the system used for in the UK's Strategy for Sustainable Development.[134] The CSD framework is included in Appendix seven of the study.

Both the UK and South Africa have developed 'country reports' in the format required by the UN. However neither country are using this to develop and implement programmes to support sustainable development and have instead produced their own systems.

---

[127] World Bank. 1996
[128] http://www.worldbank.org/data/wdi2002/tables/table1-1.pdf 02/01/03 09:37
[129] http://www.un.org/esa/sustdev/indisd/english/worklist.htm 02/01/03 10:36
[130] The structure of the indicator framework is explained in full at http://www.un.org/esa/sustdeve/indi6.htm 02/01/03 10:36
[131] http://www.un.org/esa/sustdev/csdgen.htm 02/01/03 10:40
[132] http://www.un.org/esa/agenda21/natlinfo/ 02/01/03 10:45
[133] http://www.un.org/esa/sustdev/indisd/isdms2001/table_4.htm 08:47 02/01/03 08:47
[134] http://www.sustainable-development.gov.uk/uk_strategy/quality/lifehtm 18/11/02 09:45

This suggests that the structure and indicators required for Agenda 21 are not considered appropriate for implementing national programmes. This may be because the framework is too complex (there are two many chapters) and that the structure and indicators do not reflect local priorities. For instance, South Africa reported that the indicators used in the UN country report were biased towards developed countries:

…Generally one could argue that the list of indicators reflect a developed world perspective and that it does not yet sufficiently incorporate appropriate indicators for less developed countries and countries in transition.[135]

The evolution of indicator types and formats developed by the CSD as well as their use by countries suggest that simpler, clearly linked sets of indicators tend to work better. It also suggests that while the base set of indicators and format provided are useful for international comparability it is important to ensure that enough flexibility in indicators systems and assessment should be designed in to enable local priorities to be expressed. This is an important concept that will be explored further in the development of the specification of the assessment system in Chapter five.

The International Institute for Sustainable Development (IISD)[136]

The IISD is a Canadian based non-governmental organisation that has, as a strategic aim, the development of indicators that measure progress towards sustainable development.[137] The IISD have been influential in guiding the design of sustainable development indicators systems through the Bellagio Principles for Assessment.[138] These were conceived in 1996 by the IISD in collaboration with a range of measurement practitioners and researchers. These principles guide the assessment of sustainable development progress and are listed below:

1. **Guiding vision and goals:** Assessment towards sustainable development should:
- be guided by a clear vision of sustainable development and goals that define that vision.

2. **Holistic perspective:** Assessment of progress towards sustainable development should:
- Include review of the whole system as well as its parts
- Consider the well being of social, ecological, and economic sub-systems, their state as well as the direction and rate of change of that state, of their component parts, and the interaction between parts.

[135] http://www.un.org/esa/sustdev/indi4za.htm 02/01/03 10:35
[136] http://www.iisd.ca/measure/faqcriteria.htm 02/01/03 10:35
[137] www.iisd.org/about 02/01/03 10:36
[138] http://www.iisd.org/measure/2.htm 02/01/03 10:36

- Consider both positive and negative consequences of human activities, in a way that reflects the costs and benefits for human and ecological systems in monetary and non-monetary terms.

3. **Essential elements:** Assessment of progress towards sustainable development should:

- Consider equity and disparity within current population and between present and future generations, dealing with such concerns as resource use, over-consumption and poverty, human rights, and access to services, as appropriate.
- Consider the ecological conditions on which life depends'
- Consider economic development and other, non-market activities that contribute to human/social well-being,

4. **Adequate scope:** Assessment of progress towards sustainable development should:

- Adopt a time horizon long enough to capture both human and ecosystem time scales thus responding to needs of future generations as well as those current to short term decision-making.
- Define space of study large enough to include not only local but also long distance impacts on people and ecosystems
- Building on historic and current conditions to anticipate future conditions- where we want to go, where we could go

5. **Practical focus:** Assessment of progress towards sustainable development should be abased on:

- An explicit set of categories or an organising framework that links vision and goals to indicators and assessment criteria.
- A limited number of key issues for analysis
- A limited number of indicators or indicator combinations to provide a clearer signal of progress.
- Standardisation measurement wherever possible to permit comparison
- Comparing indicator values to targets, reference values, ranges, thresholds, or direction of trends, as appropriate

6. **Openness:** Assessment of progress towards sustainable development should:

- Make methods and data that are used accessible to all
- Make explicit all judgement, assumptions and uncertainties in data and interpretations

7. **Effective communication:** Assessment of progress towards sustainable development should:

- Be designed to address the needs of the audience and set of users

- Draw from indicators and other tools that are stimulating and serve to engage decision-makers
- Aim, from the outset for simplicity in structure and use of clear and plain language.

8. **Broad participation:** Assessment of progress towards sustainable development should:

- Obtain broad representation of key grass-roots, professional, technical and social groups, including youth, women, and indigenous people- to ensure recognition diverse and changing values.
- Ensure the participation of decision makers to secure a firm linked to adopted policies and resulting action

9. **Ongoing assessment:** Assessment of progress towards sustainable development should:

- Develop a capacity for repeated measurement to determine trends
- Be iterative, adaptive, and responsive to change and uncertainty because systems are complex and change frequently
- Adjust goals, frameworks, and indicators as new insights are gained
- Promote development of collective learning and feedback to decision-making

10. **Institutional capacity:** Assessment of progress towards sustainable development should be assured by:

- Clearly assigning responsibility and providing ongoing support in decision making process
- Providing institutional capacity for data collection, maintenance, and documentation
- Supporting development of local assessment capacity.

The IISD argues that developing a conceptual framework for guiding the assessment process is important as this enables indicators to emerge and be adapted to suit local circumstances by decision-makers.[139] They suggest that this framework should be hierarchical and extend from broad sets of data to detailed measures.

The IISD also make a range of suggestions for the selection of indicators and have developed a compendium of sustainable development indicators.[140] The selection of indicators, they suggest, depends on perspective and usefulness in planning for sustainable development:

What is a good or bad measure tends to vary with one's Weltanschauung or worldview, including such factors as level of education, cultural background, economic status, political

[139] Hardi and Zardi. 1997. p. 10
[140] http://www.iisd.org/measure/compinfo.htm

affiliation, gender, and so on. Selection criteria are guidelines that one creatively applies to establish a preference for the "best" indicators that fit the needs and circumstances of a given region, institution, and at the same time enhance adaptive planning capacity for sustainable development. At a time of increasing globalisation they should help create a minimum level of comparability, coherence and consistency between measures, and, perhaps more importantly, between ways these measures are applied in real-life situations.[141]

The criteria for the selection of sustainability indicators developed by the IISD are as follows:

- **Policy relevance:** Can the indicator be associated with one or several issues around which key policies are formulated? Sustainability indicators are intended for audiences to improve the outcome of decision-making on levels ranging from individuals to the entire biosphere. Unless the indicator can be linked by readers to critical decisions and policies, it is unlikely to motivate action.

- **Simplicity:** Can the information be presented in an easily understandable, appealing way to the target audience? Even complex issues and calculations should eventually yield clearly presentable information that the public understands.

- **Validity:** Is the indicator a true reflection of the facts? Was the data collected using scientifically defensible measurement techniques? Is the indicator verifiable and reproducible? Methodological rigor is needed to make the data credible for both experts and laypeople.

- **Time-series data:** Is time-series data available, reflecting the trend of the indicator over time? If based on only one or two data points, it is not possible to visualize the direction the community may be going in the near future.

- **Availability of affordable data:** Is good quality data available at a reasonable cost or is it feasible to initiate a monitoring process that will make it available in the future? Information tends to cost money, or at least time and effort from many volunteers.

- **Ability to aggregate information:** Is the indicator about a very narrow or broader sustainability issue? The list of potential sustainability indicators is endless. For practical reasons, indicators that aggregate information on broader issues should be preferred. For example, forest canopy temperature is a useful indicator of forest health and is preferable to measuring many other potential indicators to come to the same conclusion.

[141] http://iisd.ca/measure/faqcriteria.htm 19/12/02 09:20,

- **Sensitivity:** Can the indicator detect a small change in the system? We need to determine beforehand if small or large changes are relevant for monitoring.

- **Reliability:** Will you arrive at the same result if you make two or more measurements of the same indicator? Would two different researchers arrive at the same conclusions?

The IISD also provide a range of ways that measures of sustainability can be displayed. They suggest that it is important, particularly, for aggregated indicators, that these can be read quickly and accurately by decision makers. Examples of visual reports provided include the four-sided pyramid, the elliptical cluster, the compass of sustainability and the dashboard of sustainability.[142] The idea that performance should be able to read quickly and in a highly visual way is important and particularly relevant to tools that may be used by lay people and in developing countries. The specification developed in Chapter five for the tool will develop this into a set of specific requirements.

The Global Reporting Initiative

The Global Reporting Initiative (GRI) has developed the Sustainability Reporting Guidelines.[143] The GRI was initiated by the US non-governmental organisational Coalition for the Environmentally Responsible Economies (CERES) and the United Nation's Environment programme (UNEP) with the goal of improving sustainability reporting. The GRI suggest there are strong benefits from reporting on sustainability. These have a particular emphasis on improvements in management and communications and include the following:[144]

Management: Measuring and reporting on past and anticipated performance helps improve management processes. It also helps support the longevity of business by creating a more complete picture of long-term prospects and supporting, in the eyes of customers, its "license to operate". Sustainability reporting also can also support stronger cooperation and communication between sometimes insular and discrete components of an organisation such as finance, marketing, research and development. Reporting may also enable emerging or potential problems and unanticipated opportunities to be discovered early allowing these to be addressed more effectively.

Communication: Reporting is a key aspect of building, sustaining, and continually refining stakeholder engagement. Transparency and open dialogue about sustainability performance and future plans can, it is suggested, bring about trust, and support partnership with a diverse set of groups including investors, community groups and consumers.

---

[142] http://iisd.ca/cgsdi/visuals.htm 03/01/03 10:35
[143] http://www.globalreporting.org 03/01/03 10:35
[144] Global Reporting Initiative. 2002 p. 4

The reporting process suggested by GRI places an heavy emphasis on participation and using the reporting process as a way of introducing discussion that leads to actions and changes in behaviour:

The primary goal of reporting is to contribute to ongoing stakeholder dialogue. Reports alone provide very little value if they fail to inform stakeholders or support a dialogue that influences the decisions and behaviour of both the reporting organisation and its stakeholders.[145]

The design of the GRI guidelines aims to be flexible. An example of this is the inclusion of two sets of indicators: a core set and an additional set.[146] Core indicators are those that are relevant to most reporting organisations and of interest to most stakeholders, while additional indicators may include areas only reported on by a few organisations but may be deemed to be worthy of further testing in order to be included as future core indicators. The guidelines aim to support growth and change within the field of sustainability reporting. They are designed to be used by both experienced organisations and those new to sustainability reporting. The reporting format allows organisations to progress from developing informal reports to rigorous 'in accordance' reports which comply with GRI standards.[147] This is a useful concept that should, if possible, be incorporated in the specification of the tool in Chapter five. In a developing country it is likely that there will be a wide range of potential users for a tool. Versatility and flexibility would therefore be useful attributes in a building assessment tool.

The GRI guidelines provide a description of the principles that should be applied to developing sustainability reports. These principles are as follows:

Transparency: Full disclosure of the processes, procedures, and assumptions in report preparation are essential to its credibility

Inclusiveness: The reporting organisation should systematically engage its stakeholders to help focus and continually enhance the quality of its reports.

Auditability: Reported data and information should be recorded, compiled, analysed, and disclosed in a way that would enable internal auditors or external assurance agent's providers to attest to its reliability.

Completeness: All information that is material to user for assessing the reporting organisation's economic, environmental, and social performance should appear in the report in a manner consistent with the declared boundaries, scope, and time period.

---

[145] Global Reporting Initiative. 2002. p. 9
[146] Global Reporting Initiative. 2002. p. 12
[147] Global Reporting Initiative. 2002. p. 13

Relevance: relevant is the degree of importance assigned to a particular aspect, indicator, or piece of information and represents the threshold at which information becomes significant enough to be reported.

Sustainability context: The reporting organisation should seek to place its performance in the larger context of ecological, social and economic or other limits or constraints, where such contexts add significant meaning to the reported information.

Accuracy: The accuracy principle refers to achieving the degree of exactness and low margin of error in reported information necessary for users to make decisions with a high degree of confidence

Neutrality: Reports should avoid bias in selection and presentation of information and should strive to provide a balanced account of the reporting organisation's performance

Comparability: The reporting organisation should maintain consistency in the boundary and scope of its reports, disclose any changes and re-state previously reported information

Clarity: The reporting organisation should remain cognisant of the diverse needs and backgrounds of its stakeholder groups and should make information available in a manner that is responsive to the maximum number of users while still maintaining a suitable level of detail.

Timeliness: Reports should provide information on a regular schedule that meets user needs and comports with the nation of the information itself.

4.1.3. Human Development Report

The Human Development Report is developed by the United Nations Development Programme (UNDP) and produced annually. The report includes reports on progress in terms of the Human Development Index (HDI), a composite measure of human development. The HDI is designed to capture three basic dimensions of human development – longevity, knowledge, and a decent standard of living. It is measured by life expectancy, educational attainment (adult literacy and combined primary, secondary and tertiary enrolment) and adjusted income per capita in purchasing power parity (PPP) in US dollars. The reason for developing the HDI is explained in the following way:

To capture the attention of policy makers, media and NGOs and to draw their attention away from the more usual economic statistics to focus instead on human outcomes, not economic

data. The HDI was created to re-emphasize that people and their lives should be the ultimate criteria for assessing the development of a country, not economic growth.[148]

Since the development of this index a number of variations of this have been developed to address perceived shortcomings in the HDI. These include HPI -1, which aims to measure poverty in developing countries and includes measures for adult literacy and people not using improved water source, HPI-2 which includes an assessment of social exclusion, GDI which aims to capture inequalities in gender and GEM which assesses the extent to which women take an active role in economic and political life.[149]

These indicators are important to acknowledge in the study as they provide widely accepted measures of human development. There is a clear overlap between these measures and indicators of social sustainable development. Of interest to the study are the specific criteria assessed (such as education attainment, income and gender equity) and the way these are agglomerated into indexes. The implication for the specification developed in Chapter five are that it may be important to investigate how buildings and construction can support human development (as defined in the Human Development Index) and that the agglomeration methodology used to develop the HDI may inform the assessment criteria and reporting approach applied.

4.1.4. The Genuine Progress Report[150]

Redefining Progress, a US based non-governmental organisation, developed the Genuine Progress Report. This is based on an indicator called the Genuine Progress Indicator (GPI), which aims to reflect the national health of a country in economic terms. The Genuine Progress Indicator starts with the personal consumption component of Gross Domestic Product (GDP) and adds and subtracts a range of benefits and costs ignored by the GDP.

Costs subtracted include:

Economic costs

- Adjustment for unequal income distribution
- Net foreign borrowing
- Cost of consumer durables
- Social costs
- Cost of crime
- Costs of automobile accidents
- Costs of commuting

[148] http://www.undp.org/hdr2002/faq.html#2 03/01/03 10:35
[149] http://www.undp.org/hdr2002/faq.html#1 03/01/03 10:35
[150] http://www.rprogress.org/project/gpi1999.pdf 19/12/02 09:45

- Cost of family breakdown
- Loss of leisure time
- Cost of underemployment

Environmental costs:

- Cost of household pollution abatement
- Cost of water pollution
- Cost of air pollution
- Cost of noise pollution
- Loss of wetlands
- Loss of farmlands
- Depletion of non-renewable resources
- Cost of long-term environmental damage
- Cost of ozone depletion
- Loss of old-growth forests

Benefits added include:

- Value of housework and parenting
- Value of volunteer work
- Services of consumer durables
- Services of highways and streets
- Net capital investment

Redefining Progress argue that conventional economic indicators do not reflect actual progress as this ignores environmental costs and actually counts the depletion and degradation of resources as income rather than asset depreciation. Another indicator supported by Redefining Progress is the ecological footprint.

Ecological footprint[151]

Ecological footprints are an indicator of the amount of the world's biological productive capacity that an individual or a country uses per year. It is calculated by measuring the amount of biologically productive land and water areas required to produce resources consumed, and to assimilate waste generated, using prevailing technology.

In a report titled 'The Ecological Footprint of Nations' Redefining Progress publishes ecological footprint and ecological capacity information of countries.[152] This report shows that

[151] http://www.earthday.net/footprint/index.asp# 19/12/02 09:45
[152] Wackernagel, Mofreda and Deumling. 2002

already man's consumption and waste production (the ecological footprint) exceeds the Earth's capacity to create new resources and absorb waste (the carrying capacity). It also shows which countries exist within their carrying capacity, by calculating the country's ecological footprint and subtracting this from its bio capacity in order to get a domestic ecological deficit or remainder. The report shows that South Africa is living beyond its bio capacity by 1.6 ha per person whereas many other developing countries such as Zambia, Sudan, Senegal exist within their bio capacity.

This is relevant to the study as it provides insight into the development of progress indicators. The Genuine Progress Report indicates that it is important to describe what is constituted as progress and then ensure that all factors affecting this are strictly defined in terms of whether they contribute to, or detract from, this. Adding and subtracting these factors then provides an accurate picture of progress.

It also draws attention to the fact that sustainability is often defined in terms of balance, in this case, a balance between ecological footprint and carrying capacity. This is an important concept to address in the development of the specification. The assessment tool must be able to assess the contribution of buildings and construction to both sides of the sustainability equation. Using the concepts referred to by Redefining Progress, the assessment tool must measure the contributions to both the ecological footprint as well as to carrying capacity.

4.1.5. National, Community and Project Indicator Systems

4.1.6. Quality of Life Counts (UK)[153]

The United Kingdom's indicator system was developed in order to measure progress towards sustainable development. It includes broad sustainable development objectives such as maintenance of economic growth, social progress, effective protection of the environment and prudent use of resources. Each of these broad strategies is broken down into specific objectives linked to policies and specific actions by particular groups. These objectives have associated indicators and are designed to encourage action from individuals, business and local government. The aims of the national set of indicators are described as follows:

- To describe, overall, whether we are achieving sustainable development.[154]
- To highlight key national–scale policy initiatives relevant to sustainable development and to monitor whether we are meeting key targets and commitments in those areas.
- To educate the public about what sustainable development means.
- To raise public and business awareness of particular actions that needs to be taken in order to achieve more sustainable development.
- To report progress to international audiences.

[153] http://www.sustainable-development.gov.uk/uk_strategy/quality/life/09.htm 18/11/02 09:45

- To help make transparent trade-offs and synergies between sustainable development objectives.

In developing indicators a number of criteria were used to inform the selection of indicators. Each indicator had to comply with following requirements:

- It is an overarching “state of the nation” indicator
- It reflects a key international or national commitment or target
- It supports a key message for individuals or business especially in relation to key actions needed, for example on energy efficiency, health and safety at work, ethical trading etc.
- It is recommended for use in international reporting, for example as proposed by UNSCD.

And the following scientific and technical criteria; indicators should:

- Be representative
- Be scientifically valid
- Be simple and easy to interpret
- Show trends over time
- Give early warning about irreversible trends where possible
- Be sensitive to the changes it is meant to indicate
- Be based on readily available data or be available at reasonable cost
- Be based on date adequately documented and of known quality
- Have a target level or guideline against which to compare it.

There are a number of concepts from this approach that are useful for the study to note. The system is linked to policy and measures progress in achieving policy objectives and ultimately the policy goal. It therefore measures progress along a path that has been *clearly delineated*. The UK government consider the goals of the policy to be too ambitious to be achieved solely by government. This is acknowledged in the formulation of policy and the indicator system, which aims to ensure active involvement of and support by communities and business. An explicit aim of the approach is to ensure that the goal, objectives and indicators are stated very clearly in order to ensure that there is shared understanding and therefore a coherent and integrated move towards sustainable development across many sectors.

[154] http://www.sustainable-development.gov.uk/uk_strategy/quality/life/09.htm 18/11/02 09:45

National Environment Indicators Programme (South Africa)[155]

The National Environmental Indicator programme is being undertaken by the Department of the Environment and Tourism in South Africa. In order to establish the priority environmental issues for reporting in the State of the Environment report the following was set up:

- A review of policies laws, international agreements and other relevant documentation for possible issues pertaining to environmental sustainability in South Africa
- Setting up a forum (Imbizo workshop) on emerging environmental issues in the global business and industry environment
- Consulting with representatives from key stakeholders through a workshop
- Eliciting public opinion on key national and local environmental issues in South Africa through the Human Sciences Research Council (HSRC) ' Evaluation of the Population ' Study.

This lead to the following criteria being established for indicators:

- The indicator must be based on good quality data that are available at a reasonable cost.
- The indicator should provide information that measures something that is important to decision makers.
- The information can be presented in a way that is easily understood and appealing to the target audience.
- The indicator must relate to goals, targets or objectives.
- The indicator must provide timely information (to allow for response).
- The indicator must be able to detect small changes in the system.
- The indicator must be relevant to policy and management needs within the South African context. The indicator must therefore be associated with one or several environmental policy issues.
- The indicator must be based on data that are accurate, reliable, statistically sound and scientifically valid. Metadata should define the quality of the data in the data set and include information on sensitivity, uncertainty, variability, precision, accuracy and error.
- The data must be available and accessible, particularly in the long term.
- The indicator must be based on data of the correct spatial and temporal extent. Sufficient historical data must be available to identify trends over time.
- The data collection process should have minimal environmental impact.

These criteria are similar in many ways to the criteria used in the UK policy. It is however unclear whether these criteria have been strictly applied. For instance in Chapter two it was

[155] http://www.environment.gov.za/soer/indicator/neip_pr.htm 19/12/02 11:35

noted that the indicators used in the South Africa's State of the Environment report did not appear to be linked with specific policies. A criticism made in Chapter two was that the State of the Environment report had a limited number of social and economic indicators. The report and indicators, it is therefore suggested, are of limited value to the study.

Sustainable Measures

Sustainable Measures is a private consulting firm that have been working in the evaluation and monitoring of sustainability in the USA. They describe characteristics of effective indicators as follows:

An indicator is something that points to an issue or condition. Its purpose is to show you how well a system is working. If there is a problem, an indicator can help you determine what direction to take to address the issue. Indicators are as varied as the types of systems they monitor. However, there are certain characteristics that effective indicators have in common:

- *Effective indicators are **relevant**; they show you something about the system that you need to know.*
- *Effective indicators are **easy to understand**, even by people who are not experts.*
- *Effective indicators are **reliable**; you can trust the information that the indicator is providing.*
- *Lastly, effective indicators are based on **accessible data**; the information is available or can be gathered while there is still time to act.* [156]

In particular Sustainable Measures works with communities and have developed a large database of indicators for sustainability in communities.[157] These indicators are rated by being reviewed against a set of criteria. These criteria are posed as questions and are as follows:

1. Does the indicator address the carrying capacity of the natural resources - renewable and non-renewable, local and non-local - that the community relies on? [158]
2. Does the indicator address the carrying capacity of the ecosystem services upon which the community relies, whether local, global, or from distant sources?
3. Does the indicator address the carrying capacity of aesthetic qualities - the beauty and life-affirming qualities of nature - that are important to the community?
4. Does the indicator address the carrying capacity of the community's human capital - the skills, abilities, health and education of people in the community?
5. Does the indicator address the carrying capacity of a community's social capital - the connections between people in a community: the relationships of friends, families,

[156] http://www.sustainablemeasures.com/Database/index.html 19/12/02 11:35
[157] http://www.sustainablemeasures.com/Database/index.html 19/12/02 11:35
[158] http://www.sustainablemeasures.com/Database/index.html 19/12/02 11:35

neighbourhoods, social groups, businesses, governments and their ability to cooperate, work together and interact in positive, meaningful ways?

6. Does the indicator address the carrying capacity of a community's built capital - the human-made materials (buildings, parks, playgrounds, infrastructure, and information) that are needed for quality of life and the community's ability to maintain and enhance those materials with existing resources?
7. Does the indicator provide a long-term view of the community?
8. Does the indicator address the issue of economic, social or biological diversity in the community?
9. Does the question address the issue of equity or fairness - either between current community residents (intra-generational equity) or between current and future residents (inter-generational equity)?
10. Is the indicator understandable to and useable by its intended audience?
11. Does the indicator measure a link between economy and environment?
12. Does the indicator measure a link between environment and society?
13. Does the indicator measure a link between society and economy?
14. Does the indicator measure sustainability that is at the expense of another community or at the expense of global sustainability?

The approach developed by Sustainable Measures is useful to the study for the following reasons. The approach attempts to measure difficult-to-assess aspects of sustainability such as human and social capital. These are new measurement domains and it is important to understand this area as buildings and construction may be expected in the future to contribute to social and human capital in order to support sustainable development. This will be explored further in Chapter five.

4.1.7. Log frame[159]

The log frame is a project design and monitoring methodology used widely by development agencies such as the World Bank and donor organisations such as the Department for International Development (DFID) for development projects. In the planning stages project designers and stakeholders can use this tool to:

- Set proper objectives[160]
- Define indicators of success
- Identify key activity clusters (project components)
- Define critical assumptions on which the project is based
- Identify means of verifying project accomplishments
- Defined resources required for implementation

[159] http://www.worldbank.org/html/opr/pmi/urban/urban002.html 8/11/02 13:43
[160] http://www.worldbank.org/html/opr/pmi/urban/urban002.html 8/11/02 13:43

It does this through the use of a 4x4 matrix, with a hierarchy of objectives, indicators of performance, means of verifying performance and list of assumptions and risks. An example of a log frame is provided below.

Table Four: A Log Frame[161]

Project Structure	**Indicators of Achievement**	**Means of Verification**	**Important Risks and Assumptions**
Goal What are the wider objectives which the activity will help achieve? Longer term programme impact	What are the quantitative measures or qualitative judgements, whether these broad objectives have been achieved?	What sources of information exist or can be provided to allow the goal to be measured?	What external factors are necessary to sustain the objectives in the long run?
Purpose What are the intended immediate effects of the programme or project, what are the benefits, to whom? What improvements or changes will the programme or project bring about? The essential motivation for undertaking the programme or project.	What are the quantitative measures or qualitative judgements, by which achievement of the purpose can be judged?	What sources of information exist or can be provided to allow the achievement of the purpose to be measured?	What external factors are necessary if the purpose is to contribute to achievement of the goal?
Outputs What outputs (deliverables) are to be produced in order to achieve the purpose?	What kind and quality of outputs and by when will they be produced? (QQT: Quantity, Quality, Time)	What are the sources of information to verify the achievement of the outputs?	What are the factors not in control of the project which are liable to restrict the outputs achieving the purpose?
Activities What activities must be achieved to accomplish the outputs?	What kind and quality of activities and by when will they be produced?	What are the sources of information to verify the achievement of the activities?	What factors will restrict the activities from creating the outputs?

[161] http://62.189.42.51/DFIDstage/FOI/tools/chapter_05.htm 9/12/02 11:35

It is suggested that the log frame should be developed and agreed by all stakeholders involved in the development, ideally in a workshop situation.[162] This process, it is argued, enables the following to be achieved:

- Stakeholder consensus[163]
- Organised thinking
- Activities and investment linked to expected result
- Performance indicators to be set
- Responsibilities to be allocated
- Communication to be developed that is concise and unambiguously to all key stakeholders

Indicators

The use of indicators is an important part of the log frame approach and these are important as they:

- Specify realistic targets (minimum or otherwise) for measuring or judging if the objectives at each level have been achieved[164]
- Provide the basis for monitoring; review and evaluation so feeding back into the management of programme/project implement and into less learning planning for other subsequent projects
- Contribute to transparency and develop consensus on the overall objectives, log frame and plan

Log frame indicators are divided into product and process indicators. Product indicators measure what is produced, while process indicators assess the means used to deliver the product. Process indicators are increasingly used as these are seen as more appropriate for development projects as they generally lead to better targeting of real problem, better implementation and improved sustainability.[165] It is suggested however that while product indicators generally can be quantified, it may be difficult to carry this out for process indicators, which may need to include qualitative aspects. DFID suggests that ideally a mix of quantitative and qualitative indicators should be used to develop an accurate picture of the impact of a development project. Examples of indicators they provide include:

Quantitative indicators

- The frequency of meetings, the number of people involved

[162] Box 5.5, http://62.189.42.51/DFIDstage/FOI/tools/chapter_05.htm 9/12/02 11:35
[163] Box 5.2, http://62.189.42.51/DFIDstage/FOI/tools/chapter_05.htm 9/12/02 11:35
[164] http://www.worldbank.org/html/opr/pmi/urban/urban002.html 8/11/02 13:43
[165] http://62.189.42.51/DFIDstage/FOI/tools/chapter_05.htm 9/12/02 11:35

- Growth rates
- Climate data
- Yields, prices
- The uptake of activity inputs e.g. loans, school enrolment, seeds, visits to the clinic

Qualitative indicators

- The level of participation of a stakeholder group[166]
- Stakeholder / consumer opinions; satisfaction
- Aesthetic judgements; e.g. taste, texture, colour, size, shape, marketability
- Decision-making ability
- Attitudinal change
- The emergence of leadership
- The ability to self-monitor
- The development of groups and of solidarity
- Behavioural changes
- Evidence of consensus

An example of a completed log frame including indicators can be found in Appendix nine. The approach taken to indicators by the World Bank has a stronger emphasis on performance indicators. They suggest these can be used in a range of ways to improve performance. Example of uses of performance indicators given include:[167]

Strategic planning: It is suggested that performance indicators forces greater consideration of critical assumption that underlie a program's relationships and causal paths. They also help clarify the objectives and logic of the program.

Performance accounting: Performance indicators can help inform resources allocations if they are used to direct allocations to the most successful activities and thereby promote the most efficient use of resources

Forecasting and early warning: Performance indicators can help point toward future performances, enabling areas needing improvement to be addressed.

Measuring programme results: Performance indicators can measure what has been achieved relative to objectives rather than just what has been completed, improving accountability.

[166] http://62.189.42.51/DFIDstage/FOI/tools/chapter_05.htm 9/12/02 11:35
[167] http://www.worldbank.org/html/opr/pmi/urban/urban002.html 8/11/02 13:43

Program marketing and public relations: Performance indicators can be used to demonstrate program results and thus the value to an external audience.

Benchmarking: Performance indicators can generate data against which to measure other programs and projects enabling learning and good practice to be shared.

Quality Management: Performance indicators can be used to measure customer (beneficiary) satisfaction and thereby assess whether and how a program is improving their lives.

For the purposes of the World Bank performance indicators are most useful at specific project stages. These they define as project design (strategic planning), project supervision (forecasting results) and project evaluation (measuring results and quality management) stages. Indicators are seen as a means of measuring the flow of change and are used as part of process that includes a baseline assessment (the values of performance indicators at the beginning of the project) and targets, which are the values at the end.[168] To tie in with the log frame format the World Bank identify a range of different types of indicators designed to measure different variables within a project such as objective, impact, outcome, output and input. These are described below:

Results indicators: These measure project results relative to project objectives.

Inputs indicators: These measure the resources provided for a project's activities and could include: funding, human resources, training, equipment, materials and supplies or recurrent costs of these items.

Outputs indicators measure the goods and services created or provided through the use of inputs and could include: clients vaccinated, farmers visited, miles of road built, pollution control measures installed or incentives or regulations enforce.

Outcome and Impact Indicators: These measure the quantity and quality of the results achieved through the provision of good and services and could include: reduced incidence of disease, improved farming practices, increased vehicle use, increased rural supple and consumption of electricity and reduced mortality or lower health costs.

Relevance Indicators: These aim to capture the impact on higher order objectives such as national or sectoral objectives. These could include: improved national health as measured by health indicators, increased farm profits and reduced food costs, reduced transportation costs

[168] http://www.worldbank.org/html/opr/pmi/urban/urban002.html 8/11/02 13:43

and expanded economic development and improved economic growth and consumer well-being.

Risk indicators: These measure the status of external factors identified as critical risks and enabling factors. Thus these indicators should indicate whether the right conditions are in place for the project to be a success if embarked on.

Efficacy indicators: These show how well result from one level of project implementation have been translated into results at the next level, thus these indicators would measure the efficiency of inputs, effectiveness of project outputs and sustainability of project impact.

Efficiency Indicators: These usually represent the ratio of outputs per unit of project outcome or impact, these could include: number of vaccination administered per unit decline in morbidity rate, or number of farmers visited per measured change in farm practices or, miles of road built per unit increase in vehicle use

Sustainability Indicators: these represent the persistence of project benefits over time, particularly after project funding ends. These could include:

- Disease incidence trends after external funding for a vaccination project ends.
- Persistence of changed farming practices after extension visits are completed
- Maintenance and use of roads after highway construction ends
- Persistence of institutions (programs, organisations, relations and so on) created to deliver project benefits

Criteria are also provided for the selection and development of indicators. These criteria include the following aspects:

Relevance: the indicators selected must be relevant to the basic sectoral development objectives and, if possible to overall country objectives.

Selectivity: There should be no more than a dozen indicators, with at least half of these designed to measure project impact against each of the major development objective

Practicality of indicators, ownership: stakeholders should develop indicators jointly during a participatory project planning process. Thought should also be given to the design and capture of indicators and this should be addressed in the design of programs.

Intermediate and leading indicators: It may be necessary to have early pointers of development impact in order to indicate progress towards achieving program objectives.

Advantages of the log frame approach

The World Banks lists the following advantages of the logframe approach:

- Ensures fundamental questions are asked and weaknesses are analyses in order to provide decision makers with better and more relevant information[169]
- Guides systematic and logical analysis of the interrelated elements that constitute a well-designed project
- Improves planning by highlighting linkages technology, and effects on the environment
- Facilitates common understanding and better communication between decision makers managers and other parties involved in the project

The approach developed through the log frame is relevant to the study in a number of ways. The log frame has been specifically designed to support development projects. This is relevant to the study because if buildings and construction projects are expected to support sustainable development they may be expected to support beneficial development within an area. There are two particular aspects from the log frame approach that, it is suggested, should inform the development of the specification of the tool in Chapter five.

The first is the assertion that development projects require a participatory approach and full buy-in of the communities that they affect. The second is the acknowledgement, and measurement of, a wide set of impacts and implications that may be associated with development projects. These include the use of qualitative indicators and the development of a life cycle approach, which, for instance, recognizes maintenance implications early on in the development of projects.

4.1.8. Building Environmental Performance Assessment Tools

This section reviews building assessment systems. The assessment systems reviewed assess the environmental impact of buildings. Systems reviewed include BREEAM, LEED, and the GBtool.

Each assessment system will be described under the following headings.

- **Introduction:** this will provide a background to the tool.
- **Aims of the tool:** this will describe the objectives set for the tool by its authors.
- **Aspects assessed:** this will include a list and description of the aspects assessed in buildings by the tool will be given.
- **Assessment process:** this will describe, as far as can be ascertained from the literature, the suggested method(s) for assessing buildings.

[169] http://www.worldbank.org/html/opr/pmi/contents.html 18/11/02 09:45

- **Discussion:** this will review the tool in order to understand limitations and potential to contribute to the study.

The tools are compared and discussed later in chapter in section 4.2.

4.1.9. BREEAM

Introduction

The Building Research Establishment (BRE) in the UK developed BREEAM (Building Research Establishment Environmental Rating Method) in 1990. The system has had a significant impact on commercial buildings in the UK and it is estimated that 25% of new office buildings are assessed using the system. Since 1990 the Building Research Establishment have gone on to develop a range of different systems and guidelines aiming to minimise the environmental impact of buildings. They have also updated the original BREEAM system and increased the range of building types that this covers. There is a BREEAM for offices and housing and versions of BREEAM are being developed for Hong Kong and Canada.

The BREEAM assessed here is 'BREEAM 98 for Offices', published in 1998. In updating BREEAM the authors suggest that the tool reflects a change in environmental related policy. The main shift, they suggest is that environmental issues have become a component of a much broader sustainable development movement.[170] The key aims of sustainable development described by the tool are the same as those provided by the Department of the Environment in the UK and are:

- Social progress which meets the needs of everyone
- Effective protection of the environment
- Prudent use of resources
- Maintenance of high and stable levels of growth and employment (DoE1996)

To reflect the shift to sustainability the authors state that BREEAM 98 addresses environmental impacts of buildings, prudent use of natural resources, and quality of life.

Aims of the Tool

BREEAM aims to provide guidance on how to minimise the negative environmental impacts of buildings while ensuring that these provide comfortable and healthy indoor environments.[171] It specifically sets itself the following objectives:

- To distinguish buildings of reduced environmental impact in the market place[172]
- To encourage best environmental practice in building design, operation, management and maintenance.

[170] Baldwin, Yates, Howard and Rao. 1998. p.4
[171] Baldwin, Yates, Howard and Rao. 19981998. p.1

- To set criteria and standards going beyond those required by laws and regulations
- To raise the awareness of owners, occupants, designers and operators of buildings with reduced impact on the environment

Aspects Assessed

The tool awards points for meeting or surpassing a set of performance criteria. The set of criteria are listed under the following headings:

- Management
- Health & Comfort
- Energy
- Transport
- Water
- Materials
- Land use
- Site ecology
- Pollution

Each of these headings contains specific criteria, such as, under 'Health and Comfort';

"…at least 30% of windows to office are openable. This should have an even distribution around the office area".[173]

Each of these criteria that are weighted differentially through a point system with some criteria allocated a large number of points, for instance thirty, and others a far lower number, for instance six. These weighting were achieved through what BRE call 'consensus based weighting', which reflects a consensus in the weighting of the importance of the different criteria amongst a range of interest groups including government policymakers, construction professionals, local authorities, material producers and academics. [174]

Assessment process

BREEAM provides two ways that assessment can take place. The first is by working through the assessment prediction checklist provided with the BREEAM documentation. This provides an approximate estimation of the performance. This however is a simplification of the full process, which is undertaken by trained assessors licensed by the BRE.[175]

The assessment system is designed to be able to assess three broad aspects in buildings. These are design and procurement issues, core building issues, and management and

---

[172] Baldwin, Yates, Howard and Rao. 1998. 1998. p.1
[173] Baldwin, Yates, Howard and Rao. 1998. 1998. loose A3 sheet
[174] Baldwin, Yates, Howard and Rao. 1998. 1998. p. 8
[175] Baldwin, Yates, Howard and Rao. 1998. 1998. p. 6

operation issues.[176] In this way the system attempts to provide a tool that is able to provide guidance and assessments for buildings through the lifecycle of the building.

Formal certification of buildings requires detailed assessments by trained BRE-licensed assessors. In the appendix of the document are a list of suggested services that assessor can provide. These services include:

- Design consultancy[177]
- Outline design stage guidance meeting
- Detailed design stage guidance meeting
- Formal assessment review
- Final certification
- Review after construction

On completion of an assessment the assessor provides a certificate of environmental performance of the building. These rate the buildings as: 'Excellent', 'Very Good', 'Good' and 'Pass'.

The document however suggests that a formal assessment is only a part of a more comprehensive approach that is required to address environmental impact in buildings. Guidelines for other activities required are given in checklists contained in the appendix of the document.[178]

4.1.10. LEED

Introduction

The LEED (Leadership in Energy and Environmental Design), Green Building Rating System was developed by the US Green Building Council. The system is being continuously developed. The LEED system can be downloaded at http://www.usgbc.org/. In this study, Version 2, issued in March 2000, is reviewed.

Aims of the System

The aims of LEED are:

- To provide a standard that improves the environmental and economic performance of commercial buildings using established or advanced industry principles, practices, materials and standards

[176] Baldwin, Yates, Howard and Rao. 1998. 1998. p. 9
[177] Baldwin, Yates, Howard and Rao. 1998. 1998. p. 27
[178] Baldwin, Yates, Howard and Rao. 1998. 1998. p. 33

- To be used by commercial building project stakeholders and project teams as a guide for green and sustainable design

Aspects Assessed

The system makes as assessment under five broad headings. These are:

- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality

Each of these criteria is described in terms of **Intent**, **Requirement** and **Technologies / Strategies. Intent** describes the reasoning behind the criteria and what this aims to achieve, for instance, 'reduce erosion' on a site. **Requirement** describes what the building must achieve in order to gain a point or points under the rating system. **Technologies/Strategies** provide suggestions as to how compliance with the requirement can be achieved.

The document is unclear as to how the 'Intent' descriptions where developed. The objectives of the tool appear to be very similar to those of BREEAM, namely to minimise the negative impact of buildings on the environment while achieving comfortable and healthy accommodation.

The requirements specify minimal performance requirements that must be achieved. These often refer to other documents and standards. For instance, for standards of indoor air quality the document refers to documentation developed by the Sheet Metal and Air Conditioning National Contractors Association.[179] Similarly, it suggests that a range of Environmental Protection Agency (EPA) documents be consulted in the site selection process, including 'Storm Water Management for Construction', the 'Brownfield Redevelopment Programme' and the 'OSWER Directive'.[180]

Assessment Process

The document does not specify how, when, or by whom, the assessment should be carried out. However it appears likely that the document is used in two ways. The first would be that a client wishing to achieve an environmentally building issues the document as part of a brief to a professional team. The second way is likely to be the use of LEED by a building design team to assess and shape their own designs and to influence clients on environmental issues.

[179] US Green Building Council. 2000. p.20
[180] US Green Building Council. 2000. p.4-5

The assessment process is carried out by an assessment of whether the requirements set in LEED are achieved. Where these requirements are achieved points are awarded. These points are then added up in a final page and, depending on the total, a level awarded.[181] The levels listed are:

- LEED Certified
- LEED Certified Silver
- LEED Certified Gold
- LEED Certified Platinum

4.1.11. The GBTool

Introduction

The GBTool has been developed to assess the environmental performance of buildings. The tool is part of the Green Buildings Challenge Assessment Framework, which is being developed by an international committee called the International Framework Committee.

The GBTool can be downloaded from the Internet at http://greenbuilding.ca/. The tool consists of templates in the Excel spreadsheet programme and accompanying by two volumes of manuals. The tool reviewed in this study is the GBC 2000 Assessment Manual Volume 1 and Volume 2: Office Buildings and GBTool, issued in April 2000.[182]

Aims of the GBTool and the Green Buildings Process

A number of goals are given for the Green Buildings process.[183] These are:

- To advance the state of the art in building environmental performance assessment methodologies
- To maintain a watching brief on sustainability issues to ascertain their relevance to “green” building in general, and to the content and structuring of building environmental assessment methods in particular.
- Sponsor conferences that promote exchange between the building environmental research communities and building practitioners and showcase the performance assessment of environmentally progressive buildings.
- To develop an internationally accepted generic framework that can be used to compare existing building environmental assessment methods and used by others to produce regionally based industry systems

[181] US Green Building Council. 2000. p. 25
[182] Cole and Larsson. 2000.
[183] Cole and Larsson. 2000. Volume one. p. 5

- To expand the scope of the GBC Assessment Framework from green buildings to include environmental sustainability issues and to facilitate international comparisons of the environmental performance of buildings.

Aspects Assessed

The assessment tool has a large number of performance criteria. These are organised under the following headings:

- Environmental Sustainability Indicators
- Resource Consumption
- Loadings
- Indoor Environmental Quality
- Quality of Service
- Economics
- Pre-Operations Management

The performance criteria are described in the manual in a similar way to the LEED document. The broad headings used to describe environmental sustainability indicators are: **Intention, Background, Scope**, **Performance Indicator, Units, Data and Source** and **Performance Scale**

The **Intention** provides a description of what aspects the criteria aim to assess. The **Background** provides a context and explains why the specified criteria is important to address. Under **Scope** a description is provided which delineates the extent of the assessment. **Performance Indicator** provides a description of what will be measured, for instance, the 'normalised measure of potable water consumed'. **Units** provide the units of measurement that will be used. In many instances the units provided are normalised. For instance, under 'Net Use of Water' the units provided are m3/kaph, where m3 is the annual consumption of potable water and kaph is the number of thousand annual person hours of occupancy.[184]

Data and Source indicates sources of information required to make an assessment. Finally the **Performance Scale** provides a short table which lists performance measures. The performance measures are generally provided as a performance above a benchmark (such as 120%) or below benchmark. The performance scale allocates points to each of these measures, with performance below benchmark scoring negative points and performance above this, scoring positive points.

[184] Cole and Larsson. 2000. Volume two. p. 7

Assessment Process

GBTool assessment involves inputting information into the supplied spreadsheets. This information includes occupancy (in terms of numbers of people and hours occupied) and area (in metres square) to enable performance assessments to be normalised. The tool also requires benchmarks to be included for each criterion. Benchmarks included are entered by the user and should reflect the performance within the specified criteria of an average building. Once this information has been entered, a design can be assessed.

Assessments require detailed information about the design and site and often require calculations. In some cases the calculations required are complex and require specialist knowledge or software. For instance the 'Emissions of Gases Leading to Acidification' criteria requires data from software such as Athena or Eco-Quantum or the calculation of an estimate using information such as the total embodied energy of the building and the national or regional emissions for the building industry.[185]

Once this information has been entered the GBTool generates summary graphs for each of performance areas. These indicate building performance relative to a benchmark. The assessment method is complex and it is likely at this stage to be used mainly by technical personnel such as engineers.

There is no formal training or status for the Tool currently. The main users of the tool currently are national teams who form part of the International Framework Committee of the Green Buildings Challenge. These teams use the GBTool to assess building in their country and present the results of these assessments at conferences. These discussions then guide the development of the next stage of the tool.

4.2. Addressing Hypothesis Three

The hypothesis that existing sustainable development, sustainability and development assessment systems and frameworks can inform the development of a specification for an assessment tool is shown to be true. A review of systems and frameworks provides useful material for the development of the tool. This material can be divided into a set of generic principles that should be applied to sustainability assessment systems and more detailed recommendations that come from a critique of existing building assessment systems. This is described below.

Generic Sustainability Assessment Principles

[185] Cole and Larsson. 2000. Volume two. p. 37

Indicator Systems Structure: Effective indicator systems need to be developed and used within a structure. This structure includes a number of elements. These are:

- **A context:** The indicator system should be developed with a clear understanding of the context within in which it is located. This includes developing an understanding of institutional frameworks as well as the social, economic and environmental context.

- **A vision or overarching goal:** The indicator system should have a clearly defined goal or aim in terms of changing this context.

- **Plan of action / objectives:** The indicator system should have a plan of action or route with clearly defined characteristics, which will be embarked on in order to achieve the goal stated above.

- **Indicators:** The selection or development of indicators should be designed to measure the speed of change that occurs in the direction of, or progress towards achieving, the stated objectives.

Development project outputs: Development projects aiming to support sustainable development are likely to have a range of different types of outputs. These outputs are mutually supportive and designed to achieve a particular state of sustainability. For instance, with a building project, as well as a building, maintenance and management capacity and systems may also be included as a required output to ensure that the building is maintained and operated at high levels of performance.

Development project stages: Development projects designed to support sustainable development are generally designed to have more stages, and more complex stages, than conventional projects. Early stages may involve actions to ensure support and buy–in from stakeholders as well as steps to ensure long-term sustainability (such as capacity development for maintenance). Later stages are likely to include an evaluation stage to assess impact and capture learning for future projects.

Stakeholder buy in: There is a strong emphasis on encouraging the people involved, or affected, to support development programmes and strategies, and related indicator systems. There is the suggestion that all stakeholders should be involved in the development, and selection of indicators, in order to ensure that these are fully supported.

Dialogue: The development of indicators can encourage useful dialogue and shared understanding between stakeholders, thus promoting the development of shared goals and plans of action.

Simplicity: There is a strong suggestion that indicators used should be few and simple. This can be achieved by careful selection and development of indicators. This should aim to identify the key indicators and develop aggregated indicators that are able to capture a range of aspects in one measure.

Types of indicators: There are a wide variety of different types of indicators, and it appears care should be taken to ensure the right selection and balance of these. In particular, indicators should be developed or selected to, as far as possible, report on progress towards achieving particular objectives.

Development models: There is a strong suggestion in many of the indicator systems that there is a causal link between different levels of development, and that through achieving a number of objectives at one level, higher order development goals can be supported.

Hierarchical objective and indicator systems: Hierarchical systems of objectives and indicators appear to be a common way of overcoming the problem of implementing seemingly abstract high-level goals and addressing concepts such as sustainable development.

Building Assessment Systems Critique

BREAM

It is likely that the long history of development has contributed to BREEAM becoming an effective tool for assessing the environmental impact of buildings. This is probably a result of two main factors. The first is that simplicity of the methodology and instructions that have been developed for the tool which allow ‘lay-user’ assessments to be carried out easily. The second is the strong and continued support that the tool has had from the BRE, the British government and business. The BRE have rapidly developed environmental impact assessment in buildings into a key area of their business and have invested in the ongoing development of BREEAM as well as related products. The consultation process taken as part of the development and the technical approach in assessments seems to have encouraged government and business to be strongly supportive of the tool. The legitimacy of the tool may also be assisted by the fact that it has been developed by the leading building research institute in the UK, and that formal assessments are carried out by licensed assessors.

The tool is more flexible than the other tools in that it can be used to assess different aspects of buildings such as building performance, design and procurement and management and operation. This reflects an approach, which takes into account the lifecycle of the building and the need to have a tool that can be used to assess environmental impact at the different stages in the lifecycle. This is an advantage over LEED and the GBTool, which concentrate

purely on the design stage of buildings and cannot be used to assess the design of existing buildings, or guide the management and operation of these.

BREEAM provides detailed explanation on many aspects of the tool including providing a short history of the development and the process behind the weighting of criteria. This explanation is likely to appeal to users as it allows users to ascertain the level of scientific rigour that has been applied in the development of the tool. This indicates that while a rigorous approach has been used to develop many aspects of the tool, the consensus method used to develop the assessment weighting of criteria is not scientific and likely to be highly influenced by perception and social trends.[186]

The tool clearly displays its close links with business through its efforts to demonstrate business benefits from using the tool. These include suggesting that value can be gained from developing and presenting a better company image internally, and externally, through undertaking a BREEAM assessment. This image would be supported through prominently displayed certification. The commercial aspects of the tool are also reflected in rating scales, which range from 'Excellent' to 'Pass'.[187] These suggest that even buildings which perform extremely poorly, 'Pass' merely as a result of having had an assessment taken. An approach more concerned with making significant environmental improvements, it could be argued, would have a 'Fail' category and highly challenging targets that would have to be met to achieve an 'Excellent' rating.

The tool has been developed and tested through use. For instance, different BREEAM related services are listed alongside their relevant RIBA stages of work making it easy for building professionals to understand when these could be used.[188] The simple format, pull out A3 'rapid assessment' sheet and the checklist also demonstrate an understanding of the time pressures that many building professionals work under.

The authors of the tool acknowledge the changes that are occurring in the environmental arena and suggest that they have addressed this in the tool. They assert that the tool, by including issues such as environmental impact, prudent use of materials and quality of life remains up-to-date and reflects the shift in emphasis that has occurred in the environmental arena from an emphasis on environmental issues to sustainable development.[189] However, it is suggested that this shift is not sufficiently reflected in BREEAM and that this leads, to some extent, to BREAM appearing old fashioned compared to LEED and the GBTool. It is odd that the tool does not reflect a greater emphasis on sustainable development as this concept has become firmly established in government and business in the UK. For instance, the 'Quality of Life Counts, Indicators for a Strategy for Sustainable Development for the UK' developed by

[186] Baldwin, Yates, Howard, and Rao. 1998. p 6
[187] Baldwin, Yates, Howard, and Rao. 1998. loose A3 sheet
[188] Baldwin, Yates, Howard, and Rao. 1998. p.27

the Department of Environment, Transport and the Regions demonstrates this approach by having a strong emphasis on society, equitable economics as well as the environment indicators.

LEED

It is clear that LEED has been designed for buildings in the USA. It contains an odd mix of units. For instance, distances are measured in feet [190], and lighting in footcandles [191]; measurements used in few other countries. In other sections of the document however SI units are used such as kW/ton.[192] This mix of units and the absence of conversion tables limit the ease with which people in other countries can use LEED.

In many instances the document refers to American standards and guidelines. These have been developed by a range of different bodies, including non-government organisations such as the Farmland Trust, government bodies such as the Environmental Protection Agency and professional bodies, such as ASHRAE.[193] This obviously helps to keep the document concise as detail is provided elsewhere. It also reduces the effort required to maintain and update criteria as this work is done by the association responsible for the referenced materials. There are however a number of problems with this approach. The first is that unless one has to hand all of the referenced material it is difficult to carry out an assessment quickly as one continually has to find and read through the additional material. In addition, the reference material may not be readily available to non-US users.

LEED is a very short document. This makes it easy to use. There may however be doubts about the legitimacy of the criteria used as there is no explanation of how these arose. These doubts are reinforced by the lack of detail on the organisation (the Green Building Council) that developed the tool and the motives behind why the tool was developed.

The document has a number of characteristics, which make it difficult for lay-users to use easily. It often uses acronyms such as ASTM, CFR, EPA, FEMA, which are not explained. It also refers to building terminology such as ‘development footprint’, which is also not explained.[194] The lack of a glossary may result in errors, as there is the possibility that acronyms and building terminology have different meaning in other countries.

The GB Tool

The GBTool is large and complex. This makes it difficult to use and it is unlikely that busy building professionals will make time to undertake a full building assessment on a voluntary

---

[189] Baldwin, Yates, Howard, and Rao. 1998. p. 27
[190] US Green Building Council. 2000. p. 4
[191] US Green Building Council. 2000. p. 7
[192] US Green Building Council. 2000. p. 13
[193] US Green Building Council. 2000. p. 4
[194] US Green Building Council. 2000. p. 6

basis. However it is possible, that they may use aspects of the tool to investigate particular concerns, such as ventilation, or material specification. The tool therefore is likely to be more successful as a compendium of technical information and assessment systems for reference use rather than as a widely used assessment system. This aspect may change as the system is developed and becomes simpler.

The tool, like LEED, provides little explanation as the sources of criteria. Considering the number of criteria included one could question whether these were all necessary. Generally, however, criteria are well explained and glossary at the back of the manual provides definitions.

The GBTool attempts to move away from being a national, or context related tool. It does this through avoiding reference to national standards and using internationally accepted methods and units. There are however criteria and assumptions built into the assessment system that indicate that the tool was developed in Canada. For instance, the tool often refers to HVAC systems. Increasingly, conventional air conditioning systems are not being specified in new buildings in Europe as passive systems gain in popularity. Similarly, lower cost office buildings in developing countries often do not have air-conditioning because of the capital and operating costs.

The tool has a very simple summary report for the building enabling the key performance indicators to be read easily. The report displays key indicators and graphs of performance at category level. While the key indicators measure performance in actual units – for instance in MJ of energy consumed per annum, this information is not displayed on reports. These show positive or negative performance in relation to a benchmark. The problem with this is ensuring that the benchmark is appropriate. If the benchmark selected is too low, the building assessed may show high performance reducing the tool's impact as a catalyst for improved performance. Another difficulty is that users are required to enter benchmark information, leading to the possibility that a mixture of benchmarks are used for very similar building types. This aspect limits the ability of the tool to be used for comparison purposes – this can only be done if the same benchmark is used. This aspect would appear to be somewhat in conflict with the 'international comparison' aim (see aims above) set for the tool.

The summary performance report shows performance 'by area' and 'by area and occupation'. These are normalised quantities, the first indicates a figure, for instance MJ of energy consumed per annum, divided by the area of the building measured in square metres. The second shows the same figure normalised for both area of the building and for occupancy measured in million annual person hours occupancy. This is useful as enables performance to be increased in relatively low cost ways, for instance, reducing the size of the building, or increasing the occupancy rates can improve performance. This is an important point to make

to professional teams and building owners who may think that environmentally friendly buildings are expensive and require large amounts of capital to be spent on advanced technology.

In reviewing the building environmental impact assessment tools there are a number of aspects that are relevant to the study and worth discussing.

Environmental emphasis: All of the tools appear to have an emphasis on environmental impact rather than sustainability. This suggests that the development of these tools now lags behind international developments within this area which now has an increasing emphasis on the broader and more holistic concept of sustainability. It is suggested that the specification for the tool developed by this study must reflect this change in emphasis and be based on concepts from sustainable development rather than environmental impact.

Awareness: It is interesting to note the emphasis in BREEAM on ensuring that the tool develops awareness in stakeholders that are part of the building process. This reflects the emphasis found in many of the non-building assessment tools reviewed by the study. This aspect is important; it is suggested because it is likely to be very difficult to develop and operate a building to support sustainability without the support of the developer or owner of the building and the users of the building.

Indicator selection and weighting: None of the tools were highly explicit in the methodology, or principles used in the selection of indicators. BREEAM however provided information on the process for weighting indicators. This was done through consensus and discussion with a range of interested parties. This, although better than having no method at all, seems somewhat arbitrary.

Stages and assessments: There is the realisation in BREEAM that greater impact can be achieved through linking assessment to building development stages. This enables assessments to be tied into the conventional building process, making this more likely to be adopted. Another useful aspect is that it supports continued awareness of environmental objectives, reinforcing the likelihood that these will continue to inform the implementation of the project through to completion.

Commercial building: All of the assessment systems have an emphasis on commercial buildings. This is not in line with sustainable development priorities, which include addressing the needs of the poorest. It is unlikely that reducing the environmental impact of a commercial building will have any impact on poor or marginalized people. The emphasis on addressing the needs of poor and marginalized people has not been addressed in any of the tools and, it

is suggested, this should be considered and addressed in the specification for the tool developed by the study in Chapter five.

Scope: All the tools have a limited scope. This generally focuses on ensuring that buildings become more environmentally friendly. It is suggested that this may be a missed opportunity as buildings, can be used to encourage change in the wider environment. For instance, buildings can support the development of a more diversified economy through specification of innovative and new components, produced by small emerging enterprises.

Technological emphasis: It is interesting to note the emphasis, particularly in LEED, on technology. This suggests that there is the perception that using different and better technology will result in reduced environmental impact. While this may be the case in certain circumstances it is not necessarily true and ignores the opportunities offered by changing consumption and production patterns.

Overall goal: All of the systems provide clear aims and objectives for the tool. Only one tool however, BREEAM ties this to wider policy by making reference to UK's Strategy for Sustainable Development. While linking into this context is useful for users in the UK it leads to the questioning of the relevance of the tool in countries where national policy has different priorities to the UK.

Objectives: The assessment tools have a set of simple objectives. These include supporting the development of comfortable and healthy internal environments at minimum expense to the environment. If one compares this to the complexity of sustainable development and the goals that have to be achieved these objectives appear to be too simple and not challenging enough. It is suggested that they do not fully grasp opportunities to use buildings and construction as a vehicle for change and for initiating and supporting sustainable development. Objectives for a building that supports sustainable develop should, it is argued, have a more ambitious goal in terms of supporting sustainable development and include a much larger range of lower order objectives, which support this goal.

4.3. Concluding Hypotheses Three

The hypotheses that existing sustainable development, sustainability and development assessment systems and frameworks can inform the development of a specification for an assessment tool is demonstrated.

This chapter concludes that existing building assessment tools are inappropriate in respect of the objective set for the tool by this study, namely 'the integration of sustainable development into the briefing and design processes of buildings and construction in developing countries'. It shows that these systems are only partly relevant to developing country contexts. This is

because they do not take into account the particular social, economic and environmental priorities that exist in developing countries. It is also suggested that these building assessment systems are to a certain extent out of date, as they do not fully reflect the shift in emphasis from environmental impact to sustainable development that has occurred. However existing systems have gone a long way in developing assessment systems that enable the contribution of building to sustainable development to be measured and there is much that can be learnt from existing approaches for the study.

The review enables a clear picture of best practice in sustainable development assessment to be developed. It also enables this practice to be defined in terms of a structure, components and methodology that can be used to inform the development of the specification. Effective indicator and assessment systems that are able to capture information on, and guide, sustainable development generally have particular structures and characteristics. Key aspects of these are described below.

A context: The indicator system should be developed with a clear understanding of the context within which it is located. This includes developing an understanding of institutional frameworks as well as the social, economic and environmental context. Where possible the indicators should be developed to link, and work with, existing appropriate policy and initiatives. It is also important to understand, and develop, a description of the context in terms of a number of perspectives. The perspectives that appear important from a sustainable development view are those of poor or marginalized people (to ensure their needs are met), the future (to ensure that future generation's needs are addressed) and the earth (to ensure that the carrying capacity of the earth is maintained).

Sustainable development: Indicators used for sustainable development need to be developed with a very clear understanding of sustainable development and sustainability. This needs to be understood in terms of an ultimate goal that is to be achieved, such as a 'state of sustainability', and a clear route or direction defined as to how to get there, such as 'sustainable development'. Knowledge in the field now enables approximate definitions of both of these. For instance, sustainability from a human perspective can be said to have been achieved when man is able to live within the carrying capacity of the earth (when man's ecological footprint does not exceed the earth's carrying capacity). Similarly, from within the 'sciences of sustainability' a range of tools and approaches are being developed to guide moves towards more sustainable practices. These include concepts such as " Do more with less" (methodologies and process for achieving greater resource efficiencies) and "Needs not Wants" (changing consumption patterns to make sure that everyone's basic needs are addressed).

Model of the system: Indicator systems should ideally relate to an explicit model of the system they are designed to assess. This is useful because it can assist with the design of interventions that are aim to make systems more sustainable. They can also improve performance by testing and evaluating scenarios before selecting the most favourable option. The model as far as possible should make the workings of the system explicit and show it's links to, and impact on, related social, environmental and economic systems.

A vision or overarching goal: Indicators should be linked to objectives. These should be generated and cascade down from a clearly defined goal.

Plan of action: The indicator system should have a plan of action with clearly defined characteristics that will be embarked on in order to achieve the goal state above. These characteristics should include the following. Objectives, and actions should be developed, and organised, in a hierarchical structure in order to support the achievement of an overarching goal. As far as possible all stakeholders should be involved in the development of objectives, and progress indicators. This should occur in a shared process such as a workshop in order that this is transparent and fully supported.

Indicators: The selection or development of indicators should be designed to measure the speed of change that occurs in the direction of, or progress towards achieving, stated aims and objectives. An effective indicator system that enables progress towards objectives to be ascertained can improve effectiveness as accurate information can be used to develop, and adapt strategies in order to achieve maximum performance.

5. SPECIFICATION FOR A BUILDING ASSESSMENT SYSTEM

5.1. Sub Problem Four and Hypothesis Four

Sub problem: Can a specification for an assessment tool which aims to ensure that sustainable development is addressed and incorporated in the briefing and design of buildings in developing countries, be developed by drawing on the sustainable development context (problem one), key sustainability concepts (sub problem 2) and key features of sustainable development, sustainability and development assessment systems and frameworks (sub problem 3)?

Hypothesis: A specification for an assessment tool, which aims to ensure that sustainable development, is addressed and incorporated in the briefing and design of buildings in developing countries can be developed.

5.1.1. Introduction

In this chapter a specification for an assessment framework that enables sustainable development to be addressed in the building design process will be developed. This specification will be compared with the Sustainable Building Assessment Tool that will be introduced in the next chapter, Chapter six.

The specification for this tool will have the following structure. The **Purpose of the Tool** will provide a description of the aims of the tool. This is followed by the **Scope of the Tool**, which describes the area that the tool will address and define the limits of this. **Components of the Tool** will describe components of the tool that are envisaged to be necessary. These components consist of an **Assessment Framework** and a **Structured Process.** The Assessment Framework describes the envisaged structure and content of the tool and the Structured Process describes how the tool should be used and integrated into design and construction processes. Finally, there will be a description of a number of principles in **Principles for Design and Use.** These are drawn from earlier sections of the study in which sustainable development and assessment systems are reviewed.

5.1.2. Purpose of the Tool

The purpose of the tool is to guide the development of buildings that support sustainable development in developing countries. The tool will achieve this through the use of an assessment framework and a structured process during the briefing and design stages of buildings. The tool will aim to achieve the following:

- Develop awareness about sustainable development in those involved in the building development process
- Develop an understanding of the implications of sustainable development for buildings in those involved in the building development process
- Involve those involved in the building development in discussing, and agreeing, approaches and targets for supporting sustainable development in the building
- Support decision-making in the design team by providing a framework with targets against which different design options can be evaluated.
- Monitor and report on progress towards targets set

The tool aims to support the development of buildings that support sustainable development by ensuring that sustainable development, the local context, and best practice in building and construction are explicitly addressed in a highly structured way in the design process and synthesized into high performance, appropriate, and sustainable, design solutions.

5.1.3. Scope of the Tool

The scope of the tool is as follows:

- **Buildings**: The scope of the tool will be limited to buildings. In particular, it will aim to impact on medium size buildings such as schools, clinics and small offices.
- **Design Stages:** The tool will be designed to influence the briefing and design stages of a building. It should however take into account all other stages in the building lifecycle.
- **Architects**: The main users of the tool will be design teams and in particular architects. However the tool should be designed to be easily understandable by lay people. It should enable all building stakeholders, who may be lay people, to participate in the process of using the tool.
- **Context:** The tool aims to address the context of a developing country.

5.1.4. The Components of the Tool

In order to support the design of buildings that support sustainability, a number of components are required. These consist of an assessment framework and a structured process.

The assessment framework: The assessment framework provides a structure in which high level sustainability goals can be developed into specific design objectives. Indicators can then be developed for these objectives, which enable an assessment of the extent to which these objectives have been achieved, to be assessed. The assessment framework thus enables sustainability to be interpreted into explicit objectives, which can be worked towards.

The structured process: The use of the assessment framework however requires a structured process. This is because addressing sustainable development effectively in buildings requires understanding and agreement from a number of stakeholders including the different members of a design team, the client or building owner, and building users. In addition, a structured process helps to ensure that sustainable development is an ongoing concern in all of a building's lifecycle stages.

These components are described in more detail below.

5.1.5. The Assessment Framework

The study reviewed a range of assessment frameworks in Chapter four. The specification will therefore aim to learn from these reviews in order to distil, and describe, important aspects, that the assessment framework must incorporate. These aspects can be described under three headings:

- Basis for the development of the assessment framework,
- Structure of the assessment framework, and
- The selection and development of indicators

Basis for the Development of the Assessment Framework

The review of assessment systems showed that assessment frameworks are developed, or underpinned, by theoretical and value systems. The World Bank describes this in the following way:

Behind the formulation of any system of indicators lies some implicit or explicit model of (1) what matters, and (2) the way the world works[195]

This specification should therefore aim to make explicit the main aspects of a theoretical frame of reference that should be drawn on, in developing the assessment framework. This is particularly important because of the complexity of the area being addressed and the range of definitions and models that currently exist for sustainability and sustainable development.

In addition, it is suggested, that common, existing, definitions of these areas are not necessarily useful for the development of an assessment framework. What is required, and what the specification should provide, is a description of the relationships between buildings and sustainable development. This, it is argued, will provide the elements necessary to develop an assessment framework.

[195] World Bank. 1996

The study will therefore describe the following aspects: ‘Sustainability and Sustainable Development’, ‘A Developing Country Context’ and ‘Elements of a Building’.

Sustainability and Sustainable Development

Sustainability can be described as a state in which man is living within the carrying capacity of the earth. This means that the earth has the capacity to accommodate the needs of existing populations in a sustainable way and is therefore also able to provide for future generations. However as we are currently in an unsustainable state as a result of man exceeding the carrying capacity of the earth, man must make a strong and concerted shift in direction in order to return to within the carrying capacity of the earth.

Sustainable development is the concerted and integrated action and change of direction required to enable man to return within the carrying capacity of the earth. This is designed to enable a return to a state of sustainability in which the earth is able to accommodate the needs of existing populations as well as future generations.

The review of sustainability in Chapter three suggested that sustainability could be described in terms of social, economic and environmental states that are required in order for overall sustainability to be achieved. These states are summarised below:

Social state: Safe, happy, healthy, cohesive, fulfilled, societies that have organisational structures and are able to develop innovative solutions, which enable them to share limited resources equitably and in ways that enable all existing and future populations needs to be met.

Economic state: Responsive systems and technology that are able to accommodate change and ensure that limited resources are used and maintained as efficiently and effectively as possible to provide for the needs of existing and future populations without damaging the biophysical environment.

Environmental state: Strong, robust, vibrant, biophysical systems that are able to provide resources and conditions necessary for existing and future populations on an ongoing and steady basis.

The review of sustainable development in Chapter two suggested that sustainable development objectives that support the return to a sustainable state can be defined. These are listed below:

Social Sustainable Development Objectives[196]

[196] A table showing the development of these objectives from the WSSD Plan of Implementation is provided in Appendix three.

- **Access:** Ensure that development supports increased access to land, adequate shelter, finance, information, public services, technology and communications, where this is needed.
- **Education**: Ensure that development improves levels of education and awareness, including awareness of sustainable development.
- **Inclusive:** Ensure that development processes and benefits are inclusive.
- **Health, safety and security:** Ensure that development considers human rights and supports improved health, safety and security.
- **Participation:** Ensure that development supports partnerships, social interaction and involves, and is influenced by, the people that it affects.

Economic Sustainable Development Objectives

- **Employment and self employment:** Ensure that development supports increased access to employment and supports self employment and the development of small enterprises.
- **Efficiency and effectiveness:** Ensure that development (including technology specified) is designed and managed to be highly efficient and effective, achieving high productivity levels with few resources and limited waste and pollution.
- **Indigenous knowledge and technology:** Ensure that development takes into account and draws on, where appropriate, indigenous knowledge and technology.
- **Sustainable development accounting:** Ensure that development is based on a scientific approach which measures and monitors social, environmental and economic impacts and this is used to guide development.
- **An enabling environment:** Develop an enabling environment for sustainable development through the development of transparent, equitable and supportive policies, processes, and forward planning.
- **Small-scale, local and diverse economies:** Ensure that development supports the development of small scale, local and diverse economies.

Environmental Sustainable Development Objectives

- **Size, productivity and biodiversity:** Ensure that development conserves or increases the size, biodiversity, and productivity of the biophysical environment.
- **Resource management:** Ensure that development supports the management of the biophysical environment to ensure that this is not adversely affected.
- **Resource extraction and processing:** Ensure that development minimises the use/support of environmentally damaging resource extraction and processing practices.

- **Waste & pollution:** Ensure that development manages the production of waste to ensure that this does not adversely affect the biophysical environment.
- **Water:** Ensure that development manages the extraction, consumption and disposal of water in order not to adversely affect the bio-physical environment
- **Energy:** Ensure that development manages the production and consumption of energy in order not to adversely affect the biophysical environment.

This description provides simple definitions for sustainability and sustainable development. It is useful as it describes both an ultimate state that must be strived for as well as a set of actions or objectives, which if implemented, will lead towards this state. It also allows the broad concepts of sustainability and sustainable development to be defined and broken down into more concise elements. These elements enable an assessment framework to be developed as these elements can be compared in a matrix in order to develop an understanding of the relationships that exist. The charting of these relationships will be done later in the chapter.

Having described sustainability and sustainable development it is important to understand how this relates to developing and developed countries. Developed countries may have achieved certain aspects of ‘a state of social sustainability’, such as reasonable health and safety within their populations. It therefore could be argued that social sustainable development objectives could have a lower priority to economic and environmental sustainable development objectives in these developed countries.

Developing countries on the other hand are unlikely to have achieved many aspects described for a state of social sustainability. Therefore, addressing social sustainable development objectives is likely to be a priority in developing countries.

These differences in states mean that there are often differing priorities in developing and developed countries. In sustainable development it is therefore important to understand the local context and priorities. The assessment framework therefore must acknowledge and respond to the context in which it is used. The key aspects of a developing country context relevant for the assessment framework are listed below.

A Developing Country Context

- **Infrastructure:** In developing countries there are generally lower levels of infrastructure development than in developed countries. This means that infrastructure development is required in order for key sustainable development objectives such as Access, Education and Health (for fuller descriptions see above) to

be achieved. There is an opportunity, in the development of this new infrastructure to design and manage this to support sustainable development.

- **Capacity:** There are generally low levels of capacity and education within developing countries. Sustainable development interventions are therefore likely to require the inclusion of education and capacity building programmes to ensure that development has the appropriate impact and is sustained.

- **Participation:** in developing countries populations may have had little say in how development has occurred. In order to ensure that development reflects the needs and priorities of the people it will affect, and will be supported by them, it is important to ensure that they are appropriately involved.

- **Social exclusion:** In developing countries there may be groups such as old people, poor people, disabled people, uneducated people or people from a particular tribe whose needs have not been adequately addressed by existing development approaches. It is therefore important to understand, and make sure that these needs, are addressed.

- **Social priorities:** In many developing countries there are urgent social priorities such as health and education that need addressing.

- **Economic priorities:** Developing countries often have urgent economic priorities that need to be addressed such as unemployment and inequity.

- **Development limitations**: Developing countries may have particular limitations and parameters that must be acknowledged. These may be physical, for instance developing countries may experience serious water shortages. They may also be financial with development options limited by lack of financial resources or access to foreign exchange.

- **Indigenous systems:** Developing countries may have highly evolved indigenous systems that are sustainable. These include technological, organisational, cultural and knowledge systems. These can provide highly valuable models for sustainable development as they provide working models that can be drawn on.

The description of a developing country context above suggests that interventions to support sustainable development in developing countries should address social and economic issues as a priority. It is not suggested that environmental issues should be forgotten, as this would not enable a state of sustainability to be achieved. Rather, It is suggested, that environmental

sustainable development objectives are acknowledged and addressed in interventions designed to address urgent social and economic priorities.

The description of the developing country context indicates that there may be a valuable opportunity to develop infrastructure that is aligned with sustainable development objectives. It suggests that new infrastructure, if developed correctly, may be able to avoid many of the problems associated with existing infrastructure in developed countries, which now has to be managed and adapted to try and make this more sustainable. In terms of an assessment system this context description suggests that two important questions should be asked in the assessment process. These are:

- Does the development directly address urgent national social and economic priorities?
- In the development intervention, has the unique opportunity for developing infrastructure that supports sustainability been recognised and adequately seized?

Elements of Buildings

The description and classification of buildings is complex and it is not the intention of the study to review or describe these. It is important however for the study to be able to define buildings in a simple way that enables them to be broken down into a series of finite elements that can be used to assist in the development of an assessment framework.

It is suggested that a description of buildings must acknowledge the fact that buildings are both a physical entity (a building) as well as being a dynamic process (the building life cycle). Both of these can be described in terms of distinct *elements* or *stages*:

Building Elements

A building may be described in terms of the following elements:

- **Location**: This describes the location of the building
- **Site:** This describes the site and landscaping in which the building is located
- **Size and shape:** This describes the size and shape of the building
- **Building envelope:** This describes the physical envelope enclosing the building
- **Internal space:** This describes the space enclosed by the building envelope

- **Furniture and fittings:** This describes equipment, furniture and fittings located within the internal space

- **Services:** This describes services in the building such as water, electricity and telephone

- **Materials and components:** This describes the materials and components used in the building

There are clearly overlaps between these elements, however, for the purposes of the study it is suggested that this breakdown provides the appropriate number of elements required to support the development of the assessment framework.

Building Life Cycle Stages

The life of buildings can be broken down into a number of discrete stages. These are as follows:

- **Briefing:** This stage starts with the decision to develop a building and includes initial conceptualisation of the requirements of the building

- **Design:** This stage include the development of the design of the building through to tender documentation

- **Construction:** This stage refers to the construction of the building and ends at handover to owner or users on completion

- **Operation:** This describes the stage where the building is in normal use and ends when a decision is made to refurbish or demolish the building

- **Refurbishment/demolition:** This describes the stage when the building is deconstructed, or refurbished for further use.

This is also a relatively simplistic description of the life of buildings; however it provides 5 discrete stages which can used to inform the development of the assessment framework.

The Implications of Sustainable Development for Buildings and Construction

In order to explore the relationship between sustainable development and building and construction elements identified in each area can be entered into a matrix. This is shown in Table five.

Table Five: Sustainable Development and Building and Construction Element Matrix

		Brief	Design	Design elements								Construction	Operation	Demolition /refurbishment
				Location	Site	Size and form	Envelope	Internal space	Furniture and fittings	Services	Materials & component			
		A	B	C	D	E	F	G	H	I	J	K	L	M
Size, productivity & biodiversity	1			●	●	●	●	●	●	●	●	●	●	●
Resource Management	2			●	●				●	●	●	●	●	●
Resource extraction & processing	3								●	●	●	●	●	●
Waste and pollution	4			●	●			●	●	●	●	●	●	●
Water	5			●	●	●	●		●	●	●	●	●	●
Energy	6			●	●	●	●	●	●	●	●	●	●	●
Employment and self employment	7	●	●	●	●	●	●	●	●	●	●	●	●	●
Efficiency and effectiveness	8	●	●	●	●	●	●	●	●	●	●	●	●	●
Indigenous knowledge & technology	9	●	●						●	●	●	●	●	●
Sustainable development accounting	10	●	●									●	●	●

An enabling environment	11	●	●									●	●	●
Small-scale, local and diverse economies	12	●	●	●	●	●	●	●	●	●	●	●	●	●
Access	13	●	●	●	●	●		●		●			●	
Education	14	●	●	●	●			●	●	●		●	●	●
Inclusive	15	●	●	●	●		●	●	●	●	●	●	●	●
Health, safety and security	16	●	●	●	●	●	●	●	●	●	●	●	●	●
Participation	17	●	●	●	●	●	●	●	●	●		●	●	●

Buildings and Construction Sustainable Development Objectives

The matrix is helpful in that it begins to enable the implications of sustainable development for buildings and construction to be elucidated. In order to chart this relationship sustainable development objectives (vertical column, numbers 1-17) were compared with building and construction elements (horizontal rows letters A-M). Dots indicate where there appears to be implications for a building element of a sustainable development objective. The implications for building elements of sustainable development objectives have been used to generate building and construction sustainable development objectives. These detail specific objectives that should be aimed for in buildings and construction in order to support sustainable development. These are listed in Appendix eleven. This list is not intended to be exhaustive as it is designed primarily as a prompt, and checklist, for the development of an assessment tool. The list of objectives forms a ‘comprehensiveness check’ within the specification, ensuring that important building and construction sustainable development objectives are not missed out in the assessment tool.

5.1.6. Structure of the Assessment Framework

The review of assessment frameworks carried out in Chapter four provide a number of recommendations for the structure of assessment frameworks. These recommendations suggest that there should be a hierarchical structure consisting of goals, objectives and

indicators. This structure, it was suggested, enables complex high-level goals to be broken down into manageable and understandable actions and objectives. In order to assess progress towards achieving actions of objectives, indicators linked to these objectives should be used. The assumption being that by achieving all the objectives one is able to achieve a higher-level goal. In many of the assessment systems reviewed this hierarchy was reflected in a tabular form similar to that show in Table six.

Table Six: Assessment Framework Structure

Goal	Objective 1	Sub objective 1a	Indicator 1a
		Sub objective 1b	Indicator 1b
	Objective 2	Sub objective 2a	Indicator 2a
		Sub objective 2b	Indicator 2b

Having defined a broad structure it is useful to consider how the content should be developed. What are, for instance, the criteria that should be used in developing or selecting goals, objectives and indicators for the assessment framework? To a certain extent this has already been answered in the previous sections of the chapter, however it is useful to review this.

Goal: The goal in the assessment framework describes a high level goal that should be achieved. Examples of this high level goal can be found in national policy frameworks for instance the UK Strategy for Sustainable Development has as goal ‘to improve quality of life’ while South Africa’s Reconstruction and Development Plan (RDP) had the major goal of ‘achieving better equity’.

In the assessment framework, ideally, the goal should be a simple, easily understandable statement. For instance the goal that the assessment tool may aim to achieve could be:

The development of buildings and construction processes that support sustainable development.

Objective: In the assessment framework this high level goal should be broken down in to objectives that can be achieved in the building. This area has already been explored in an earlier in this chapter and building and construction sustainable development objectives generated and listed in Appendix ten. This section provides a large number of suggested objectives that should be achieved in a building in order to make sure that the goal of achieving buildings and construction processes that support sustainable development is achieved. There is however little overall order in the way the objectives are currently organised, and it is apparent that there are overlaps between these. In addition, the list has no prioritisation.

In order to be able to address objectives it is valuable to be able to develop a clear structure and prioritisation for these. The structure chosen is likely to be guided by how the tool will be used. For instance, if mainly architects use the tool, a structure related to how architects work, and describe buildings, would be appropriate. This will be explored in more depth in the next section titled 'The Use of the Tool'. The selection and prioritisation of objectives is also important. It is suggested that explicit criteria are used for this. The criteria suggested for the selection and ranking of objectives are as follows:

- **Context:** This criterion ascertains whether the objective addresses important social and economic priorities that exist in many developing country contexts. The social and economic priorities used are those defined in the Millennium Goals.[197] It is suggested that this is important because there are priorities in developing countries that need to be addressed first, and it is important that the assessment framework prioritises these. This is not to say that other objectives are not important, just that they may not be the first priority to address.

- **Ease of implementation:** This criterion ascertains whether the objective can be achieved reasonably easily with the resources and capacity that exist in a developing country.

- **Cross support:** This criterion investigates the extent to which the objective supports sustainable development in other areas. For instance an objective such as provision of space for education may not only support increased social sustainability but also increased economic sustainability (through increased ability to innovate) and environmental sustainability (through greater awareness and understanding).

These criteria enable objectives to be ranked. It is argued that objectives that are prioritised in this way should be the ones that are addressed first as these are relatively easy to implement and will have the greatest impact on a developing country context.

It is important however to note that objectives that do not emerge as a top priority through this ranking processes should not be ignored. Instead there should be a system of primary and secondary objectives. The highest ranked objectives should be primary objectives, which once achieved, should be replaced with secondary objectives, which are lower ranked. In this way there is a dynamic development process that progresses through a series of sustainable development objectives in order to move towards a state of sustainability. The ranking of objectives can be carried out using a simple table as indicated below.

[197] http://www.un.org/millennium/sg/report 19/12/02 09:00

Table Seven: Objective Rating Criteria

Objective	Context: Addresses social and economic priorities (as defined in the Millennium Goals)	Ease of implementation: Can be achieved with limited resources & technical capacity	Cross support: Addresses other social/ economic/ environmental objectives	Rating
Objective one	Y			1
Objective two		Y	Y	2

Having developed a list and structure for the objectives in the assessment framework it is useful to check this by asking the following questions.

- What is the balance between objectives that are designed to address social, economic and environmental aspects? Is this balance correct?
- Can the objectives be used or changed in a dynamic way to respond to different contexts and priorities? Is there a logical progression of objectives that can be followed to support a continuous sustainable development process, as objectives are achieved over time?

5.1.7. The Selection and Development of Indicators

Once a system of objectives have been designed it is important to develop or select indicators linked to these objectives that can be used to measure progress towards achievement of these objectives. Care should be taken however in selecting or developing indicators, as they are unlikely to be used if they are not reliable, or too complex. In order to assist in the design and selection of indicators it is suggested that a number of criteria are used. These are as shown below.

Table Eight: Indicator Rating Criteria

Indicator	The indicator is easy to understand by all stakeholders	The information required for the indicator is readily available	The indicator requires minimal additional modelling, calculatio	The method of measuring the indicators is objective	Has a target against which it can be compared	Rating

		and easy to capture	n or investigation			
Indicator one		Y			Y	2
Indicator two	Y	Y	Y	Y	Y	5

These criteria, it is suggested, will assist in the selection or development of suitable indicators for the assessment framework. It is important however that these are treated as guidelines and not hard and fast rules. For instance a building objective may be the development of adaptable and flexible space. While this may be a very important building and construction sustainable development objective there may be very few indicators that are suitable or meet the above criteria. In cases like this it may be important to relax the criteria applied and note the area, as one to be addressed, in further research.

It is also important that the right mix of information is collected. This is because sustainable development is about qualities, such as quality of life, as well as about quantity. Many aspects of sustainable development also centre on people, and it is often difficult to develop reliable quantifiable indicators for aspects of human life, like social cohesion or motivation.

Another aspect that is important to acknowledge in the selection and development of indicators is the importance of relationships and links within sustainable development. Indicators that enable information about these links are useful because they are more reliable ways of measuring whether the overall intention behind objectives is being achieved. For instance, a broad objective might be to support education and small businesses by ensuring that buildings provide facilities for a local community to access the Internet. In this case, as well as measuring access to the Internet by the local community, it is important to assess whether this access is affordable for them. The inclusion of affordability ensures that the indicator is more reliable as it takes in to account income levels, which may be an obstacle, as well as levels of access to the Internet.

Thus in reviewing indicators, it is suggested that the following questions should be asked.

- Has the right mix of indicators been developed to reflect fully sustainable development progress in qualitative as well quantitative terms?
- Do the indicator mix reflect the right balance between sustainable development (short term objectives) and sustainability objectives (long term objectives)
- Do the indicators capture important relational information that ‘cross check’ the achievement of objectives and help ensure that these are reliable?

In order to indicate how these elements form a whole, a simple example is provided in the table below.

Table Nine: Building and Construction Sustainable Development Assessment Framework

Goal	Objective	Building Objectives	Indicators
Social Sustainability	Provide access to appropriate education	Design space in buildings to support education	% area of floor area provided for education as a proportion of total floor area
		Provide services such as access to the Internet to support education	Number of workstations with access to the Internet available for use, relative to number of building occupants

5.1.8. The Structured Process

In order to make the assessment framework an effective tool for addressing sustainable development in the design of buildings it must used as part of a structured process. This process is required because it enables the assessment framework to be effective by:

- Ensuring that the assessment framework is used at the right time where it will make the most impact and can be fully integrated into the building development process

- Helping to make sure that there is an awareness about sustainable development amongst building stakeholders and that there is an understanding of how, through early briefing and design decisions, this issue can be addressed effectively in the building development process.

- Making sure that the decisions required by the assessment framework to support sustainable development are taken by the right people, and that these decisions are documented appropriately.

- Making sure that this has an ongoing influence on the building and on construction processes throughout the building life cycle.

The Building Lifecycle and the Use of an Assessment Framework

The structured process should integrate the use the assessment framework into conventional processes that take place in the development of buildings. This requires key decision and monitoring points to be identified when the tool can used to set the direction and monitor progress. These points and the use of the assessment tool in the various building life cycle stages are described below.

- **Briefing:** This stage is the most important for the assessment framework. This is when the use of the assessment framework should be agreed to by all involved in the building development. It should also include an initial discussion, which uses the assessment framework to develop and agree, an outline performance targets for the building. Ideally these outline performance targets should support decision making on areas such as whether a new building is really required, and where this should be sited. A valuable aspect of this stage is achievement of an 'in principle' agreement by all involved in the building development, that sustainable development is an important aspect to address, and integrate into the briefing and design of the building.

- **Site analysis:** The site analysis stage provides an opportunity to evaluate opportunities offered, and needs that could be addressed, at the selected site in terms of sustainable development. This analysis should be used to inform and prioritise targets set, in the next stage, the target setting stage.

- **Target setting:** During this stage the design team should develop detailed and challenging performance targets for the building. These should draw on the outline target sets during the briefing stage, the findings of the site analysis, and best practice performance and benchmarks from buildings of similar function and locations. These detailed targets are used by the design to inform the decision making during the design process. They are also used by all involved in the building development to monitor and evaluate progress in supporting and integrating sustainable development in the building.

- **Concept design:** During this stage the first conceptual designs for a building are developed. Having an assessment framework with detailed performance targets should ensure that designers generate solutions that support sustainable development. These solutions can be evolved through iterative processes where design options are evaluated against targets set in the assessment framework.

- **Detailed design:** This iterative process continues as the detail of the design develops. Ideally this should inform all aspects of the design including decisions such as the location of light switches and the specification of finishes. It is suggested that at key stages in the design process, design reports accompanied by an assessment should be developed and presented to all of those involved in the development of the building. Where performance targets set in the assessment framework are not being met the reports should hi-light these, enabling these to be discussed and addressed at project design meetings.

- **Tender documentation:** In conventional practice building designs are developed into production information and tender documentation. This is used by contractors to prepare tenders and for constructing the building. In the structured process it is important that this documentation make the sustainable development objectives of the building explicit to the contractor. In addition, where there are particular targets that must be addressed through the construction process, these should be included in a way that ensures that a contractor is contractually bound to address them. Examples of these types of targets may be the minimisation of construction waste and the training of local personnel during construction.

- **Construction:** During construction, the contractor should address sustainable development targets identified for this stage. Progress towards the achievement, of these targets should also be reported on. Care should be taken to make sure reporting is accurate, and it may be useful to ensure that this is done by an independent party such as a Clerk of Works. Reporting on targets should be integrated into conventional construction and contract administration. It therefore should be included in monthly construction reports provided to a design team and client. It should also be an agenda item at project progress meetings. Where it becomes apparent that progress is not being made towards the achievement of targets this needs to be hi-lighted and addressed at progress meetings and, if necessary, through administration of the construction contract.

- **Handover:** On completion of the construction stage the building becomes ready for occupation. In terms of the assessment framework this is an important moment because this marks a change in emphasis from design and construction objectives to management objectives. In order that management objectives are achieved it is important that building users and managers understand and support the sustainable development objectives that are being aimed for. They also need to understand how the building and its systems may have been designed to support sustainable development and are able to use and manage the building in a way that achieves this. As buildings may be complex it is important that the design team, and possibly

contractors and suppliers, provide adequate support. This can be done through an induction process for new occupants of the building, training for building managers and a building user manual. In each of these elements ideally sustainable development objectives should be hi-lighted and inform the content.

- **Operation:** During the life of the building it is important that the sustainable development objectives developed for the design also informs the use, and the management and maintenance of the building. Making these explicit during training, induction and in building user manuals can support this. However to fully integrate these objectives into the use of the building requires that progress towards achieving these objectives, be reported on regularly. The assessment framework developed for the design process may therefore be used to inform the development and setting of targets set in a 'management' assessment framework designed to ensure that sustainable development objectives are achieved in the operation of the building. This framework can be developed in a similar way as the design assessment framework. It should also be supported and understood by the key stakeholders such as the building owner and building users and indicators used to monitor progress towards the achievement of objectives. Examples of objectives set could be energy and water consumption targets.

- **Demolition or refurbishment:** At the end of the useful life, a building may be demolished or refurbished for further use. If it is demolished, hopefully the use of the assessment framework will have contributed to ensuring that this can take place in a way that supports sustainable development. For instance, the building may have been designed to be readily disassembled enabling components and materials to be recycled. The building user manual may also contain disassembly instruction to enable this to occur with a minimum of waste. If the building is to be refurbished it should be upgraded for better performance in terms of sustainable development. In order to do this an assessment framework similar to the one used for a new building could be used.

5.1.9. Principles for Design and Use of the Assessment Framework

In addition, as the assessment tool will be used to ensure that sustainable development is thoroughly addressed in buildings, it is important to ensure that it learns from the related fields of sustainable development and assessment systems.

Sustainable Development Principles

A number of principles were proposed for sustainable development from the literature reviewed in Chapters two, three and four. For the specification, the key principles are presented below:

- **Participatory:** The process of development should involve local people and reflect their priorities and needs

- **Social exclusion:** Development should take care not to exclude any groups such as women and disabled people from being fully involved.

- **Transparent:** The process for reaching decisions and carrying out actions should be as transparent as possible.

- **Local resources:** where possible development should draw on existing local skills, knowledge and resources.

- **Precautionary principle**: Development action and intervention should be guided by the precautionary principle and should not wait until there is comprehensive knowledge and understanding within an area**.**

- **Top-down and bottom-up:** The approach should enable development to be understood and monitored at a detailed level and at a holistic level.

Sustainability Assessment System Principles

A range of sustainability and environmental impact systems were reviewed earlier in Chapters two and four. The key best practice principles applied in these systems are listed below:

- **Hierarchical structure:** Assessment frameworks should have a hierarchical structure consisting of the following elements:

  - Overarching goal
  - Objectives
  - Sub objective
  - Indicators

- **Involve key stakeholders:** The process of assessment should actively involve those affected or concerned by the development.

- **Awareness:** The assessment process should increase awareness about sustainable development amongst those affected or concerned by the development. This encourages a shared understanding to be developed, which in turn, enables sustainable development to be addressed more effectively.

- **Agreement:** The assessment process should ensure that all those affected or concerned by the development are not only involved, but also actively participate in designing and agreeing objectives and indicators.

- **Monitor progress towards achievement of objectives:** Indicators should be used as part of the assessment framework to monitor and evaluate progress towards the achievement of sustainable development objectives.

- **Support decision-making**: The assessment frameworks should be used to inform decision-making. In order to check that appropriate decisions are being made, limited modelling may be necessary to check the performance of different options in order to ensure the most appropriate one is selected. The tool should support an iterative process where options can be tried and tested in order to develop, and evolve, the most appropriate solutions.

- **Responsive:** The tool should be able to respond to the local context, the users and the function of the building. It is therefore important that the tool is flexible enough to be used in different situations and care should be taken that the tool is not too prescriptive. In many situations, solutions and approaches may have to ‘emerge’ from an iterative design process.

- **Tool development:** A description of how and why the tool was developed should be provided.

- **Logical:** The tool must be structured in way that enables users to easily understand how the tool works and how this relates to buildings and sustainable development.

- **Linkages:** The assessment process should encourage investigation into understanding of linkages and interdependencies in systems.

- **Justifiable:** As far as possible, the content and emphasis in the tool should be justifiable though reference to research and other information.

- **Strong and weak science:** The tool should distinguish between areas where there is strong knowledge and areas where this is weak. In order to address differences in knowledge it may be appropriate to have a system of primary indicators and secondary indicators. Primary indicators should be used to monitor progress in well-established knowledge areas and secondary indicators used for areas where knowledge is not as strong, or where information may be unreliable.

- **Assumptions:** where important assumptions are made these assumptions should be described.

- **Reference materials:** Where reference information has been material to the development of the tool, full references for this material should be included.

- **Definitions:** Key definitions should be included in the tool. In particular it is important to include definitions for terms alluded to in the overarching goal of the assessment framework, such as sustainable development.

5.2. Addressing Hypothesis Four

The development of a specification raises a number of considerations that can be discussed. These are:

Sustainable development: The specification is helpful in that it provides a clear definition for sustainability and sustainable development. It also provides a clear set of sustainable development objectives. These objectives however have been developed from the UN's WSSD Plan. This means that the assessment tool will be aligned to UN policy. However, as discussed in Chapter two, there are concerns about whether the UN plan reflects sustainable development best practice and is comprehensive and rigorous enough to be used to implement sustainable development on the ground. A useful area of research would therefore be to analyse the UN WSSD and other sustainable development frameworks in order to develop sets of succinct sustainable development objectives for specific sectors such as education, health and building and construction. It is suggested that the implementation of sustainable development could be greatly supported if sector specific, practical objectives, and measures, were readily available. These would vary depending on context, and developing countries would have different objectives to those of developed countries.

Building and construction sustainable development objectives: The methodology used to generate building and construction objectives in the specification could be developed more rigorously and would be an interesting area to research further. However as the purpose in the specification was to develop a 'comprehensiveness checklist' it is suggested that the methodology is adequate.

Criteria: The specification provides a useful set of checklists and criteria for guiding the development of an assessment system.

Structured process: The structured process described in the specification is useful as it provides a guide as to how the assessment framework should be used and integrated into the building and construction processes. This process is not explored earlier in the study and

could be researched further. It is suggested that the level of detail developed in the specification is reasonable as the structured process is a supporting aspect of the assessment framework, which is the primary focus.

5.3. Concluding Hypothesis Four

The hypothesis that “a specification for an assessment tool, which aims to ensure that sustainable development, is addressed and incorporated in the briefing and design of buildings in developing countries can be developed” is demonstrated. The study shows that it is possible to develop a specification for an assessment tool that reflects the sustainable development context, sustainability theory and sustainable development assessment methodology.

6. THE SUSTAINABLE BUILDING ASSESSMENT TOOL

6.1. Sub Problem Five and Hypothesis Five

Sub problem: How does the specification for an assessment tool developed in sub problem four compare with the Sustainable Building Assessment Tool (SBAT)?

Hypothesis: A comparison between the specification for an assessment tool and the SBAT will support the validation of the assessment tool specification and identify whether the SBAT is an appropriate tool for integrating sustainable development into the briefing and design of buildings in developing countries.

6.1.1. Introduction

The Sustainable Building Assessment Tool (SBAT) was developed in 1999. The initial idea and approach was developed as part of a school pilot project. The tool however, has evolved through use on a range of projects including leisure, education, residential and commercial buildings. This chapter will include a text version of the SBAT. A later, software version, of the SBAT has been developed. This forms a component of the ‘Sustainable Buildings CD’ and is available from the CSIR in Pretoria, South Africa.

The Sustainable Building Assessment Tool

1. Introduction

Non-renewable resources are being depleted and there is increasing environmental damage as result of human activities. It is therefore increasingly important that this is addressed, and that sustainability becomes a key issue in the way we live and work.

Building and construction can play an important role in supporting sustainability. This is done through careful planning in which design decisions, material specifications and so on are carefully evaluated in terms of their economic, social and environmental impact.

The Sustainable Building Assessment Tool (SBAT) has been designed to help evaluate the sustainability of buildings. This is done by assessing the performance of a building in relation to a number of economic, social and environmental criteria. The tool has been designed for use in developing countries.

The tool can be used in design stages of a new building, or for the refurbishment of an existing building. In the design stage it aims to encourage the development of more sustainable buildings by enabling different options to be evaluated rapidly and compared. It can also be used for existing buildings. This enables the building to be rated in terms of its sustainability and compared with other buildings and to benchmarks.

The SBAT can be used as:

- Part of a brief to the design team: by building owners and developers planning new buildings or refurbishments

- A decision support tool for: building design teams including Architects, Quantity Surveyors, Structural Engineers and Mechanical and Electrical Engineers

- A way of ensuring that policies on sustainability are implemented and integrated into the construction environment: by government and other organisations.

The tool is designed to be easy to use and generates graphical reports, which enable targets and performance to be easily read. The SBAT can be used in a number of ways depending on the level of detail required. It can be used as a design tool by providing a checklist of the main ‘rules of thumb’ and criteria used to design for and assess sustainability in buildings. It can also be used to make a rapid outline assessment of the building and provide the framework for a more detailed analysis of the building if this is required.

Sustainability is a complex issue and not fully understood. The tool therefore is likely to be developed and change over time. It's development and use is based on the precautionary principle, that suggests that it is important to address and implement sustainability in building as a matter of urgency even if this is not fully understood.

2. Using the SBAT

The SBAT can be used for the following purposes:

- Briefing
- Design and Outline assessment
- Detailed Assessment

A. Briefing

To use SBAT as a briefing tool you need to fill in the table in the 'Target Setting' section of this document. This details the criteria that the SBAT assess. Target setting should occurr after a site has been identified, and outline brief for the building has been developed. To ensure that there is proper support from the stakeholders it is suggested that this process happens during a workshop with all of these present. Stakeholders should include, as a minimum, the client, users of building and the design team. Before this workshop each of the stakeholders should have visited the site and read and understood the outline brief for the building.

The Target Setting table should have an option selected for each of the criteria listed. So the group needs to discuss the importance of occupant comfort in terms of users and the site. If they decide that this is a very important issue, they might then tick the 'essential' box. In order to get a clear and shared understanding of the criteria, the description in Section five can be read.

The completed table forms your outline sustainability performance targets. To visualize this target and the different weightings, the radar graph under the Graphical Report can be filled in. To do this read the number at the top of the column in which the 'tick' appears. Then find the appropriate axes on the chart and plot the reading as a dot on this axis. Do this for each of the criteria. When you have completed this, join the dots. This will give you 'target footprint' which enables you to see, and compare the different weightings you have allocated. The further out the points are (ie 4's or 5s) the more rigorous the targets are.

Once these targets have been agreed, this can be provided to the design team, as part of the briefing documents. The design team should then use this as well as other information to

develop their designs. Once they have an outline specification and design they can check to see if this is meeting the targets by assessing the design. This is described next.

B. Design and Outline Assessment

The SBAT can be used to support decision-making during the design process in the following ways. Once the criteria have been read and understood the design team can develop sketch designs and an outline material/component specification. Where there are choices in design or choices of material, the relevant criteria can be referred to in order to come to a decision. As soon as there is a full sketch design and outline material/component specification, an outline assessment can take place.

To do this go through each of the criteria listed in Section five and see if the existing design/specification complies with the criteria. If it does you can ‘tick’ the box adjacent to this. In order to ‘read’ the performance of the building count up the number of ‘ticks’ under each heading ie under Occupant Comfort and record this. These numbers should then be plotted as dots on the relevant axis in the radar diagram in the Graphical Report. Once you have done this join the dots to get a ‘assessment footprint’. If you have already used the diagram to set a ‘target footprint’, make sure you use a different colour in order to distinguish from this!

If you have plotted a ‘target footprint’, comparing this with the ‘assessment footprint’ enables you to see if the targets are being met. If points on the ‘assessment footprint’ are nearer the center of the radar than the ‘target footprint’, the targets have not been met and the design needs to be revisited, in order to see if these targets can be met or exceeded.

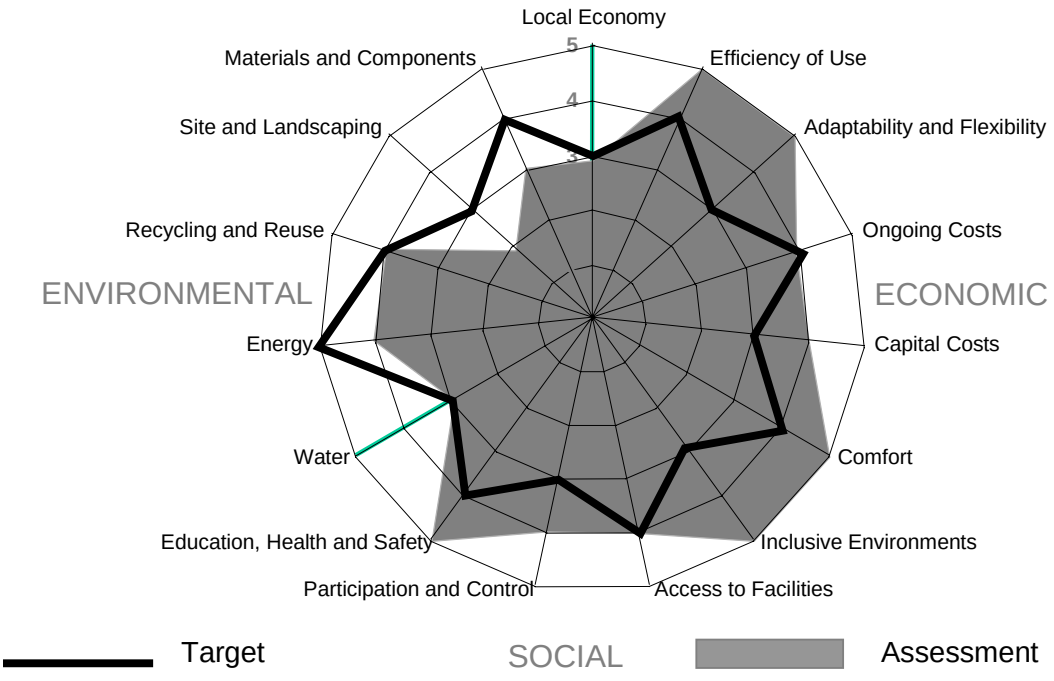
C. Detailed Assessment

Detailed Assessment requires considerable more time than an outline assessment, however it can provide a more accurate and detailed picture of the potential performance of the building. To carry this, detailed benchmark building performance information is required for similar building types for the performance areas described in the tool, such as water, energy, occupant comfort. This information needs to be analysed and developed into challenging performance targets, which replace the existing generic performance targets found in the SBAT. Once these are set, design evaluations are likely to need more detailed calculations or modelling in order to arrive at the performance of the building (for instance of predicted mains potable water consumption). These figures then need to be compared to target performance figures provided in the SBAT in order to evaluate whether the design meets the performance targets set. Target footprints, and assessment footprints are plotted in the same ways as A and B above. The calculations or modelling tools required to assess the performance of the building are available and can be found in building literature or downloaded from the Internet. A number of references are provided at the end of this document.

3. Project Information

A	Project	
B	Physical Address	
C	Contact person Telephone Fax Email	
D	Description of function	
E	Description of users	
F	Description of location	
G	Assessment based on (information sources):	
H	SBAT use	❑ Brief ❑ Outline Assessment ❑ Detailed Assessment
I	Assessment carried out by:	Name: Telephone: Fax: Email:

Graphical Report



4. Target Setting

Criteria	No Requirement 1	Low Requirement 2	Medium Requirement 3	High Requirement 4	Essential 5
Social					
Occupant Comfort					
Inclusive Environments					
Access to Facilities					
Participation and Control					
Education Health and Safety					
Economic					
Local Economy					
Efficiency of Use					
Adaptability and Flexibility					
Ongoing Costs					
Capital Costs					
Environmental					
Water					
Energy					
Waste					
Site					
Materials and Components					

5. Building Performance: Social (SO)

SO1 Occupant Comfort

The quality of environments in and around buildings has been shown to have a direct impact on health, happiness and productivity of people. Healthier, happier, more effective people contribute to sustainability by being more efficient and therefore reducing resource consumption and waste. However, the quality of this internal environment must be achieved with minimal cost to the environment. Occupant comfort is reliant on a number of factors including amount of fresh air, day lighting, air temperature, views, and the level of control that individuals have over their indoor environment.

SO1.1 Lighting

The main working spaces are well day lit. Effective solar control. Glare minimised.

Criteria: 5% day light factor

SO1.2 Ventilation

Adequate clean air supply to each inhabitant. Supply taken from unpolluted source

Criteria: All working spaces have equivalent of opening window area equivalent to 10% of floor area

SO1.3 Noise

Noise levels limited in working spaces to acceptable levels.

Criteria: Noise levels not over 45dB (A) for long continuous periods

SO1.4 Views
Design to all working areas to have access to a view out.

Criteria: All working spaces to be maximum of 6m from a window

SO1.5 Thermal comfort
Thermal comfort throughout year

Criteria: Indoor environment maintained within temperature range (range dependent on activities etc)

SO2 Inclusive Environments
Buildings should be designed to accommodate, and be accessible to everyone, or specially designed buildings need to be provided. Ensuring that buildings are inclusive supports sustainability as replications is avoided and change of use supported. It also ensures that as legislation in this area tightens, expensive retrofits are not required in order to ensure compliance.

SO2.1 Public Transport
The building can be accessed by disabled people using public transport.

Criteria: Entrance located 100, or fewer metres to disabled accessible public transport

SO2.2 Routes, Changes in level
All routes between and within buildings can be easily navigated by physically disabled people and other people.

Criteria: Adequate width, turning circles, no changes in level between or within buildings or, all changes in level catered for with appropriate ramps of 1:12 fall, or lifts, routes surfaces have smooth and even surface

SO2.3 Signage & Edges
Visually impaired and other people can move around and use the building easily and safely

Criteria: all edges i.e. between walls and floors and stair nosings clearly distinguished through the use of contrasting colour. Accessible signage provided.

SO2.4 Furniture and Fittings
Furniture and fittings can be easily used by disabled and other people

Criteria: Location, configuration and design of furniture and fittings specified

SO2.5 Toilets, Bathrooms and kitchens
Toilets and bathrooms are or can be easily adapted for use by disabled

Criteria: Spatial configuration of and equipment in spaces

SO3 Access to Facilities
Conventional living and working patterns require regular access to a range of services. Ensuring that these services can be accessed easily and in environmentally friendly ways supports sustainability by increasing efficiency and reducing environmental impact.

SO3.1 Childcare
Occupants of building can pick up / drop children easily, without having to make additional long distance car journeys.

Criteria: Distance between home and or work and schools and or crèches not more than 3km.

SO3.2 Banking
Occupants have easy access to banking facilities.

Criteria: Banking services (i.e. ATM) provided close by (within 3km) or Internet service or mobile service provided.

SO3.3 Retail
Occupants have easy access to retail facilities for everyday items (ie groceries).

Criteria: Relevant retail outlets provided within 3km or alternative Internet or delivery service provided.

SO3.4 Communication
Occupants have easy access to communications facilities during their working day or on their route home.

Criteria: Postal, telephone or email facilities close by (within 3km).

SO3.5 Work
Occupants do not have to undertake long vehicular journeys to get to and from work.

Criteria: Maximum distance between work and residence 10km.

SO4 Participation & Control
Ensuring that users are allowed to participate in decisions about their work environment helps ensure that they care for and manage this properly. Control over

aspects of their local environment enables personal satisfaction and comfort. Both of these support sustainability by promoting proper management of buildings and increasing productivity.

SO4.1 Environmental control
Occupants of building have reasonable control over their environmental conditions

Criteria: Level of control over environmental conditions by individuals; access to openable windows, blinds, control of light and temperature

SO4.2 User manual and training
Occupants and managers of the building understand the building and it's systems and how these should be operated.

Criteria: Building user manual, facilities management training, induction for new occupants

SO4.3 Social spaces
Occupants have access to spaces which enable formal / informal social interaction to take place easily.

Criteria: Design and location of spaces provided for informal and formal social interaction

SO4.4 Amenity
Amenities provided and easily accessible to building users and visitors

Criteria: Design and location of amenities

SO4.5 Community involvement
Space and equipment shared with local communities

Criteria: Accessibility of facilities by local communities

SO5 Education Health and Safety
Buildings need to cater for the well-being, development, health and safety of the people that use them. Learning and access to information is increasingly seen as a requirement of a competitive work force. All of these factors contribute to sustainability by helping ensure that people remain healthy and economically active, thus reducing the 'costs' (to society, the environment and the economy) of unemployment and ill health.

SO5.1 Education
Support for learning provided.

Criteria: Access to and provision of space, equipment and material to support learning

SO5.2 Security
Occupants are safe and feel safe in the building and on regularly used routes to and from the building.

Criteria: Spatial configuration, visual links, lighting, technological and physical security systems

SO5.3 Smoking
Smokers do not affect health of building users

Criteria: Avoidance of cross contamination

SO5.4 Health

Internal environmental conditions do not affect health of occupants

Criteria: Materials, components and finishes screened for health hazards

SO5.5 Exercise and recreation
Occupants have easy access to sport and recreational facilities

Criteria: Facilities within 3km.

6. Building Performance: Economic (EC)

EC1 Local Economy
The construction and management of buildings can have a major impact on the economy of an area. The economy of an area can be stimulated and sustained by buildings that make use and develop local skills and resources.

EC1.1 Local contractors
Building makes use of local contractors

Criteria: Type and location of contractors used, percentage of total contractor cost spent on local contractors

EC1.2 Local building material supply
Building uses local materials

Criteria: Percentage of total construction materials such as cement, sand, bricks etc that are sourced locally

EC1.3 Local component, fittings and furniture manufacture
Building uses component, fittings and furniture sourced locally

Criteria: Percentage of building components i.e. windows and doors that are produced locally

EC1.4 Outsource opportunities
Building creates opportunities for small emerging businesses. This includes outsourcing of catering, cleaning services and security as well as making space and equipment available for businesses to use for retail, education etc.

Criteria: Design, location of spaces, management plan

EC1.5 Repairs and maintenance
Building maintenance and repairs can be carried out by users or by local contractors.

Criteria: Percentage of building and furniture and fittings that can be serviced locally

EC2 Efficiency of Use
Buildings cost money and make use of resources whether they are used or not. Effective and efficient use of buildings supports sustainability by reducing waste and the need for additional buildings.

EC2.1 Space Use
Buildings should make good use of space

Criteria: m^2 per person

EC2.2 Space Management
Space should be managed efficiently

Criteria: Effective space management systems

EC2.3 Shared Use
Facility shared between a number of users

Criteria: Spatial, technological and managerial arrangements for shared use

EC2.4 Use of technology
Access to technology (ie email, internet, video conferencing) to reduce requirement for travel and space.

Criteria: Access to technology, reduction in travel and space requirements

EC2.5 Occupancy schedule
Systems to ensure efficient use of space and services

Criteria: Hours of the week that the building is occupied

EC3 Adaptability and Flexibility
Most buildings can have a life span of at least 50 years. It is likely that within this time the use of the building will change, or that the feasibility of this will be investigated. Buildings, which can accommodate change easily, support sustainability by reducing the requirement for physical adaptation and associated disruption, energy consumption and cost as well as the need for new buildings.

EC3.1 Spaces
Spaces should be readily adapted for different uses. For instance spaces may be required for work during the day, social activities in the evening and quite study during weekends and at night.

Criteria: Spatial configuration

EC3.2 Furniture
Internal spaces can be easily reconfigured to suite different organisation requirements / users

Criteria: Configuration and shape of spaces, construction of partitions.

EC3.3 Services
Services can configured to allow different internal arrangements and can be accessed easily to be extended / altered

Criteria: Location and access to services

EC3.4 Structure
Structure / load bearing elements configured to enable variety of different internal arrangements

Criteria: Location and size of structural elements

EC3.5 Vertical Circulation and Service Cores
Vertical circulation and service cores configured to enable range of different spatial arrangements

Criteria: Location and size of vertical circulation and service cores.

EC4 Ongoing Costs

EC4.1 Maintenance
Level of requirement for ongoing maintenance of the building considered and understood. Costs for this limited through design, and planned for.

Criteria: Lifecycle costs considered in specification of materials, components, and equipment. Design items such as light bulbs can be easily reached and replaced without use of expensive equipment).

EC4.2 Cleaning
Building can be kept clean easily and safely

Criteria: Window location and access, floor materials and access

EC4.3 Security / care taking
Building is reasonably secure without requiring large ongoing costs.

Criteria: Spatial layout and visual supervision by neighbouring occupied buildings

EC4.4 Insurance / water / energy / sewerage
Ongoing costs of water, energy and insurance minimised.

Criteria: Meters can be easily accessed. Building manual provides detail on when these should be read, to enable ongoing monitoring and improvement.

EC4.5 User awareness
Building occupants aware of levels of consumption and waste production

Criteria: Highly visual information (sign boards or intranet) displaying current, previous and targeted consumption and waste performance

EC5 Capital Costs
Buildings are generally one of the most valuable assets that people, and often organisations and governments own. Money spent on buildings is not available for other uses such as health, education and business development. Often in addition, the high cost of buildings results in the services (i.e. health and education) and the accommodation (for work and living) being provided at costs beyond the reach of people, and enterprises with the limited resources.

EC5.1 Consultant fees
Consultant fees not just calculated on total project cost basis. Incentives provided to consultants to reduce capital and ongoing costs.

Criteria: Professional fee structure

EC5.2 Build-ability
Building design cost efficient to build and minimise waste

Criteria: Building form. Replication of elements and components. Design / planning grid that relates to materials / component module sizes

EC5.3 Initial costs
Initial cost of building limited.

Criteria: Building design which enables building to be built at minimal initial cost, allowing building to be developed and grow, over time, as additional funding becomes available – buildings designed as a set of independent, interrelated components, building built as shell first with finishes etc to be added later.

EC5.4 Shared costs
Capital costs to building users and developers minimised

Criteria: Partnerships – cost savings through agreement with other users/partners

EC5.5 Sharing arrangements
Capital costs of the building minimised:

Criteria: Quantity of new space reduced through arrangements to use existing spaces and buildings.

Building Performance: Environmental (EN)

EN1 Water
Water is required for many activities. However the large-scale provision of conventional water supply has many environmental implications. Water needs to be stored (sometimes taking up large areas of valuable land and disturbing natural drainage patterns with associated problems from erosion etc); it also needs to be pumped (using energy) through a large network of pipes (that need to be maintained and repaired). Having delivered the water, parallel efforts are then required to dispose of this after it is used in reticulation and sewerage systems. Reducing water consumption supports sustainability by reducing the environmental impact required to deliver water, and dispose of this after use. Maintaining natural ground water systems also supports sustainability through maintaining existing ecosystems and avoiding the environmental impact associated with for disposal of storm water and runoff.

EN1.1 Rainwater
Water consumption reduced through use of rainwater

Criteria: Systems for capturing, storing and using rainwater

EN1.2 Water use
Water consumption reduced through efficient delivery devices:

Criteria: Specification of water efficient delivery devices.

EN1.3 Grey water
Water consumption reduced through reuse

Criteria: Use of grey water systems

EN1.4 Runoff
Runoff and storm water run off minimised

Criteria: Design and specification to minimised runoff: Specification of pervious or absorbent materials for hard external surfaces.

EN1.5 Planting
Water consumption and existing ground water (water table etc) maintained.

Criteria: Low water requirement landscaping/planting scheme.

EN2 Energy
Buildings consume a large proportion of all energy produced. Conventional energy production is responsible for making a large contribution to environmental damage and non-renewable resource depletion. Using less energy or using renewable energy in buildings therefore can make a substantial contribution to sustainability.

EN2.1 Location
Building located to minimise transport energy requirements of users

Criteria: Building located within 400m of public transport

EN2.2 Ventilation System
Ventilation design and management to minimise energy requirements

Criteria: All ventilation requirements met through passive systems.

EN2.3 Heating and Cooling System
Environmental control system design to minimise requirement for non-renewable energy

Criteria: Heating and cooling requirements met through passive environmental control design

EN2.4 Appliances and Fittings
Energy requirements of appliances, plant and fittings minimised

Criteria: Specification of energy efficient fittings, appliances, plant and lighting

EN2.5 Renewable Energy
Energy consumption of building supplemented / sourced from renewable sources

Criteria: Ten per cent of energy required for building obtained from renewable source

EN3 Waste
Raw materials and new components used in buildings consume resources and energy in their manufacture and processes. Buildings accommodate activities that consume large amounts of resources and products and produce large amounts of waste. Reducing the use of new materials and components in buildings and in the activities accommodated supports sustainability by reducing resource and energy consumption. Limiting waste and pollution in building and the activities accommodated in buildings reduces energy consumption and environmental damage.

EN3.1Toxic waste
Toxic waste processed safely and with minimal environmental impact

Criteria: Design and management for the safe disposal / recycling of toxic/harmful substances such as batteries, printer toners and vehicle oil.

EN3.2 Organic waste
Organic waste recycled locally

Criteria: Design and management that ensures 100% of organic waste produced, reused on site / arrangements made for local provider to carry this out.

EN3.3 Inorganic waste
Inorganic waste recycled locally

Criteria: Design and management that ensures a minimum of 30% of inorganic waste produced is recycled – arrangements made to sort, store and transport waste

EN3.4 Sewerage
Contribution to mains sewerage minimised

Criteria: Use of compost toilets, and other 'local' systems.

EN3.5 Construction waste
Construction waste minimised

Criteria: Design which minimises waste production ie prefabrication/using planning grid generated by component dimensions. Requirement for construction waste minimisation detailed in tender documentation.

EN4 Site

Buildings have a footprint and a size that take up space that could otherwise be occupied by natural ecosystems which contribute to sustainability by helping to create and maintain an environment that supports life. (By, for instance, controlling the carbon dioxide and oxygen balance and maintaining temperatures within a limited range). Buildings can support sustainability by, limiting development to sites that have already been disturbed, and working with nature by including natural ecosystems within the development.

EN4.1 Brownfield site
Building occupies already disturbed site

Criteria: Site has been previously built on / developed.

EN4.2 Neighbouring buildings
Building does not have harmful affect on neighbouring buildings

Criteria: No / minimal reduction to neighbouring building's access to sunlight and natural ventilation

EN4.3 Vegetation
Building and site supports vegetation

Criteria: Area of vegetation provided and maintained equivalent or greater than that of the footprint of the building and hard surfaces.

EN4.4 Habitat
Building supports diversity of plant and animal life

Criteria: Number and range of different species supported.

EN4.5 Landscape inputs
Landscapes designed to function naturally

Criteria: No or minimal artificial inputs (fertilizer, pesticides etc) required to maintain landscape.

EN5 Materials and Components
The construction of buildings usually requires large quantities of materials and components. These may require large amounts of energy to produce. Their development may also require process that are harmful to the environment and consume non-renewable resources.

EN5.1 Embodied energy
Majority of building materials and components used to have low embodied energy.

Criteria: Embodied energy of materials

EN5.2 Material / component sources
Majority of building components used are from 'grown' or renewable (ie timber, thatch) sources.

Criteria: Proportion of materials used from grown sources

EN5.3 Manufacturing processes
Processes for processing / manufacturing materials has minimal negative impact on the environment.

Criteria: No materials used whose production involves large-scale direct pollution of the environment, and direct release of greenhouse gas emissions.

EN5.4 Recycled / reused materials and components
Materials and components used in the building are from recycled sources

Indicator: Percentage of building materials (by volume) that are from recycled sources.

EN5.5 Construction processes
Building design and construction developed to minimally affect the environment

Criteria: Building and construction process designed to minimally impact the environment. Requirement for large-scale vegetation clearing and earth movement minimised.

8 Resources

GB Tool
Cole, R., and Larsson, N. 2000. *GBC 2000 Assessment Manual: Volume 2: Office Buildings*. Green Buildings Challenge 2000. http://greenbuilding.ca/.

BREEAM
Baldwin, R., Yates, A., Howard, N., and Rao, S. 1998. *BREEAM 98 for offices*. Construction Research Communications. London.

LEED
US Green Building Council 2000 *Green Building Rating System Version 2.0 Leadership in Energy and Environmental Design* http://www.usgbc.org/.

6.2. Addressing Hypothesis Five

6.2.1. Introduction

In this section the hypothesis set, namely 'that a specification for an assessment tool, which aims to ensure that sustainable development, is addressed and incorporated in the briefing and design of buildings in developing countries can be developed' will be discussed. In order to undertake this, the specification will be compared to the Sustainable Building Assessment Tool. This comparison will allow the findings of the study described in the specification, to be tested and validated. It will also enable the different aspects of the SBAT to be explored in some detail, allowing weaknesses and strengthens to be hi-lighted. This will contribute to Chapter seven of the study in which conclusions and recommendations are made. The form of the discussion will follow the structure developed in the specification of the tool. It will therefore have the following sections:

- Purpose of the Tool
- Scope of the Tool
- Components of the Tool
- Assessment Framework
- Structured Process
- Evaluation Criteria

6.2.2. Purpose of the Tool

The specification lists five key goals for the assessment tool. Of these, it is suggest, two are of key importance. The first is to ensure that there is adequate understanding about sustainable development and buildings amongst stakeholders, to enable informed discussion, and the development, and agreement, of sustainable development performance targets for the building.

The second is to ensure that the relationship between sustainable development and buildings and construction is made explicit and understandable. This includes understanding how buildings and construction can be used to support sustainable development. It encompasses a process of prioritising aspects of sustainable development and ensuring that these are reflected in the building performance targets set for the building. The specification proposes that once set, these targets should guide the design process and be used to monitor progress towards achieving targets.

The introduction to the SBAT does not make the purpose of the tool explicit. Although it does point out the importance of design decisions and suggests that SBAT can provide decision support, it does not make it clear that a key purpose of the tool is to *integrate sustainability*

into building briefing and design processes. The SBAT also does not hi-light the value of developing awareness and support for sustainable development in building stakeholders. The specification therefore implies that although the SBAT may achieve many of the objectives listed for an assessment tool, it would benefit by making these explicit in the introduction to the tool.

6.2.3. Scope of the Tool

The specification of the tool includes a description of the scope of the tool, and suggests that this should be limited to: buildings, the design stage and architects. The SBAT does not define the scope of the tool. This is risky as it could lead to inappropriate use of the tool. It is clear however, that the tool has been developed specifically for developing countries.

It is suggested that the introduction to the SBAT describe the function and use envisaged for the tool. It should also express who the tool is aimed at. Finally, the SBAT should describe a scoped for the tool and include a warning that indicated that use of the tool beyond this scope would require more care and possible adaptation of the tool.

6.2.4. Components of the Tool

The specification of the tool makes it clear that there should be two components to the tool; an assessment framework and a structured process. The SBAT is not explicit about these components. However, implicit reference is made to a structured process in the guidelines included for use of the tool. This however does not provide a high level of detail. For instance there is no guidance on how to set up and run a target setting workshop with stakeholders.

The effectiveness of the tool, it is suggested, could be improved by showing how the tool could be integrated and used within conventional briefing and design processes. One way of addressing this would be to be to include a guide that showed how the use of the tool could be integrated into conventional architects' work stages such as those outlined by the Royal Institute of Architects or the South African Institute of Architects.

6.2.5. Assessment Framework

The specification states that it is important that the assessment framework provides a clear explanation of its theoretical foundation. It also suggests that a description of the development process of the tool would enable users to gain a better understanding of the tool.

The SBAT does not explain why it was developed. It also does not describe the basis and assumptions used in its development. No definitions for sustainability, sustainable development or sustainable buildings are included.

Explaining why the tool was developed would help justify the need for the tool and explain why a different approach was developed relative to other tools such as BREEAM and the

GBTool. A clear definition of sustainable development would also help clarify the theoretical basis for the tool.

The SBAT claims it has been designed for developing countries. The introduction hints at some of the differences between developed and developing countries, this however could be more comprehensively described. This, it is suggested, would help ensure that users of the tool consider, and take into account, the local context.

The specification provides an outline structure for the assessment tool. Aspects of this can be found in the SBAT, such as the hierarchy of objectives and sub-objectives. This could however be developed further. For instance the SBAT could include an overarching goal that should be aimed at. This would provide the focus from which objectives and sub-objectives would then cascade.

The objectives generated in the specification can be compared with the objectives described in the SBAT. This is a valuable test of the comprehensiveness of the SBAT. This comparison has therefore been carried out and the detailed results can be found in the Appendix ten. The findings of this comparison indicate the following:

- **Location:** Many of the objectives that relate to location are not addressed in the SBAT. This may be beyond the scope of the SBAT. However it would be useful if the SBAT could hi-light the substantial impact that buildings and construction can make to sustainable development through providing employment and access to education, *if deliberately located in areas of high need*.

- **Site:** Many of the objectives that relate to site are not addressed in the SBAT. This area therefore should be investigated in more detail. For instance, the tool could hi-light the potential contributions that a site could make to the development of effective water and waste management and recycling systems.

- **Management**: The SBAT does not make reference to environmental management. This should be addressed by ensuring that the criteria on materials and components requires all “grown” materials come from managed sources.

- **Furniture and Fittings:** This aspect is only referred to in passing in the SBAT. In order to ensure that this area is included, the SBAT should broaden the ‘Materials and Components’ set of criteria to include furniture and fittings.

- **Demolition and Refurbishment**: This aspect is not addressed in detail in the SBAT. It is suggested that should be included as an aspect within the EC criteria. In addition

it is suggested that one of the requirements of the building user manual should be to provide information that will enable the building to be easily refurbished or demolished with a minimum amount of waste.

- **Waste Management:** The comparison hi-lights the need in the SBAT for more detail on the design and management of waste management systems. In particular it would be useful if more information on system requirements could be provided such as space and service allocations.

- **Water**: This aspect is addressed in detail within the SBAT. However the SBAT does not have any criteria, which cover the consumption of water in the production or processing of materials and components. It also does not cover consumption of water during construction. With the increasing scarcity of water in some areas, these aspects may be increasingly important. It is therefore recommended that this be investigated for possible inclusion in the SBAT.

- **Labour intensive processes**: The comparison suggests that the SBAT does not address this aspect comprehensively enough. It is therefore suggested that this is addressed more thoroughly. For instance, labour intensive processes should be addressed in materials and components, construction, and building operation criteria.

- **Construction energy efficiency:** The SBAT does not address this, although it does include criteria for embodied energy. It is suggested that this area should be investigated to see whether this should be included in the SBAT.

- **Design process:** The comparison indicates that the design process may also have a role in supporting a number of sustainable development objectives. For instance this could support the development of a local, diverse economy, participation and education. This aspect is unlikely to have a high impact so should not be addressed as a high priority in terms of inclusion in the SBAT

- **Efficiency**: This aspect is not addressed as a specific issue in the SBAT, but is referred to under a number of criteria. It is recommended that the criteria in the SBAT be reviewed in order to ensure that they have a strong emphasis on efficiency.

- **Indigenous technology**: This aspect is not addressed at all in the SBAT. This should be investigated for possible inclusion.

- **Evaluation and monitoring systems**: The comparison indicates that the SBAT could have a stronger role in encouraging the development and implementation of

ongoing performance management systems in order to ensure that sustainable development issues are addressed throughout the life of the building.

- **Enabling environment**: The comparison suggests that the design and construction process could, in a small way, support an enabling environment for sustainable development. It could do this by including criteria that support transparent, equitable and inclusive contract and tender processes and documentation.

- **Services**: Objectives generated by the matrix indicate that buildings may be able to support sustainable development within the services (ie energy, water) area. It would do this by supporting local, labour intensive, environmentally sound service providers. This may not be possible in South Africa or many developing countries currently as there are a limited number of service providers, however the inclusion of this aspect into the SBAT could be investigated at a later stage when this becomes a possibility.

- **Education for construction workers:** The comparison indicates that there are opportunities for education during the construction process. This should be investigated for inclusion in the SBAT.

- **Briefing and design process should be inclusive:** The SBAT process is participatory, but no reference is made to making sure that it is inclusive. This should be addressed in the SBAT.

- **Inclusive building envelope:** The comparison indicates that the building envelope should be designed to be inclusive. This is currently not adequately covered by the existing criteria with the SBAT and it is recommended that this is addressed, and reference made to ensuring that views, window opening controls and so on are able to be accessed easily by everyone, including disabled people.

- **Inclusive construction processes:** The SBAT does not currently have a criterion requiring that the construction process is inclusive. This should be addressed, by ensuring that there are criteria to ensure inclusion, by for instance, requiring the appropriate involvement of youth, women and disabled people.

- **Healthy location:** The comparison indicates that it is important that the building is located in areas conducive to human health. This is not addressed by the SBAT and should be investigated for future inclusion.

- **Healthy and safe construction practices:** The SBAT does not include criteria in this area. It is therefore suggested that this is considered for inclusion.

- **Participative sites:** The role of sites in contributing to participation and social cohesion is not addressed in the SBAT. This area should be considered for future inclusion.

- **Participative operation:** The role of building management in supporting participation and social cohesion is not explored in the SBAT. It is recommended that this investigated for possible inclusion under the SO criteria.

In addition, the specification provides a method for prioritising objectives. This has been applied to the objectives generated by the specification and the results are also illustrated in Appendix eleven. This indicates that the following objectives should be prioritised in buildings in developing countries.

- **Water:** Ensure that development manages the extraction, consumption and disposal of water in order not to adversely affect the bio-physical environment

- **Employment and self-employment:** Ensure that development supports increased access to employment and supports self employment and the development of small businesses

- **Small-scale, local and diverse economies**: Ensure that development supports the development of small scale, local and diverse economies

- **Access:** Ensure that development support increased access to land, adequate shelter, finance, information, public services, technology and communications where this is needed.

- **Education:** Ensure that development improves levels of education and awareness, including awareness of sustainable development

- **Health, Safety and Security:** Ensure that development considers human rights and supports improved health, safety and security.

The SBAT does not have prescribed priorities, as users of the tool set these. This is a useful feature for helping ensure effective participation in the use of the tool. This benefit, it is suggested, should not be lost. A way of continuing to achieve effective participation while making recommendations about priorities would be through the inclusion of case studies and sample target ‘foot prints’ that could be aimed for. This would support a better understanding

of how buildings can be developed to support sustainable development and help ensure that prioritisation of objectives was appropriate.

The SBAT includes a set of indicators. However using the tool across a number of building types soon illustrates the need to alter these in order to make these more appropriate for the building and context in question. This flexibility is both a strength and a weakness. It is a weakness currently as comparisons of performance within a particular building type is difficult as indicators are not prescribed and particular targets are not set. This could change as a database of indicators and performance targets for a variety of building types and contexts is developed.

It is therefore suggested that the effectiveness of the SBAT could be substantially improved by developing an accompanying database of indicators and performance targets, which can be drawn on in setting targets. This should support design improvements in buildings over time as knowledge on indicators improves and performance targets are made increasingly challenging.

The lack of prescribed performance targets is also a strength. This is because the tool can be used in a much wider range of situations than similar tools such as BREEAM and the GBTool, which focus on particular building types such as office buildings, houses and schools. Avoiding prescribed targets, it is suggested, helps ensure that there is greater participation from all parties interested in the building process. By ensuring specific targets are considered for each building it encourages the development of an approach in which the local context is taken into account and there is continuous improvement.

The specification provides a number of criteria for the selection of indicators. These criteria have been applied to the objectives included in the SBAT. The results of this are shown in Appendix eleven. This suggests that the following sets of indicators work well:

- Occupant Comfort indicators (with the exception of thermal comfort and noise)
- Inclusive Environments
- Access to Facilities
- Participation and Control (with the exception of community involvement)
- Water
- Energy (with the exception of heating and ventilation)
- Site (with the exception of habitat and landscape inputs)

It however suggests that a number of sets of indicators included in the SBAT require further development. These are as follows:

- Education, Health and Safety (with the exception of smoking)
- Local economy
- Efficiency of Use (with the exception of space use)
- Adaptability and Flexibility
- Ongoing Costs (with the exception of user awareness)
- Capital Costs
- Waste
- Materials and Components

There appear to be a number of problems with these indicators. Many of these have not been reduced into simple criteria that do not require extensive additional modelling or data collection. They also concern aspects of buildings where the knowledge base is currently weak. For instance there is little available information on assessing the flexibility and adaptability of buildings. Clearly in order for the SBAT to be more effective additional work is required to develop more precise objective criteria and simple, quick methodologies for capturing performance information.

6.2.6. Structured Process

The specification for the tool provides a high level of detail on how the assessment tool should be used. This describes how the use of the assessment tool fits into conventional briefing and design processes. It also describes actions that need to be taken before the tool is used and how the tool can be used to involve all interested parties in setting sustainability performance targets for the building (target setting workshop).

The SBAT does include some explanation as how the tool should be used for setting targets in the briefing stages and for decision support in design. It is suggested that the explanation provided is adequate. It is recommended that more information on how to use the tool could help increase it’s effectiveness. This information however should be packaged separately, allowing users to refer to this if they so wished.

Finally, the specification provides a set of principles that the tool should be aligned with. The SBAT is examined with respect to these principles and the results of this can be found in Appendix thirteen. A review of this suggests that, on the whole, the SBAT is in line with the principles outlined however there are a number of aspects that can be commented on:

- **Overarching goal:** The review indicates that the SBAT should provide a clear goal that buildings and construction processes should aim for in order to support sustainable development.

- **Tool development:** The review suggests that the SBAT would benefit from a short description of the background to the development of tool. This would help explain the design of the SBAT and help ensure that it was used correctly.
- **Assumptions and definitions:** The review suggests that the SBAT should list assumptions made, include definitions, references and differentiate between areas where there is strong knowledge and weak knowledge.

6.3. Concluding Hypothesis Five

The hypothesis that a specification for an assessment tool, which aims to ensure that sustainable development, is addressed and incorporated in the briefing and design of buildings in developing countries can be developed is demonstrated. The specification is shown to be both comprehensive and robust through a detailed comparison with the Sustainable Building Assessment Tool. It proves to be an effective framework that enables a thorough review of the SBAT. The comparison process highlighted ways that the Sustainable Building Assessment Tool and the specification could be improved. Broad recommendations from this review will be included as recommendations in the next chapter, Chapter seven, Conclusions and Recommendations.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Conclusions

The thesis effectively proposes a specification for an assessment tool that integrates sustainable development into briefing and design of buildings in developing countries. The sub-problems investigated each of the aspects to compile and test the specification.

The first sub-problem: *"What are the key aspects of the international and local context of sustainable development useful in understanding how buildings and construction can support sustainable development?",* investigated current international, British and South African plans for implementing sustainable development. It indicated that the existing international plan of action for addressing sustainable development, as developed by the World Summit on Sustainable Development was complex and requires simplification in order to be applied to the building and construction sector. It demonstrated how this could be simplified into objectives that could be applied to buildings and construction. In addition, the study showed that implementing sustainable development in developing countries is dissimilar to developed countries and requires a different approach.

Hypothesis one: *"The international and local context of sustainable development can inform the development of a specification for an assessment tool that aims to integrate sustainable development into building briefing and design processes."* is substantiated through the investigation of international, British and South African plans for implementing sustainable development.

The second sub problem: *"What are key concepts in sustainability that are useful in understanding how buildings and construction can support sustainable development?"* investigated concepts within sustainability. The chapter indicates that sustainability as being the ultimate goal of sustainable development. It also identifies characteristics of sustainability. These findings are valuable as they helped to define the goal set, and the approach advocated, by the specification.

Hypothesis Two: "Concepts from sustainability can inform the development of a specification for an assessment tool that aims to integrate sustainable development into building briefing and design processes" is substantiated through the investigation of literature on sustainability.

The third sub problem: *"What are the key features of existing sustainable development, sustainability and development assessment systems and frameworks?"* investigated current sustainable development and sustainability assessment systems and development

frameworks. It is valuable for the study as it reveals methodologies and approaches that are worthy of inclusion in the specification.

Hypothesis Three: “Existing sustainable development, sustainability and development assessment systems and frameworks can inform the development of a specification for an assessment tool that integrates sustainable development into building briefing and design processes” is substantiated through an investigation of sustainable development assessment systems and development frameworks.

The fourth sub problem: “*Can a specification for an assessment tool which aims to ensure that sustainable development is addressed and incorporated in the briefing and design of buildings in developing countries, be developed by drawing on the sustainable development context (problem one), key sustainability concepts (sub problem 2) and key features of sustainable development, sustainability and development frameworks (sub problem 3)?* “ completes the main objective of the study through the development of specification. This incorporates knowledge from Chapters two, three and four in order to specify the objectives, scope, structure, components and methodology of assessment tool.

Hypotheses four*: “A specification for an assessment tool, which aims to ensure that sustainable development, is addressed and incorporated in the briefing and design of buildings in developing countries can be developed”* is substantiated through the development of a specification.

The fifth sub problem: ”*How does the Sustainable Building Assessment Tool (SBAT) compare with the specification for an assessment tool developed in (sub problem 4)?*” tests the specification through comparison of this with the Sustainable Building Assessment Tool. This comparison shows the specification to be a robust and comprehensive framework enabling shortcomings in the SBAT to be identified and recommendations for improvement to be made. This is valuable for the study as it validates the specification.

Hypothesis five: *“A comparison between the specification for an assessment tool and the SBAT will assist in validating the specification and identify whether the SBAT is an appropriate tool for integrating sustainable development into the briefing and design of buildings in developing countries”* is substantiated by findings which reveal that the specification and the SBAT can be validated.

7.2. Recommendations

The study makes the following recommendations:

The Sustainable Building Assessment Tool: It recommends that the Sustainable Buildings Assessment Tool address the shortcomings identified by the specification. Detailed shortcomings and recommendations for the tool are made in Chapter six. In addition to addressing specific recommendations the study recommends that additional research be undertaken in order to develop associated components and methodologies that will assist in the implementation and effectiveness of the tool. This includes:

- **Sustainable building and construction performance objectives and indicators database**: A database of objectives and indicators for different building types, contexts and construction methodologies should be developed. This should include reference framework (such as sustainable development or building and construction policy and plans) and up to date benchmark information. This data will support the effectiveness of the SBAT by enabling highly specific and challenging performance targets to be set for projects.

- **Structured approach:** It is recommended that the structured approach described by the specification be developed further and formalised through linking this with existing professional and legislated processes such as the South African Institute of Architects project stages and municipal planning requirements.

- **Associated tools and methodologies:** The study indicates that more specific and detailed tools and capacity development will be required in order to ensure that sustainable building and construction objectives are effectively integrated and addressed. In particular it is recommended that research be carried out in the priority areas identified in Chapter six of the study, such as water and employment creation. The aim of this research should be to identify specific interventions that should be made within buildings and construction in the areas identified and should lead to the specification of tools and capacity development that will enable these to be implemented.

7.3. Areas for Future Research

It is recommended that the following areas be investigated for further study:

a. The relationship between building briefing processes and sustainable development in developing countries
b. The relationship between design methodologies and sustainable development in developing countries
c. The relationship between construction methodologies and management and sustainable development in developing countries

d. The relationship between building operation and sustainable development in developing countries

e. The relationship between building reuse and demolition and sustainable development in developing countries.

8. Works Referred to in the Thesis

1. Alliance for Global Sustainability. 2003. *Definitions for Sustainability* http://globalsustainability.org/Education/Definitions/
2. Baldwin, R., Yates, A., Howard, N., and Rao, S. 1998. *BREEAM 98 for Offices*. Construction Research Communications. London.
3. Bell, S., and Morse, M.1999. *Sustainability Indicators*. Earthscan Publications. London.
4. Cole, R., and Larsson, N. 2000. *GBC 2000 Assessment Manual: Volume 1: Overview.* Green Buildings Challenge 2000. http://greenbuilding.ca/.
5. Carley, M. and Spapens, P. 1998. *Sharing the World: Sustainable Living and Global Equity in the 21st Century.* Earthscan Publications. London.
6. Clayton, A and Radcliffe, N.1996. *Sustainability: A Systems Approach*. Earthscan Publications, London.
7. Cole, R., and Larsson, N. 2000. *GBC 2000 Assessment Manual: Volume 2: Office Buildings*. Green Buildings Challenge 2000. http://greenbuilding.ca/.
8. Confederation of International Contractor's Association.2002. *Industry as a Partner for Sustainable Development.* http://www.cicanet
9. Cooke, J.G.1984. *Glossary of technical terms. In Exploitation of Marine Communities* in R.M. May (ed). Springer-Verlag.
10. Department for International Development. 2002. *Tools for Development* http://62.189.42.51/DFIDstage/FOI/tools/chapter_05.htm
11. Department of the Environmental Affairs and Tourism. 1999. *State of the Environment report* http://www.ngo.grida.no/soesa/
12. Department of the Environmental Affairs and Tourism. 1999. *State of the Environment South Africa 2002*. http://www.environment.gov.za 17/12/0217 15:30
13. Department of the Environment, Transport and the Regions. 1999. *A better quality of life: a strategy for sustainable development for the United Kingdom*. TSO. London. http://www.sustainable-development.gov.uk/uk_strategy/factsheets/monitor/index.htm
14. Department of the Environment, Transport and the Regions. 1999. *Quality of life counts. Indicators for a strategy for sustainable development for the United Kingdom: a baselines assessment*. DETR Publications. London.
15. Department of Finance. 1998. *Growth, Employment and Redistribution A Macroeconomic Strategy.* Government Gazette
16. DFID. 2000. *Eliminating World Poverty: Making Globalisation Work for the Poor.* White Paper on International Development. http://www.dfid.gov.uk/Pubs/files/whitepaper2000.pdf
17. Ekins, P., Hillman, M., and Hutchinson, R.1992. W*ealth beyond Measure: An Atlas of New Economics.* Gaia Books Limited. London.
18. Elkington, J.1997. *Cannibals with Forks.* Capstone. Oxford.
19. Steele, J.1997. *Sustainable Architecture: Principles, Paradigms and Case Studies*. McGraw-Hill. New York.
20. European Environmental Agency. 2003. *EEA multilingual environmental glossary.* http://glossary.eea.eu.int/EEAGlossary
21. FAO.1999. *Technical Guidelines for Responsible Fisheries.* 8: p68 p. FAO. Rome.
22. FAO. 1998. *Guidelines for the routine collection of capture fishery data*. FAO Fish. Tech. Pap, 382.
23. FAO. 2003. SD Dimensions. http://www.fao.org/scripts/Rural_D/query/Glo_Select.idc
24. Fresco, L.O. and Kroonenberg, S.B. 1992.*Time and spatial scales in ecological sustainability* Land use policy. vol 9.
25. Fukuyama .F.1995. Trust: The Social virtues and the creation of prosperity. Hamish Hamilton. New York.
26. Global Reporting Initiative.2002. *Sustainability reporting Guidelines.* Global Reporting Initiative.
27. Gosling, L. and Edwards, M. 1995. *Toolkits: A Practical Guide to Assessment, Monitoring, Review and Evaluation.* Save the Children Publications. London.

28. Hardi, P., and Zardi, T. 1997. *Assessing Sustainable Development in Practice.* International Institute for Sustainable Development. Winnipeg. http://www.iisd.ca/measure/faqcriteria.htm
29. Hawken, P., Lovins, A., Lovins, L.H. 1999. *Natural Capitalism*. Earthscan. London.
30. International Union for Conservation of Nature. 1991. *Caring for the Earth: A strategy for Sustainable Living* IUCN. Gland.
31. International Union for the Conservation of Nature. 2003. *Environmental Glossary.* Virtual Environment: A Southern Africa Training System. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm
32. Little, W., Fowler, H.W.,Coulson, J. 1998. The Shorter Oxford English Dictionary, Guild Publishing. London.
33. Lovelock, J. 1991. *Gaia The Practical Science of Planetary Medecine*. QPD. London.
34. Lynam, J.K., and Herdt, R. W. 1989. *Sense and sustainability: sustainability as an objective in international agricultural research*. Agricultural economics. Vol3
35. Maclean, J.H., and Scott, J.S. 1995. *Dictionary of Building.* Penguin. London.
36. Odum, E.O. 1989. *Ecology and our endangered life-support systems*. Sinauer Associates Inc. Massachusetts.
37. Odum, E.P.1959. *Fundamentals in ecology*. 2nd Edition, Philadelphia, Saunders Co
38. Office of the President. 1994. *White Paper on Reconstruction and Development Programme.* Government Gazette
39. Pauli, G. 1998. *Upsizing*. Greenleaf Publishing. Sheffield.
40. Pearce, D.1993. *Blueprint, Measuring Sustainable Development 3.* Earthscan. London.
41. Pearce, D.W., and Turner, R.K. 1990. *Economics of Natural Resources and the Environment.* Harvester Wheatsheaf. Hemel Hempstead.
42. Prescott-Allen, R. 2001. *The Well-Being of Nations*. Island Press.
43. Putnam, R.1993. *The Prosperous Community, Social Capital and Public Life*. The American Prospect. Volume 4. Issue 13.
44. Scialabba N. (ed.), 1998. Integratred Coatal Area Management and Agriculture, Forestry and Fisheries. FAO Guidelines.
45. Scoones, I. 1998. *Sustainable rural livelihoods: A framework for analysis*. IDS Working Paper, 72. Brighton.
46. Redefining Progress. 2003. Ecological Footprint Glossary http://www.redefiningprogress.org/programs/sustainability/glossary/terms.html
47. Resources for the Future. 2003. Weathervane Glossary http://www.weathervane.rff.org/glossary/index.html
48. Sustainable Measures. 2002. *Sustainable Measures.* http://www.sustainablemeasures.com/Database/index.html 19/12/02 11:35
49. United Nations (2002) World Summit on Sustainable Development, Plan of Implementation, advance unedited text. http://www.johannesburgsummit.org/index.html 11/11/02 10.32
50. United Nations.1992. *Agenda 21*. http://www.un.org/esa/sustdev/indisd/english/worklist.htm
51. United Nations. 2002. *Global Challenges Global Opportunities.* http://www.johannesburgsummit.org/index.html 11/11/02 10:30
52. United Nations.1997. *Glossary of Environment Statistics*. Studies in Methods, Series F, No. 67
53. United Nations Development Programme. 2001. *Human Development Report 2001*.Oxford University Press. Oxford
54. United Nations. 2000. *The Millennium Goals.* http://www.un.org/millennium/sg/report
55. United Nations. 1992. *The Rio Declaration on the Environment and Development* http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm
56. United Nations Division for Sustainable Development. 2002. CSD Theme Indicator Framework, http://wwwun.org/eas/sustdev/isd.htm
57. US Green Building Council 2000 *Green Building Rating System Version 2.0 Leadership in Energy and Environmental Design* http://www.usgbc.org/.
58. Wackernagel, M., Mofreda, C., and Deumling, D. 2002. *Ecological Footprint of Nations November 2002 Update*. Redfining Progress. http://www.RedefiningProgress.org

59. World Commission on the Environment and Development. 1987. *Our Common Future.* Oxford University Press. Oxford.
60. World bank. 1996. *Performance Monitoring Indicators: A Handbook for Task Managers* http://www.worldbank.org/html/opr/pmi/urban/urban002.html
61. World Bank. 2002. *World Development Indicators*. http://www.worldbank.org/data/wdi2002/tables/table1-1.pdf 02/01/03 09:37
62. World Wild Life Fund. 2000. *Living Planet Report 2000.* World Wild Life Fund
63. World Bank. 2003. *What is the World Bank?* http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/0,,contentMDK:20040558~menuPK:34559~pagePK:34542~piPK:36600,00.html? 23/04/2003

8.1. Supplemental Reading

1. African National Congress.1994.*The Reconstruction and Development Programme*. Umanyano Publications, Johannesburg.
2. Banham, R. 1969. *The Architecture of the Well Tempered Environment*. Architectural Press. London.
3. Bitan, A. (ed) 1989.*The Impact of Climate on Planning and Building*. Elsevier Sequoia, Lausanne, Switzerland
4. Brand, S. 1994. *How Buildings Learn, What Happens After They're Built*. Phoenix Illustrated London.
5. Correa, C. 2000. Housing and Urbanisation. Thames and Hudson New York
6. Daniels, K. 1998. *Low Tech, Light Tech High Tech: Building in the Information Age.* Birkhauer Publishers. Basel.
7. De Soto, H. 2000. *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else*. Bantam Press. London
8. Department of Environment and Tourism 1999 *South African Country Report: To the Commission on Sustainable Development 1999*. Department of Environment and Tourism. South Africa.
9. Department of the Environment, Transport and the Regions. 1995, Report 30, A Performance Specification for the Energy Efficient Office of the Future. The Stationary Office London.
10. Duffy, F. 1992. *The Changing Workplace*. Phaidon Press. London.
11. Giradet, H. 1999. *Creating Sustainable Cities*. Green Books. Bristol.
12. Holmes-Siedle, J. 1996. *Barrier Free Design A Manual for Building Designers and Managers*. Butterworth Heinemann. London.
13. Hawkes, D. 1996. *The Environmental Tradition, Studies in the Architecture of the Environment*. E & FN Spon. London.
14. Fathy, H. 1986. *Natural Energy and Vernacular Architecture: Principles and Examples with Reference to Hot Arid Climates*. University Chicago Press. Chicago.
15. Garg, S 1998 *Water Supply Engineering.* Khanna Publishers. Delhi.
16. Garg S. 1998 *Sewage Disposal and Air Pollution Engineering.* Khanna Publishers. Delhi.
17. Goffman, 1959.E. *The Presentation of Self in Everyday Life*. Pelican Books, London.
18. Goulding, J.R, Lewis, J.O,. Steemers, T.C., 1994. *Energy in Architecture the European Passive Solar Handbook*. Batsford. London.
19. Hamdi, N. 1995. *Housing without Houses*, Intermediate Technology Publications London.
20. Harper, D. and Thorpe, D.1994. *Managing Your Waste.* Centre for Alternative Technology. Machynlleth.
21. Hillier, B. and Hanson, J 1994. *The Social Logic of Space*. Cambridge University Press. Cambridge.
22. Holm. D 1996. *Manual for Energy and Conscious Design*. Department of Minerals and Energy Pretoria. South Africa.
23. Holm, D. 1983. *Energy Conservation in Hot Climate.* Architectural Press. London.
24. Illich, I. 1973. *Tools for Conviviality*. Calder & Boyars. London.
25. Khanna, P.N. 1996. *Indian Practical Civil Engineers' Handbook*. Engineer's Publishers. Delhi.
26. Kelly, K. 1995. *Out of Control The New Biology of Machines*. Fourth Estate. London.

27. Kuhn, T. 1962. *The Structure of Scientific Revolutions* University of Chicago. Chicago.
28. Larsson, A. and Larsson, V.1984. *A Documentation of Twelve Tswana Dwellings.* University of Lund. Lund.
29. McHarg, I. 1969. *Design with Nature*. Falcon Press. Philadelphia.
30. Moore, J. 1978. *Design for Good Acoustics and Noise Control.* Macmillon Press. London
31. Norton, J. 1997. *Building with Earth A Handbook.* Intermediate Technology Publications. London.
32. Papanek, V. 1995. *The Green Imperative: Ecology and Ethic in Design and Architecture.* Thames and Hudson. London.
33. Papanek V. 1974. *Design for the Real World.* Thames and Hudson. London.
34. Pearson, D. 1989. *The Natural House Book*. Gaia Books London
35. The Royal Institution of Chartered Surveyors. 1993. *Energy Efficiency in Buildings, Energy Appraisal of Existing Buildings*. RICS Books. London.
36. Sealey, A. 1979. *Introduction to Building Climatology*. Commonwealth Association of Architects. London.
37. Rogers, R and Gumuchdjian,P. 1997. *Cities for a Small Planet*. Faber and Faber. London.
38. Turner, F.1979. *Housing By People: Towards Autonomy in Building Environments.* Marion Boyars. London.
39. Stein, B. and Reynolds, J. 1986. *Mechanical and Electrical Equipment for Buildings*. John Wiley and Sons Inc. New York
40. Tapscott, D 1995 *The Digital Economy: Promise and Peril in the Age of Networked Intelligence.* Mcgraw Hill New York.
41. Taylor, G.D. 1985 *Materials in Construction.* Longman Scientific and Technical. London.
42. Tilley, A. 1993 *The Measure of Man and Woman*. Whitney Library of Design New York.
43. Whyte, W.H. 1956. *The Organisation Man.* Pelican Books. London.
44. Vale, B. and Vale, R. 1976. *The Autonomous House: Design and Planning for Self Sufficiency*. Thames and Hudson. London.
45. Yannas, S. 1994. *Solar Energy and Housing Design*. Architectural Association. London
46. Yeang, K. 1995. Designing with Nature: the Ecological Basis for Architectural Design. McGraw-Hill. New York.
47. Van Straaten, J. 1967. The Thermal Performance of Buildings. Elsevier Publishing Company. London.

APPENDIX ONE: DEFINITION OF TERMS

Adaptability: Refers to the degree to which adjustments are possible in practices, processes, or structures of systems to projected or actual changes of climate. Adaptation can be spontaneous or planned, and be carried out in response to or in anticipation of changes in conditions. http://www.weathervane.rff.org/glossary/index.html

Architect: A person who designs and supervises the construction of building. Dictionary of buildings. Maclean, J.H., and Scott, J.S. 1995.

Assessment framework: A document designed to support the integration of particular goals and objectives (such as sustainable development objectives) in to particular fields (such as building and construction).

Benchmark: A measurable variable used as a baseline or reference in evaluating the performance of an organisation. Benchmarks may he drawn from internal experience or that of other organisations or from legal requirement and are often used to gauge changes in performance over time. http://glossary.eea.eu.int/EEAGlossary

Benchmarking: Developed in areas such as Total Quality Management (TQM), benchmarking involves the comparison, ranking or rating of different processes, units or organisation against standards. The aim of this is identify ways of improving the performance of operations, systems and processes. Elkington, J.1997.

Binding targets: Refer to environmental standards that are to be met in the future. http://www.weathervane.rff.org/glossary/index.html

Biodegradeable: Capable of decomposing rapidly by microorganisms under natural conditions (aerobic and/or anaerobic). Most organic materials, such as food scraps and paper are biodegradable. http://glossary.eea.eu.int/EEAGlossary/B/biomass

Biodiversity: Assemblage of living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. http://glossary.eea.eu.int/EEAGlossary/B/biomass

Biological productivity: Refers to nature's ability to reproduce and regenerate living matter. Biological productivity of a given land category (i.e. pasture, forest, etc.) is determined by dividing the total biological production (how much is grown and living on the land) by the total land area available in this category. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Biomass or biomatter: Is the amount of living organic matter of an ecosystem - usually measured in dry weight.
http://www.redefiningprogress.org/programs/sustainability/glossary/terms.html

Biomass: The biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste. http://glossary.eea.eu.int/EEAGlossary/B/biomass

Brief: Set of instructions developed by a client to be used by an architect to design a building.

Buffer zone: The region near the border of a protected area; a transition zone between areas managed for different objectives http://glossary.eea.eu.int/EEAGlossary/B/biomass

Building: A building is any structure with a roof to provide shelter from the weather for its occupants or contents. Maclean, J.H., and Scott, J.S. 1995.

Building lifecycle: Term used to describe the different stages in the development, use and demolition and reuse of buildings.

Building site: A plot of land for building or on which work for a building project is in hand. Maclean, J.H., and Scott, J.S. 1995.

Building stakeholder: People actively involved in, or affected by the design and use of buildings such as occupants, owners and developers, a design team and local communities and government.

Carbon sequestration: Generally refers to capturing carbon -- in a carbon sink, such as the oceans, or a terrestrial sink such as forests or soils -- so as to keep the carbon out of the atmosphere. http://www.weathervane.rff.org/glossary/index.html

Carrying capacity: Is conventionally defined as the maximum population size of a given species that an area can support without reducing its ability to support that same species in the future. In the human context, William Catton defines it as the maximum "load" (population x per capita impact) that can safely and persistently be imposed on the environment by people. http://www.redefiningprogress.org/programs/sustainability/glossary/terms.html

Conservation: Maintenance or sustainable use of the earth's resources that maintains ecosystems, species and genetic diversity and the evolutionary and other processes that shaped them. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Construction: The activity of erecting buildings and other structures, including commercial, industrial and residential work. Maclean, J.H., and Scott, J.S. 1995.

Consumption: Refers to all the goods and services used by households. This includes purchased commodities at the household level (such as food, clothing, and utilities), the goods and services paid for by government (such as defense, education, social services and health care), and the resources consumed by businesses to increase their assets (such as business equipment and housing). http://www.redefiningprogress.org/programs/sustainability/glossary/terms.html

Contractor: A person (or company) who agrees to do something in return for payment Maclean, J.H., and Scott, J.S. 1995.

Community participation: Process whereby a community or communities are encouraged to voluntarily take part in decision making and implementation of development programmes especially when the community of the beneficiary. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Composting: The controlled biological decomposition of organic material in the presence of air to form a humus-like material. Controlled methods of composting include mechanical mixing and aerating, ventilating the materials by dropping them through a vertical series of aerated chambers, or placing the compost in piles out in the open air and mixing it or turning it periodically. http://glossary.eea.eu.int/EEAGlossary

Descriptive indicator: Descriptive indicators show the development of a variable, but are not connected with a concrete policy target. http://glossary.eea.eu.int/EEAGlossary

Developing countries:, Or *less developed countries (LDCs),* are those countries which are in the process of becoming industrialized but have constrained resources with which to combat their environmental problems http://www.weathervane.rff.org/glossary/index.html

Differentiation: In the context of the Framework Convention refers to differing national circumstances that might imply differing obligations. It can refer to North-South distinctions, or to differences within the rich Annex 1 countries. The differences can reflect population, income, economic composition, or energy http://www.weathervane.rff.org/glossary/index.html

Disability: A disability is any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being (WHO). The term 'disability' can also summarise a great number of different functional limitations occurring in any population in any country of the world. People may be disabled by physical, intellectual or sensory impairment, medical conditions or mental illness. (Standard Rules on the Equalisation of Opportunities for Persons with Disabilities, United Nations, 1994) It is also defined as the disadvantage or restriction caused by contemporary social organisation which takes no or little account of people who have impairments and thus excludes them from the mainstream of social activities (Disabled Peoples International)
http://www.fao.org/scripts/Rural_D/query/Glo_Select.idc

Downstream: Refers to any point in the economy, and in particular, at the level of energy consumers rather than suppliers. It is commonly interpreted to be industrial boilers, electric utilities and other major energy users, but also applies, in theory, to all consumers of gasoline, coal, electricity etc. Conversely, *upstream* refers to the point (or close to it) where fossil fuels enter the economy. In the U.S., it means at the input to oil refineries, at coal processing plants and where natural gas enters pipelines.
http://www.weathervane.rff.org/glossary/index.html

DPSIR: The causal framework for describing the interactions between society and the environment adopted by the European Environment Agency: Driving forces, Pressures, States, Impacts, Responses (extension of the PSR model developed by OECD).
http://glossary.eea.eu.int/EEAGlossary

Ecodevelopment: Development at regional and local levels, consistent with the potentials of the area involved, with attention given to the adequate and rational use of natural resources, technological styles and organizational forms that respect the natural ecosystems and local social and cultural patterns. http://www.fao.org/scripts/Rural_D/query/Glo_Select.idc

Eco-labelling: Special product labels that indicate that a product meets standards of environmental soundness that are supported by extensive research into the product's impact on the environment http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Ecology: Study of natural environment and of the relations of organisms to each other and to their surroundings. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Ecological approach: Natural processes that recycle nutrients in various in various chemical forms from the non-living environment to living natural resource planning and management activities that assure consideration of the relationships among all organisms, including humans and their environment. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Ecological diversity: Variety of forests, deserts, grasslands, oceans, streams, lakes, and other biological communities interacting with one another and with their nonliving environment.
http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Ecological integrity: Degree to which an ecosystem has the ability to be self-sustaining over the long term. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Ecological footprint: Land (and water) area of the planet or particular area required for the support either of humankind's current lifestyle or the consumption pattern of a particular

population. It is the inverse of the carrying capacity of a territory. United Nations.1997.*Glossary of Environment Statistics*.

Ecological land use planning: Method for deciding how land should be used; development of an integrated model that considers geological, ecological health, and social variables. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Ecological processes: Actions or events that link organisms, including humans, and their environment, including production, decay, nutrient cycling, disturbance and successional development. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Ecological zone: A large natural unit controlled by a set of common processes, mostly climatic and dominated by life forms with similar physical adaptations to those processes. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Ecosphere: Entire global ecosystem that comprises atmosphere, lithosphere, hydrosphere, and biosphere as interacting components. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Ecosystem: Is the complex of plant, animal, fungal, and microorganism communities and their associated non-living environment interacting as an ecological unit. Ecosystems have no fixed boundaries; instead, their parameters are set according to the scientific, management, or policy question being examined. Depending upon the purpose of analysis, a single lake, a watershed, or an entire region could be considered an ecosystem. http://www.weathervane.rff.org/glossary/index.html

Ecosystem approach: Comprehensive and holistic approach to understanding and anticipating ecological change, assessing the full range of consequences, and developing appropriate responses. It recognises the complexity of ecosystems and interdependence of component parts. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Ecosystem diversity: Variety of ecosystems in which species or communities of organisms, occur. It also includes an ecosystem structure and function. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Ecosystem restoration: Returning an ecosystem from a non-sustainable to a sustainable condition. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Ecosystem sustainability: Ability to sustain biodiversity, productivity, health, resilience to stress, renewability, yields of desired values, resource uses, products or services from an ecosystem, while maintaining the integrity of the ecosystem over time. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Ecotourism: Tourism that focuses on nature-related, non-consumptive activities or experiences such as bird watching. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Efficiency indicator: Indicators that relate environmental pressures to human activities. These indicators provide insight in the efficiency of products and processes: Efficiency in terms of the resources used, the emissions and waste generated per unit of output. http://glossary.eea.eu.int/EEAGlossary

Embodied energy: Of a commodity is the energy that is used during the entire life cycle of the commodity for manufacturing, transporting, and disposing of the commodity. http://www.redefiningprogress.org/programs/sustainability/glossary/terms.html

Erosion: Is the process of soil and nutrient loss that leads to a decline in the ability of the land to support life. Can also be used metaphorically to refer to depletion (e.g. of natural capital). http://www.redefiningprogress.org/programs/sustainability/glossary/terms.html

Effluent: A liquid waste material that is a by-product of human activity (e.g. liquid industrial discharge or sewage) http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Environmental degradation: Depletion or destruction of a potentially renewable resource such as soil, grassland, forest or wildlife by using it at a faster rate than it is naturally replenished. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Environmental impact assessment: Critical appraisal of the likely ecological effects of a proposed project, activity, or policy, both positive and negative. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Environmental indicator: Selected key statistic that represents or summarizes the state of the environment, natural resource sustainability or related human activity. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Environment: Components of the earth, including air, land and water, all layers of the atmosphere, all organic and inorganic matter and living organisms, and the interacting systems that include all these organisms http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Environmental accounting: 1) National accounting: physical and monetary accounts of environmental assets and the costs of their depletion and degradation. 2) Corporate accounting: the term usually refers to environmental auditing, but may also include the costing of environmental impacts caused by the corporation. http://glossary.eea.eu.int/EEAGlossary

Environmental impact assessment: A technique used for identifying the environmental effects of development projects. As a result of Directive 85/337/EEC (as amended 1997), this is now a legislative procedure to be applied to the assessment of the environmental effects of certain public and private projects which are likely to have significant effects on the environment. An EIA requires a scoping study to be undertaken in order to focus the assessment. This can be carried out in the field or as a desk study depending on the nature/scale of the project. http://glossary.eea.eu.int/EEAGlossary

Environmental management system: A means of ensuring effective implementation of an environmental management plan or procedures and compliance with environmental policy objectives and targets. A key feature on any effective environmental management system (EMS) is the preparation of documented system procedures and instructions to ensure effective communication and continuity of implementation. There are certification systems for EMS ISO 14001 and EC´s EMAS scheme (EMAS is now compatible with ISO 14001) which demonstrate that a system is operated to an internationally recognised standard. Alternatively a customised system can be developped addressing the particular needs of the operation. http://glossary.eea.eu.int/EEAGlossary

Financial capital: The financial resources which are available to people (whether savings, supplies of credit, or regular remittance of pensions) and which provide them with diferent livelihood options. Adapted from Scoones. I. 1998.

Fossil fuels: Are coal, natural gas and fuels made from crude oil (such as petrol and diesel). http://www.redefiningprogress.org/programs/sustainability/glossary/terms.html

Full cost accounting: A tool to identify, quantify and allocate the direct and indirect environmental costs of ongoing company operations. Full cost accounting helps identify and

qualify the following four types of costs for a product, process or project: direct costs, hidden costs, contingent liability costs, and less tangible costs. http://glossary.eea.eu.int/EEAGlossary

Gaia: Greek Goddess of the earth. Also name given to a hypothesis proposed by James Lovelock which views the planet as a self regulating and self-organising organism. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Gaia Hypothesis: This postulates that they physical and chemical condition of the surface of the Earth, of the atmosphere, and of the oceans has been and is actively made fit and comfortable by life itself. This contrasts with conventional wisdom, which held that life adapted to the planetary conditions as it, and they evolved their separate ways. Lovelock, J.1987

Genetic diversity: Infinite variation of possible genetic combinations among individuals. Genetic diversity is what enables a species to adapt to ecological change. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Global warming: Modification of climates due to retention of an increased proportion of radiation on land, and increasing temperatures. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Greenhouse effect: Is the progressive, gradual warming of the earth's atmospheric temperature, caused by the insulating effect of carbon dioxide and other greenhouse gases that have proportionately increased in the atmosphere. The greenhouse effect disturbs the way the Earth's climate maintains the balance between incoming and outgoing energy by allowing short-wave radiation from the sun to penetrate through to warm the earth, but preventing the resulting long-wave radiation from escaping back into the atmosphere. http://www.weathervane.rff.org/glossary/index.html

Greenhouse gases: Include the common gases of carbon dioxide and water vapor, but also rarer gases such as methane and chlorofluorocarbons (CFCs) whose properties relate to the transmission or reflection of different types of radiation. The increase in such gases in the atmosphere, which contributes to global warming, is a result of the burning of fossil fuels, the emission of pollutants into the atmosphere, and deforestation. http://www.weathervane.rff.org/glossary/index.html

Green taxes: Economics jargon for a group of financial instruments favoured by those who see market forces as the best form of forcing business to pay for pollution. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Gross domestic product (GDP): Unduplicated value of production originating within the boundaries of a country, regardless of the ownership of the factors of production. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Gross national product (GNP): Unduplicated value of production by nationally-owned factors of production, regardless of where it takes place. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Ground water: All water, which is below the surface of the ground in the saturation zone and in direct contact with the ground of the soil. http://glossary.eea.eu.int/EEAGlossary
Greenhouse effect: Warming of the atmosphere due to the reduction in outgoing solar radiation resulting from concentrations of gases such as carbon dioxide
http://glossary.eea.eu.int/EEAGlossary

Habitat: The place where an organism lives or the place one would go to find it. The habitat is the organism's address, and the ecological niche its profession, biologically speaking. Odum, E.P.1959. p. 53.

Hazardous waste: Waste that poses a risk to human or ecological health. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Human Capital: The skills, knowledge, ability to labour and good health important to the ability to pursue different livelihood strategies. Adapted from Scoones, I. 1998.

Human Development Index (HDI): Measure based on three indicators: (a) longevity, as measured by life expectancy at birth, (b) educational and combined primary, secondary and tertiary enrolment ratios (one-third weight) and (c) standard of living, as measured by real gross domestic product (GDP) per capita (in purchasing power. United Nations. 1997. *Glossary of Environment Statistics.*

Human well-being: A condition in which all members of society are able to determine and meet their needs and have a large range of choices to meet their potential. Prescott-Allen, R. 2001.

Hydrological cycle: Is the natural cycle of water from evaporation, transpiration in the atmosphere, condensation (rain and snow), and flows back to the ocean (e.g. rivers). http://www.redefiningprogress.org/programs/sustainability/glossary/terms.html

ICT: Information and Communication Technologies - generally refers to Internet-based computer technologies and applications http://www.fao.org/scripts/Rural_D/query/Glo_Select.idc

Indicators: A variable, pointer, or index. Its fluctuation reveals the variations in key elements of a system. The position and trend of the indicator in relation to reference points or values indicate the present state and dynamics of the system. Indicators provide a bridge between objectives and action. 2. Signals - of processes, inputs, outputs, effects, results, outcomes, impacts, etc. - that enable such phenomena to be judged or measured. Both qualitative and quantitative indicators are needed for management learning, policy review, monitoring and evaluation Indicators for sustainable development of marine capture fisheries. FAO.1999.

Indigenous: People, plants or animals that originate naturally in a region. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

I**ndigenous ecological and environmental knowledge:** Through a traditional way of life over many generations, indigenous people have developed an in-depth knowledge of the ecosystems in which they live. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Infiltration: Penetration of water into the ground. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Internet: Worldwide collection of interconnected, heterogeneous computer networks. http://www.fao.org/scripts/Rural_D/query/Glo_Select.idc

Intranet: A collection of interconnected computer networks at a local level. http://www.fao.org/scripts/Rural_D/query/Glo_Select.idc

Landfill: Tipping of wastes into holes in the ground. A relatively cheap way of using domestic waste and more hazardous chemicals. Landfill sites to handle more difficult wastes are now engineered, managed and monitored to prevent poisons leaking out. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Lifecycle: Consecutive or interlinked stages of a product or service, from the extraction of natural resources to the disposal of the final product. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Lifecycle assessment: The overall process of assessing the lifecycle impacts associated with a system, function, product or service. Elkington, J.1997.

Life support systems: According to the World Conservation Union (IUCN), refer to the biophysical processes "that sustain the productivity, adaptability and capacity for renewal of lands, waters, and / or the biosphere as a whole." http://www.redefiningprogress.org/programs/sustainability/glossary/terms.html

Management: The art of taking measures affecting a resource and its exploitation with a view to achieving certain objectives, such as the maximization of the production of that resource. Management includes, for example, fishery regulations such as catch quotas or closed seasons. Managers are those who practice management. Cooke, J.G.1984.

Monitoring: 1) A combination of observation and measurement for the performance of a plan, programme, or measure, and its compliance with environmental policy and legislation. 2) The provision of the necessary information about progress of implementation of a project, plan, etc. in order to ensure that project management and cooperation partners are able to follow the implementation of the projects and if necessary adjust activities, inputs and budgets, in order to obtain the objectives laid down for the project. http://glossary.eea.eu.int/EEAGlossary

Municipal wastewater: Discharge of effluent from waste water treatment plants which receive waste water from households, commercial establishments, and industries. Combined sewer/separate storm overflows are included in this category. http://glossary.eea.eu.int/EEAGlossary

Municipal waste: Waste from households, as well as other waste which, because of its nature or composition, is similar to waste from household. http://glossary.eea.eu.int/EEAGlossary

Modelling: An investigative technique using a mathematical or physical representation of a system or theory that accounts for all or some its known properties. Models are often used to test the effect of changes of system components on the overall performance of the system. http://glossary.eea.eu.int/EEAGlossary

Natural Capital: Refers to the existing air, water, land and energy resources from which all resources derive. Main functions include resource production (such as fish, timber or cereals), waste assimilation (such as CO2 absorption, sewage decomposition), and life support services (UV protection, biodiversity, water cleansing, climate stability). http://www.redefiningprogress.org/programs/sustainability/glossary/terms.html

Non-renewable resource: Natural resource that cannot be replaced, regenerated, or brought back to its original state once it has been extracted. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Non-renewable: Minerals, oil, gas and coal. Their use as material and energy sources leads to depletion of the Earth’s reserves and are characterised that they do not renew in human relevant periods. http://glossary.eea.eu.int/EEAGlossary

Noise pollution: Harmful or unwanted sounds in the environment, which in specific locals, can be measured and averaged over a period of time http://glossary.eea.eu.int/EEAGlossary

Natural Capital: The natural assets (i.e. stocks of resources such as land, water, wildlife, biodiversity, and other environmental resources) providing inputs for economic production and from which resource flows useful for livelihoods are derived. Natural assets in their role of providing natural resource inputs and environmental services for economic production The natural resource stock from which resource flows useful for livelihoods are derived (e.g. land, water, wildlife, biodiversity, environmental resources). Adapted from Scoones. I. 1998

Objective: Expresses the object of an action or what is intended to be achieved. Any objective will include explicit statements against which progress can be measured, and identify which things are truly important and the way they inter-relate; quantified objectives are referred to as targets. Natural resource that does not have a barrier to its use. Scialabba N. (ed.), 1998. p.256

Ozone: At the ground level is a form of air pollution that is produced when nitrogen oxides and hydrocarbons react in sunlight. It is not to be confused with stratospheric ozone, which is found 9 to 18 miles high in the Earth's atmosphere and protects people from harmful radiation from the sun. Ground-level ozone pollution, or smog, is mainly a problem during hot summer days. http://www.fao.org/fi/glossary

Ozone layer: A thin layer of ozone that lies about 25 kilometres above the earth, in the stratosphere. It forms a prospective screen against harmful radiation, filtering out ultraviolet rays from the sun. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Performance indicator: Performance indicators compare actual conditions with a specific set of reference conditions. They measure the 'distance(s)' between the current environmental situation and the desired situation (target): 'distance to target' assessment. http://glossary.eea.eu.int/EEAGlossary

Performance: Accomplishment; fulfilment; functioning, usually with regard to effectiveness. Indicators of performance will be interpreted in relation to reference points and objectives. FAO. 1998. p113

Photovoltaics: Light-sensitive panels used to generate electricity from the sun. Used to power electronics in satellites, navigation buoys, oil rigs and ocean-going yachts but is still too expensive for most domestic or general industrial uses. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Physical Capital: The basic infrastructure (transport, shelter, water, energy, and communications) and the production equipment and means which enable people to pursue their livelihoods Adapted from Scoones, I.1998

Policy: A set of government or corporate objectives and guidelines deliberately chosen to influence future decisions http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Pollution: The poisoning of land, air or water with anything that reduces its ability to support life. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Population: A group of organisms of the same species living within a specified region. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Precautionary principle: 1) Principle adopted by the UN Conference on Environment and Development (1992) that in order to protect the environment, a precautionary approach should be widely applied, meaning that where there are threats of serious or irreversible damage to the environment, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation. 2) The precautionary principle permits a lower level of proof of harm to be used in policy-making whenever the consequences of waiting for higher levels of proof may be very costly and/or irreversible. http://glossary.eea.eu.int/EEAGlossary

Recycling: 1) A resource recovery method involving the collection and treatment of a waste product for use as raw material in the manufacture of the same or a similar product. 2) the EU waste strategy distinguishes between: reuse meant as a material reuse without any structural changes in materials; recycling meant as a material recycling, only, and with a reference to

structural changes in products; and recovery meant as an energy recovery only. http://glossary.eea.eu.int/EEAGlossary

Renewable resources are energy sources that do not use exhaustible fuels. Sources of renewable energy include water, wind, solar energy and geothermal energy, as well as some combustible materials, such as landfill gas, biomass, and municipal solid waste http://www.weathervane.rff.org/glossary/index.html

Renewable resources: Resources which renew themselves within a human time-scale, such as trees and freshwater, and have the potential to be used on a sustainable basis without depletion. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Resilience: Capacity for a natural area to recover from disturbance. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Resource depletion: For renewable resources, the part of the harvest, logging, catch and so forth above the sustainable level of the resource stock; for non-renewable resources, the quantity of resources extracted. Portion of rainfall, melted snow or irrigation water that flows across the ground's surface and is eventually returned to streams. Run-off can pick up pollutants from air or land and carry them to receiving waters. http://glossary.eea.eu.int/EEAGlossary

Reuse: Material reuse without any structural changes in materials. http://glossary.eea.eu.int/EEAGlossary

Runoff: Storm water running off from the ground surface. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Social Capital: A measure of the ability of people to work together for a common purpose in groups or organisations. A key element of social capital is the sense of mutual trust. Elkington, J.1997

Solar energy: Energy from the sun which can be captured and used. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Solid waste: Wastes disposed of on land. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

State indicator: Indicator for the condition of different environmental compartments and systems in physical (e.g. temperature), chemical (e.g. atmospheric CO2 concentrations) or biological (fish stocks) variables http://glossary.eea.eu.int/EEAGlossary

Species: Group of related individuals with common hereditary morphology, chromosome number and structure, physiology and way of life, separated from neighbouring groups by a barrier that is generally-related in nature. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Species diversity: Total number of different species in a given area. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Species richness: Number of species in a region, site or sample http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Stewardship: Management of natural resources that conserves them for future generations. Usually used to distinguish from short-term, utilitarian management objectives http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Structured process: A process designed to ensure that the assessment framework and target setting document are used in effective ways to integrate sustainable development into building and construction processes. This involves ensuring that it uses the right information, involves the right people at the right time and influences decision-making.

Surface water: Water found on the surface of the land, for example rivers, lakes and dams. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Sustainability: The ability of an ecosystem to maintain ecological processes and functions, biodiversity and productivity over time. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Sustainable Building Assessment Tool or SBAT: A tool that has been developed to support the integration of sustainable development into building briefing and design processes.

Sustainable development: Term coined by the World Commission on Environment and Development to denote development which meets the needs of the present without compromising the ability of future generations to meet their own needs; development that does not require a continuous input from the outside to sustain itself. - there is no consensus on the definition of SD. Ekins, P., Hillman, M., and Hutchinson, R.1992.

Sustainable resource use: Use of resources (I.e. organisms or ecosystems) in a way and at a rate that does not lead to the long-term decline of biodiversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Sustainability: There are over 100 definitions of sustainability and sustainable development, but the best known is that of the World Commission on Environment and Development. This suggests that development is sustainable where it “meets the needs of present without compromising that ability of future generations to meet their own needs” http://globalsustainability.org/Education/Definitions/

Sustainability indicator: A variable, a pointer, an index of a complex phenomenon. Its fluctuations reveal the variations in components of the ecosystem, the resource or the sector. The position and trend of the indicator in relation to the criteria indicate the present state and dynamics of the system. Ideally, composite indicators are needed, the position and trajectory of which, within a system of reference of related criteria, would allow simple holistic assessment of sustainability. One can distinguish indicators of state of the system, pressure (or stress, driving forces) on the system, and response (reflecting action taken to mitigate, reduce, eliminate or compensate for the stress). http://glossary.eea.eu.int/EEAGlossary/S/sustainability_indicator

Species: Group of related individuals with common hereditary morphology, chromosome number and structure, physiology and way of life, separated from neighbouring groups by a barrier that is generally-related in nature. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Sustainable use: The use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations. FAO.1998.

Target setting document: A document consisting of sustainable development objectives and targets that have been discussed and agreed by building stakeholders for a building project.

Target setting workshop: A workshop involving key stakeholders of a building project where an *assessment framework* is used to discuss and agree sustainable development objectives and targets for a building project in order to produce a *target setting document.*

Tender: Offer made by a contractor to do certain work for a prices. Maclean, J.H., and Scott, J.S. 1995.

Tendering: The process of sending out drawings and bills of quantities to contractors for them to prepare a tender price. Maclean, J.H., and Scott, J.S. 1995.

Toxic: Any substance entering or that may enter the environment in a quantity or concentration or under conditions constituting a danger to the environment or human life or health. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Trend: A persistent tendency in the slope of a time series. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Urban: A place or area that ahs a population of at least 1,000 people concentrated within a continuously built up areaa, at a density of at least 400 per square kilometre. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Urban wastewater: The liquid wastes deriving from domestic, commercial and industrial activities of an urban settlement. 2) Urban waste water means domestic waste water or the mixture of domestic waste water with industrial waste water and/or run-off rain water. http://glossary.eea.eu.int/EEAGlossary

Vulnerable: Official designation of any indigenous species, subspecies or any geographically separate population that is particularly at risk because of low or declining numbers, small range , or some other reason but is not a threatened. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Waste: Physical waste is product that is caught but does not have market value. It is a by-product of the production process, which is not utilized. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Water consumption: Water abstracted, which is no longer available for use because it has evaporated, transpired, been incorporated into products and crops, consumed by man or livestock, ejected directly into sea, or otherwise removed from freshwater resources. Water losses during transport of water between the points or points of abstractions and point or points of use are excluded. http://glossary.eea.eu.int/EEAGlossary

Water erosion: Process of soil erosion beginning when raindrops bombard bare soil, loosening and washing away soil particles and culminating eventually in gully formation, most severe in areas with long dry seasons and agricultural practices that leave little vegetation cover on the soil. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Water harvesting: Any system to collect and concentrate rainwater or any other precipitation. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Water infiltration: Water moving down into pore spaces in the soil. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Water table: A more or less horizontal layer in the soil below which all spaces between soil particles are saturated with water. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

Zero emissions: Industrial or other waste producing processes which completely recycle or capture wastes so that none are released to the environment except in completely benign forms. http://www.iucnrosa.org.zw/work/vesats/m2/m2gloss.htm

APPENDIX TWO: AGENDA 21 CHAPTERS

1 Preamble

Social and economic Dimensions

2. International cooperation to accelerate sustainable development in developing countries and related domestic policies
3. Combating poverty
4. Changing consumption patterns
5. Demographic dynamics and sustainability
6. Protecting and promoting human health conditions
7. Promoting sustainable human settlement development8. Integrating environment and development in decision-making

Conservation and Management of Resources for Development

9. Protection of the atmosphere
10. Integrated approach to the planning and management of land resources
11. Combating deforestation
12. Managing fragile ecosystems: combating desertification and drought
13. Managing fragile ecosystems: sustainable mountain development
14. Promoting sustainable agriculture and rural development
15. Conservation of biological diversity
16. Environmentally sound management of biotechnology
17. Protection of the oceans, all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas and the protection, rational use and development of their living resources
18. Protection of the quality and supply of freshwater resources: application of integrated approaches to the development, management and use of water resources
19. Environmentally sound management of toxic chemicals, including prevention of illegal international traffic in toxic and dangerous products
20. Environmentally sound management of hazardous wastes including prevention of illegal international traffic in hazardous waste.
21. Environmentally sound management of solid wastes and sewage-related issues
22. Safe and environmentally sound management of radioactive wastes

Strengthening the Role of Major Groups

21. Preamble
24. Global action for women towards sustainable and equitable development
25. Children and youth in sustainable development
26. Recognizing and strengthening the role of indigenous people and their communities
27. Strengthening the role of non-governmental organizations: partners for sustainable development
28. Local authorities' initiatives in support of Agenda 21
29. Strengthening the role of workers and their trade unions
30. Strengthening the role of business and industry31. Scientific and technological community
32. Strengthening the role of farmers

Means of Implementation

33. Financial resources and mechanisms
34. Transfer of environmentally sound technology, cooperation and capacity-building
35. Science for sustainable development

36. Promoting education, public awareness and training
37. National mechanisms and international cooperation for capacity-building in developing countries
38. International institutional arrangements
39. International legal instruments and mechanisms
40. Information for decision-making

APPENDIX THREE: WORLDS SUMMIT ON SUSTAINABLE DEVELOPMENT SUSTAINABLE DEVELOPMENT OBJECTIVES

Focus	Description	Items on WSSD
Environmental Sustainability		
Size, productivity and biodiversity	Ensure that development conserves or increased the size, biodiversity and productivity of the bio-physical environment	7l, 38a, 38b, 40d, 40m, 42b, 43b, 44a, 44b, 44c, 44e, 44f, 44g, 44h,44i, 44t, 45i, 63n, 70b, 70e,
Resource Management	Ensure that development supports the management of the bio-physical environment	10f, 24, 25c, 38g, 38h, 40b, 40c, 40p, 43, 43a, 45a, 45b, 45c, 45d, 63n, 70a
Resource extraction and processing	Ensure that development minimises the use/support of environmentally damaging resource extraction and processing practices	38a, 38b, 39a, 39b, 39c, 39d, 39e,42b,
Waste & pollution	Ensure that development manages the production of waste to ensure that this does not adversely affect the bio-physical environment	22a, 22b, 23a, 23b, 23c, 23d, 23e, 23f, 23g, 39b, 38b, 38c, 68
Water	Ensure that development manages the extraction, consumption and disposal of water in order not to adversely affect the bio-physical environment	25, 25c, 25e, 26a, 26b, 26c, 26d, 26e, 26f, 26g, 27, 28,29, 66a, 66b, 66c, 66d
Energy	Ensure that development manages the production and consumption of energy in order not to adversely affect the bio-physical environment	9a, 9b, 9c, 9d, 9f, 9g, 20b, 20c, 20d, 20e, 20g, 20h, 20j, 20k, 20l, 20m, 20n, 20o, 20p, 20q, 20r, 20s, 21b, 63j, 63k, 63l,
Economic Sustainability State		
Employment and self employment	Ensure that development supports increased access to employment and supports self employment and the development of small businesses	10b, 10c, 16a, 43c,
Efficiency and effectiveness	Ensure that development (including technology specified) and is designed and managed to be highly efficient and effective, achieving high productivity levels with few resources and limited waste and pollution	10a, 10e, 10b, 15f, 16a, 16d, 52,105, 11353f,
Indigenous knowledge and technology	Ensure that development takes into account and draws on, where appropriate, indigenous knowledge and technology.	7e, 19g, 40h, 40r, 42e, 44j, 44m, 45h, 70c,
Sustainable development accounting	Ensure that development is based on a scientific approach and measures and monitors social, environmental and economic impacts and that this is used to inform the development.	7a, 7b, 7c, 18a, 18c, 10b, 19e, 44o,97d, 98, 101, 109, 110, 111,112, 129, 130, 131, 132, 133, 135, 136,
An enabling environment	Develop an enabling environment for sustainable development including developing transparent, equitable supportive policies and processes and forward planning.	4, 710d, 10e, 16b, 17,19a, 19c, 21a, 37a, 37b, 37c, 37d, 37e, 41, 46a, 47a, 53a, 53b, 63b, 63g, 69, 71,99, 114, 137, 138, 139
Small-scale, local and diverse economies	Ensure that development supports the development of small scale, local and diverse economies	7i, 42d, 43e, 53f, 95,96,
Social Sustainability		
Access	Ensure that development support increased access to land, adequate shelter, finance, information, public services, technology and communications where this is needed.	5, 7c, 7h, 7i, 9a, 10d, 11a, 11e, 40i, 40l, 52, 63f, 63g, 63j, 67a, 67b, 67c,
Education	Ensure that development improves levels of education and awareness, including awareness of sustainable development	7g, 7j, 8d, 10c, 7d, 16c, 16d, 18d, 19d, 20a, 20m, 40d, 63e, 107, 108, 116, 117, 119, 121, 122, 123, 124, 125, 126, 127
Inclusive	Ensure that development processes and benefits are inclusive	3, 5, 7d, 7e, 11a, 7f, 42c, 44k, 46b, 65, 120,
Health, Safety and Security	Ensure that development considers human rights and supports improved health, safety and security.	5, 7, 7a, 7f, 7m, 8, 12,13, 21a, 22b, 25c, 40a, 46a, 53a, 53b, 53c, 53d, 53e, 53f, 53g, 53h, 53i, 53j, 53k, 53l, 53m, 53o, 55, 56, 57, 63a, 63b, 63c, 63d, 63e, 100,118,
Participation	Ensure that development supports partnerships, interaction and involves, and is influenced by, the people that it affects.	7, 7k 18b, 25b, 37f, 37g, 40f, 42e, 44k, 46b, 106, 128

APPENDIX FOUR: OBJECTIVES AND INDICATORS OF THE UK SUSTAINABLE DEVELOPMENT STRATEGY

Objectives	Indicators
A SUSTAINABLE ECONOMY	
A Doing more or less: improving resource efficiency	
Greater resource efficiency	UK resource use
Energy efficiency of the economy	Energy efficiency of economy
	Energy use per household
Move away from disposal of waste towards waste reduction, reuse, recycling and recovery	Waste arisings and management
	Waste by sector
	Household waste and recycling
	Materials recycling
	Hazardous waste
B Economic stability and competitiveness	
Our economy must continue to grow	Total output of the economy (GDP and GDP per head)
Deliver low inflation	Rate of inflation
Government borrowing at stable and prudent level	Public sector net borrowing and net debt
Promote UK competitiveness	Labour productivity
	UK imports, exports, trade balance
Investment (in modern plant and machinery, as well as research and development) is vital to our future prosperity	Total and social investment as a percentage of GDP
Also invest in "social assets	Social investment as a per cent of GDP
C Developing skills and rewarding work	
Equip people with the skills to fulfil their potential	Qualifications at age 19
Raise educational standards at all levels and close the widening gap between high and low achievers	16 year-olds with no qualifications
	Adult literacy/numeracy
To become a learning society - in a rapidly changing world people need the skills to adapt, and opportunities to update them throughout their lives	Learning participation
Boost workplace learning	Businesses recognised as Investors In People
Maintain high and stable levels of employment so everyone can share greater job opportunities	Proportion of people of working age who are in work
	Proportion of people of working age in workless households
	Proportion of people of working age out of work for more than two years
	Proportion of lone parents, long-term ill and disabled people who are economically active
Fairness at work	People in employment working long hours
	Low pay
Maintain a safe and healthy environment for workers	Work fatalities and injury rates; working days lost through illness
" Raise quality of life of workers in global supply chains of companies importing into the UK	UK companies implementing ethical trading codes of conduct
D Sustainable production and consumption	
Give consumers better information and encourage purchasing initiatives which help to move the market	Consumer information
" Contextual indicator	Consumer expenditure
Take-up of best practice in key sectors	Energy and water consumption by sector/Waste and hazardous emissions by sector
Encourage businesses to assess environmental impacts and set targets, and produce environmental reports	Adoption of environmental management systems (ISO 14001) and the EU Eco-Management and Audit Scheme (EMAS)
	Corporate environmental engagement
	Environmental reporting
Need housing which is more energy-efficient, uses fewer resources and creates less waste	Household water use and peak demand
	Thermal efficiency of housing stock
Greater use of sustainable construction materials	Primary aggregates per unit of construction value
	Construction and demolition waste going to landfill
Need more efficient appliances	Energy efficiency of new appliances
Minimise the impact of pesticides on human health	Pesticide residues in food
Encourage environmentally sensitive land management by farmers	Area under agreement under the Environmentally Sensitive Area and Countryside Stewardship agri-environment schemes
Organic production methods	Area converted to organic production
Encourage production, marketing, purchase and use of vehicles that are more fuel efficient	Energy efficiency of road passenger travel/Average fuel consumption of new cars
UK tourism industry to grow significantly in ways which are economically, socially and environmentally beneficial	Sustainable tourism
Address transport issues; integrate tourism with public transport	Leisure trips by mode of transport
	Overseas travel
Reduce environmental impact of chemicals	Chemical releases to the environment

Develop distribution systems which support economic growth, protect the environment and benefit society	Freight transport by mode
	Heavy goods vehicle mileage intensity
BUILDING SUSTAINABLE COMMUNITIES	
E Promoting economic vitality and employment	
Improve economic performance and enhance regional competitiveness	Regional variations in GDP
Closing the gap between the poorest communities and the rest	Index of local deprivation
Tackling poverty and social exclusion	Indicators of success in tackling poverty and social exclusion
	Truancies and exclusions from school/teenage pregnancies
Promoting local business diversity	New business start-ups net of closures
Reducing disproportionate unemployment among ethnic minorities	Ethnic minority employment and unemployment
F Better health for all	
Improve health of the population overall	Expected years of healthy life
Deliver key health targets	Death rates from cancer, circulatory disease, accidents and suicides
Environmental factors affecting health	Respiratory illness
Address major factors leading to health inequalities	Health inequalities
Provide people with access to effective healthcare, based on patients' needs, and not on where they live or their ability to pay	NHS hospital waiting lists
G Travel	
Improve choice in transport; improve access to education, jobs, leisure and services; and reduce the need to travel	Road traffic
	Passenger travel by mode
	How children get to school
	Average journey length by purpose
The cost of traffic congestion	Traffic congestion
The link between rising prosperity and increased travel must be broken	Distance travelled relative to income
J Access	
Need better access to services	People finding access difficult
	Access to services in rural areas
Ensure that disabled people have access to a wider range of goods, services and facilities	Access for disabled people
Arts and sport should be accessible to everyone	Participation in sport and cultural activities
Reduce the proportion of unfit (housing) stock	Homes judged unfit to live in
Ensure that everyone has the opportunity of a decent home	Temporary accommodation/rough sleepers
" Improving significantly the energy efficiency of all residential accommodation	Fuel poverty
K Shaping our surroundings	
Re-using previously developed land, in order to protect the countryside and encourage urban regeneration	New homes built on previously developed land
Bring empty homes back into use and convert buildings to new uses	Vacant land and properties and derelict land
Shopping, leisure and entertainment, offices and other key town centre uses should, wherever possible, be located within existing centres	New retail floor space in town centres and out of town
Contextual indicators	Population growth
	Household growth
Ensure that development takes account of history and look for opportunities to conserve local heritage	Buildings of Grade I and II* at risk of decay
Attractive streets and buildings, low levels of traffic, noise and pollution, green spaces, and community safety	Quality of surroundings
	Access to local green space
	Noise levels
Reduce both crime and fear of crime	Level of crime
	Fear of crime
L Involvement and stronger institutions	
All local communities to have sustainable development strategies in place by 2000	Number of local authorities with LA21 strategies
Voluntary and community activity can promote social inclusion and cohesion	Voluntary activity
Help build a sense of community by encouraging and supporting all forms of community involvement	Community spirit
MANAGING THE ENVIRONMENT AND RESOURCES	
M An integrated approach	
Must not store up pollutant problems for the future (8.6)	Concentrations of persistent organic pollutants
	Dangerous substances in water
	Radioactive waste stocks
	Discharges from the nuclear industry

N Climate change and energy supply	
Climate change must be kept within limits which global society can accommodate	Rise in global temperature
Assess vulnerability to changed weather patterns and higher sea levels and develop adaptation strategies	Sea level rise
Continue to reduce our emissions of greenhouse gases now, and plan for greater reductions in the longer term	Emissions of greenhouse gases
	Carbon dioxide emissions by end user
In the longer term more energy will have to come from new and renewable sources	Electricity from renewable sources
Fossil fuel resources managed in an environmentally-acceptable way	Depletion of fossil fuels
P Air and atmosphere	
Reduce air pollution and ensure air quality continues to improve through the longer term	Days when air pollution is moderate or higher
	Concentrations of selected air pollutants
	Emissions of selected air pollutants
Ensure that polluting emissions do not cause harm to human health or the environment	Sulphur dioxide and nitrogen oxides emissions
	Acidification in the UK
Controls on ozone depleting substances	Ozone depletion
Q Freshwater	
Improving river quality	Rivers of good or fair quality
	Nutrients in water
Safeguarding resources and ensuring affordable supplies	Water demand and availability
	Water affordability
Avoiding waste of water	Water leakage
	Abstractions by purpose
Ensure that abstraction controls play a full part in protecting the best wildlife and amenity sites	Sites affected by water abstraction
R Seas oceans and coasts	
Reduce or eliminate inputs of hazardous and radioactive substances of most concern	Estuarine water quality, marine inputs
Aim to raise consistent compliance with the European Bathing Water Directive	Compliance with Bathing Water Directive
Protection of marine habitats and species	Biodiversity in coastal/marine areas
Improve the management and conservation of fish stocks	Fish stocks around the UK fished within safe limits
Work with other countries to achieve effective management and conservation of fish stocks	State of the world's fisheries
S Landscape and wildlife	
Minimise the loss of soils to new development	Net loss of soils to development
Soil protection	Concentrations of organic matter in agricultural topsoils
Reverse the long-term decline in populations of farmland and woodland birds	Populations of wild birds
	Trends in plant diversity
Reverse the decline in UK wildlife and habitats	Biodiversity action plans
Protection for individual landscape features such as hedges, dry stone walls and ponds	Landscape features - hedges, stone walls and ponds
Strengthen protection for special sites	Extent and management of SSSIs
Protecting the wider landscape	Countryside quality
Promoting public access and enjoyment of the landscape	Access to the countryside
Contextual indicator	Native species at risk
Continuing expansion of UK woodland area	Area of woodland in the UK
Protecting and expanding ancient and semi-natural woodlands	Area of ancient semi-natural woodland in GB
Better management of existing woodlands	Sustainable management of woodland
Sustainable forestry management overseas	Number of countries with national forest programmes
Aim to maximise efficient use of materials and greater use of recycled and waste materials	Amount of secondary/ recycled aggregates used compared with virgin aggregates
All mineral working sites are restored to a standard suitable for a specific beneficial afteruse	Land covered by restoration and aftercare conditions
SENDING THE RIGHT SIGNALS	
T Sending the right signals	
Integrating the environment into each department's policies and operations	Greening government operations
Help promote women's interests and fairness at work	Women in public appointments and senior positions
Contextual indicator	Prices of key resources - fuel
Explore the scope for using economic instruments to deliver more sustainable development, and avoid "perverse subsidies" which work against sustainable development	Real changes in the cost of transport
Cost-effective ways to comply with pollution abatement and aim to move to cleaner processes in the long term	Expenditure on pollution abatement
Where new regulation is used it will conform to the	Enforcement of regulations

government's principles of better regulation and be enforced effectively	
Improve awareness of sustainable development	Public understanding and awareness
	Awareness in schools
Encourage individuals to do their bit	Individual action for sustainable development
INTERNATIONAL CO-OPERATION AND DEVELOPMENT	
U International co-operation and development	
Work with others to eliminate global poverty and raise living standards in developing countries	Global poverty
	Net Official Development Assistance (oda)
Contextual indicator	Global population
Work with others to tackle global pressures on the environment and resources	UK public expenditure on global environment protection
International conventions aimed at protecting the environment: UK commitment to Multilateral Environmental Agreements	Implementation of multilateral environmental agreements
Contextual indicators	International emissions of carbon dioxide per head
	World and UK materials consumption levels per head

APPENDIX FIVE: SOUTH AFRICA STATE OF THE ENVIRONMENT REPORT 2002 INDICATORS

Theme	Indicator
Climate Change	Greenhouse gas emissions (carbon dioxide, nitrous oxide and methane)
	Energy use (fossil fuels vs. non-fossil fuels)
	Size of the national net carbon sink
	Malaria: morbidity and mortality
	Mean annual temperature
	Cost of carbon abatement
	Cost of natural disaster relief
	Energy intensity
Stratospheric Ozone	Consumption of ozone depleting substances
	UV-B trends
	Stratospheric ozone level
Air Quality	Ambient Sulphur Dioxide Concentration
	Ambient Nitrogen Dioxide Concentration
Species Diversity	Threatened and extinct species per taxonomic group
	Endemic species per taxonomic group
	Alien (non-indigenous) species per taxonomic group
	Population trends of selected species
	Distribution and abundance of selected alien (non-indigenous) species
Habitat Change	Extent of conserved areas
	Extent of natural areas remaining
	Disturbance regimes : fire frequency
	Disturbance regimes : flood and drought
Resource Value	Contribution to job creation : conservation areas
	Contribution to job creation : eradication of alien species
	Economic contribution of commercially utilised indigenous species
	Economic contribution of commercially utilised freshwater species
	Economic contribution of commercially utilised marine, coastal & estuarine species
	Economic contribution of commercially utilised terrestrial species
Environmental Management	Multi-lateral environmental agreements
	Budgetary allocation to natural resource management
	Budgetary allocation to environmental education
	Budgetary allocation to environmental research
	Inclusion of Integrated Environmental Management (IEM) into IDPs and SDIs
	Conciliation Cases
	Voluntary adoption of environmental management systems
	Voluntary use of environmental accounting & reporting
	Government capacity for environmental management
	Environmental reporting by government departments
Human Settlements	Green space per settlement
	Contaminated land per settlement
	Housing density
	Urban and rural population
	Proportion of urban area in South Africa
Vulnerability	GDP per capita
	Life expectancy
	Adult literacy rate
	Employment rate
	Population growth rate
	HIV / AIDS incidence
	Household energy use
	Access to water
	Access to sanitation
Water Quantity	Intensity of use of surface water resources
	Intensity of use of ground water resources
	Total surface water used per sector
	Total ground water used per sector
	Total surface water resources available per capita
	People dependent on ground water resources
	Surface water affordability
Water Quality	Surface water salinity
	Ground water salinity
	Surface water nutrients
	Ground water nutrients
	Surface water microbiology
	Ground water microbiology
	Surface water toxicity

Theme	Indicator
Freshwater Ecosystem Integrity	Riparian vegetation
	Aquatic macro-invertebrate composition
	Fish community health
	Aquatic habitat integrity
Land Use	Land cover
	Land productivity vs. potential
Land Condition	Desertification
	Soil loss
	Soil acidification
	Soil salinisation
	Land degradation
	Persistent organic pollutants
Resource Management	Catches and Maximum Sustainable Yield per fishery sector
	Distribution and abundance of resource species
	Catch per unit effort per fishery sector
	Commercial fishing rights supporting SMME
Resource Quality	Estuarine Health Index (State of South African estuaries)
	Pollutant loading entering the seas from land based sources
	Blue Flag beaches
	Concentrations of heavy metals in sediments or biological tissues
	Oil pollution accidents along the coast
	Land cover change in the coastal zone
	Population density change in the coastal zone
Natural Heritage Resources	Status of natural heritage resources
	Investment into natural heritage resources
	Visitors to natural heritage resources
Waste Generation	General waste produced per income group per year
	General waste produced per capita per year
	Hazardous waste produced per sector per year
Waste Reduction	Waste recycling
	Value of waste recycled
	General waste correctly disposed through landfill
	Hazardous waste correctly disposed
	Available landfill lifespan
	Provincial expenditure on waste management
	Provincial waste collection capacity

APPENDIX SIX: AGENDA 21 INDICATORS OF SUSTAINABLE DEVELOPMENT

Chapter of Agenda 21	Driving Force indicators	State indicators	Response Indicators
Economic Category			
Chapter 3: Combating poverty	-Unemployment rate	-Head count index of poverty -Poverty gap index -Squared poverty gap index -Gini index of income inequality -Ratio of average female wage to male wage	
Chapter 5: Demographic dynamics and sustainability	-Population growth rate -Net migration rate -Total fertility rate	-Population density	
Chapter 36: Promoting education, public awareness and training	-Rate of change of school-age population -Primary school enrolment ratio (gross and net) -Secondary school enrolment ratio (gross and net) -Adult literacy rate	-Children reaching grade 5 of primary education -School life expectancy -Difference between male and female school enrolment ratios -Women per hundred men in the labour force	-GDP spent on education
Chapter 6: Protecting and promoting human health		-Basic sanitation: Percent of population with adequate excreta disposal facilities -Access to safe drinking water -Life expectancy at birth -Adequate birth weight -Infant mortality rate -Maternal mortality rate -Nutritional status of children	-Immunization against infectious childhood diseases -Contraceptive prevalence -Proportion of potentially hazardous chemicals monitored in food -National health expenditure devoted to local health care -Total national health expenditure related to GNP
Chapter 7: Promoting sustainable human settlement development	-Rate of growth of urban population -Per capita consumption of fossil fuel by motor vehicle transport -Human and economic loss due to natural disasters	-Percent of population in urban areas -Area and population of urban formal and informal settlements -Floor area per person -House price to income ratio	-Infrastructure expenditure per capita
Economic Category			
Chapter 2: International cooperation to accelerate sustainable development in countries and related domestic policies	-GDP per capita -Net investment share in GDP -Sum of exports and imports as a percent of GDP	-Environmentally adjusted Net Domestic Product -Share of manufactured goods in total merchandise exports	
Chapter 4: Changing consumption patterns	-Annual energy consumption -Share of natural-resource intensive industries in manufacturing value-added	-Proven mineral reserves -Proven fossil fuel energy reserves -Lifetime of proven energy reserves -Intensity of material use -Share of manufacturing value-added in GDP -Share of consumption of renewable energy resources	
Chapter 33: Financial resources and mechanisms	-Net resources transfer / GNP -Total ODA given or received as a percentage of GNP	-Debt / GNP -Debt service / export	-Environmental protection expenditures as a percent of GDP -Amount of new or additional funding for sustainable development
Chapter 34: Transfer of environmentally sound technology, cooperation and capacity-building	-Capital goods imports -Foreign direct investments	-Share of environmentally sound capital goods imports	-Technical cooperation grants
Environmental category			
Chapter 18: Protection of	-Annual withdrawals of	-Groundwater reserves	-Waste-water treatment

Chapter of Agenda 21	Driving Force indicators	State indicators	Response Indicators
the quality and supply of freshwater resources	ground and surface water -Domestic consumption of water per capita	-Concentration of faecal coliform in freshwater -Biochemical oxygen demand in water bodies	coverage -Density of hydrological networks
Chapter 17: Protection of the oceans, all kinds of seas and coastal areas	-Population growth in coastal areas -Discharges of oil into coastal waters -Releases of nitrogen and phosphorus to coastal waters	-Maximum sustained yield for fisheries -Algae index	
Chapter 10: Integrated approach to the planning and management of land resources	-Land use change	-Changes in land condition	-Decentralized local-level natural resource management
Chapter 12: Managing fragile ecosystems: combating desertification and drought	-Population living below poverty line in dryland areas	-National monthly rainfall index -Satellite derived vegetation index -Land affected by desertification	
Chapter 13: Managing fragile ecosystems: sustainable mountain development	-Population change in mountain areas	-Sustainable use of natural resources in mountain areas -Welfare of mountain populations	
Chapter 14: Promoting sustainable agriculture and rural development	-Use of agricultural pesticides -Use of fertilizers -Irrigation percent of arable land -Energy use in agriculture	-Arable land per capita -Area affected by salinization and waterlogging	-Agricultural education
Chapter 11 : Combating deforestation	-Wood harvesting intensity	-Forest area change	-Managed forest area ratio -Protected forest area as a percent of total forest area
Chapter 15: Conservation of biological diversity		-Threatened species as a percent of total native species	-Protected area as a percent of total area
Chapter 16: Environmentally sound management of biotechnology			-R & D expenditure for biotechnology -Existence of national biosafety regulations or guidelines
Chapter 9: Protection of the atmosphere	-Emissions of greenhouse gasses -Emissions of sulphur oxides -Emissions on nitrogen oxides -Consumption of ozone depleting substances	-Ambient concentrations of pollutants in urban areas	-Expenditure on air pollution abatement
Chapter 21: Environmentally sound management of solid wastes and sewage-related issues	-Generation of industrial and municipal solid waste -Household waste disposed per capita		-Expenditure on waste management -Waste recycling and reuse -Municipal waste disposal
Chapter 19: Environmentally sound management of toxic chemicals		-Chemically induced acute poisonings	-Number of chemicals banned or severely restricted
Chapter 20: Environmentally sound management of hazardous wastes	-Generation of hazardous wastes -Imports and exports of hazardous wastes	-Area of land contaminated by hazardous wastes	-Expenditure on hazardous waste treatment
Chapter 22: Safe and environmentally sound management of radioactive wastes	-Generation of radioactive wastes		
Institutional category			
Chapter 8: Integrating environment and development in decision-making			-Sustainable development strategies -Programme of integrated environmental and economic accounting

Chapter of Agenda 21	Driving Force indicators	State indicators	Response Indicators
			-Mandated Environmental Impact Assessment -National councils for sustainable development
Chapter 35: Science for sustainable development		-Potential scientists and engineers per million population	-Scientists and engineers engaged in R & D per million population -Expenditure on R & D as a percent of GDP
Chapter 37: National mechanisms and international cooperation for capacity-building in developing countries			
Chapter 38: International institutional arrangements			
Chapter 39: International legal instruments and mechanisms			-Ratification of global agreements -Implementation of ratified global agreements
Chapter 40: Information for decision-making		-Main telephone lines per 100 inhabitants -Access to information	-Programmes for national environmental statistics
Chapter 23-32: Strengthening the role of major groups			-Representation of major groups in national councils for sustainable development -Representatives of ethnic minorities and indigenous people in national councils for sustainable development -Contribution of NGOs to sustainable development

APPENDIX SEVEN: COUNCIL FOR SUSTAINABLE DEVELOPMENT THEME INDICATOR FRAMEWORK[1]

SOCIAL		
Theme	**Sub-theme**	**Indicator**
Equity	Poverty (3)	Percent of Population Living below Poverty Line
		Gini Index of Income Inequality
		Unemployment Rate
	Gender Equality (24)	Ratio of Average Female Wage to Male Wage
Health (6)	Nutritional Status	Nutritional Status of Children
	Mortality	Mortality Rate Under 5 Years Old
		Life Expectancy at Birth
	Sanitation	Percent of Population with Adequate Sewage Disposal Facilities
	Drinking Water	Population with Access to Safe Drinking Water
	Healthcare Delivery	Percent of Population with Access to Primary Health Care Facilities
		Immunization Against Infectious Childhood Diseases
		Contraceptive Prevalence Rate
Education (36)	Education Level	Children Reaching Grade 5 of Primary Education
		Adult Secondary Education Achievement Level
	Literacy	Adult Literacy Rate
Housing (7)	Living Conditions	Floor Area per Person
Security	Crime (36, 24)	Number of Recorded Crimes per 100,000 Population
Population (5)	Population Change	Population Growth Rate
		Population of Urban Formal and Informal Settlements

ENVIRONMENTAL		
Theme	**Sub-theme**	**Indicator**
Atmosphere (9)	Climate Change	Emissions of Greenhouse Gases
	Ozone Layer Depletion	Consumption of Ozone Depleting Substances
	Air Quality	Ambient Concentration of Air Pollutants in Urban Areas
Land (10)	Agriculture (14)	Arable and Permanent Crop Land Area
		Use of Fertilizers
		Use of Agricultural Pesticides
	Forests (11)	Forest Area as a Percent of Land Area
		Wood Harvesting Intensity
	Desertification (12)	Land Affected by Desertification
	Urbanization (7)	Area of Urban Formal and Informal Settlements
Oceans, Seas and Coasts (17)	Coastal Zone	Algae Concentration in Coastal Waters
		Percent of Total Population Living in Coastal Areas
	Fisheries	Annual Catch by Major Species
Fresh Water (18)	Water Quantity	Annual Withdrawal of Ground and Surface Water as a Percent of Total Available Water
	Water Quality	BOD in Water Bodies
		Concentration of Faecal Coliform in Freshwater
Biodiversity (15)	Ecosystem	Area of Selected Key Ecosystems
		Protected Area as a % of Total Area
	Species	Abundance of Selected Key Species

ECONOMIC		
Theme	**Sub-theme**	**Indicator**
Economic Structure (2)	Economic Performance	GDP per Capita
		Investment Share in GDP
	Trade	Balance of Trade in Goods and Services
	Financial Status (33)	Debt to GNP Ratio

(2)		Total ODA Given or Received as a Percent of GNP
Consumption and Production Patterns (4)	Material Consumption	Intensity of Material Use
	Energy Use	Annual Energy Consumption per Capita
		Share of Consumption of Renewable Energy Resources
		Intensity of Energy Use
	Waste Generation and Management (19-22)	Generation of Industrial and Municipal Solid Waste
		Generation of Hazardous Waste
		Management of Radioactive Waste
		Waste Recycling and Reuse
	Transportation	Distance Traveled per Capita by Mode of Transport
INSTITUTIONAL		
Theme	**Sub-theme**	**Indicator**
Institutional Framework (38, 39)	Strategic Implementation of SD (8)	National Sustainable Development Strategy
	International Cooperation	Implementation of Ratified Global Agreements
Institutional Capacity (37)	Information Access (40)	Number of Internet Subscribers per 1000 Inhabitants
	Communication Infrastructure (40)	Main Telephone Lines per 1000 Inhabitants
	Science and Technology (35)	Expenditure on Research and Development as a Percent of GDP
	Disaster Preparedness and Response	Economic and Human Loss Due to Natural Disasters

APPENDIX EIGHT: GLOBAL REPORTING INITIATIVE INDICATORS

Core indicators	Additional indicators
DIRECT ECONOMIC IMPACTS	
Customers	
Monetary flow indicator: Net sales	
Geographic breakdown of sale	
Suppliers	
Cost of all goods, materials, and services purchase	Supplier breakdown by organisation and country
Percentage of contracts that were paid in accordance with agreed terms, excluding agreed penalty arrangements	
Employees	
Total payroll and benefits(including wages, pension, other benefits, and redundancy payments) broken down by country or region	
Providers of Capital	
Distributions to providers of capital broken down by interest in debt ad borrowings, and dividends on all classes, of shares, with any arrears of bad dept to be disclosed.	
Increase/decrease in retained earnings at end of period	
Public sector	
Total sum of taxes of all types broken down by country	Total spent on no-core business infrastructure development (This is infrastructure built outside the main business activities for the reporting entity such as a school, or hospital for employees and their families.
Donations to community, civil. Society, and other groups broken by case and in-kind donations per type of group.	
ENVIRONMENTAL PERFORMANCE	
Materials	
Total materials use other than water by type	
Percentage of materials used that are waste(processed or unprocessed) from sources to the reporting organisation.	
Energy	
Direct energy. use segmented by primary source	Initiatives to use renewable energy sources and increase energy efficiency.
Indirect energy use. report on all energy used to produce and deliver energy products purchased by the organisation.	Energy consumption footprint of major products
	Other indirect (upstream/downstream) energy use and implications, such as organisational travel, product lifecycle management, and use of energy-intensive materials
Water	
Total water use	Water sources and related ecosystem/habitats significantly affected by use of water
	Annual withdrawals of ground and surface water as a percentage of annual renewable quantity of water available from sources
	Total recycling and reuse of water
Location and size of land owned, leased, or managed in biodiversity-rich habitats	Total amount of land owned. Leased, or managed for production activities
Biodiversity	
Description of the major impacts on biodiversity associated with activities and/or products and services in terrestial, freshwater and marine environments.	Amount of impermeable surfaces as a percentage of land purchased or elapsed.
	Impacts of activities and operations on protected and sensitive areas
	Changes in natural habitats resulting from activities and operations and percentage protected ore restored.
	Objectives, programmes, and targets for protecting and resourcting native ecosystems and species in degraded areas.
	Number of IUCN Red list species with habitats in areas affected by operations
	Business units currently operating of planning operations in and or around protected or sensitive areas
Emissions, Effluents, and Waste	
Greenhouse emissions	Other relevant indirect greenhouse gas emissions
Use of and emissions of ozone-depleting substances	All production transport, import, or export of any waste deemed “hazardous” under the terms of the Basel Convention Annex I, II, VIII.

Core indicators	Additional indicators
Nox. Sox, and other significant emissions by type	Water Sources and related ecosystems/habitats significantly affected by discharge of water and waste.
Total amount of waste by type and destination	
Significant discharges to water by type	
Significant spills of chemicals, oils and fuels in terms of total number and total volume	
Suppliers	
	Performance of suppliers relative to environment components of programmes and procedures described in response to Government Structure and Management Systems section.
Products and Services	
Significant environmental impacts of principal products and services	
Percentage of the weight or products sold that is reclaimable at the end of the product's useful life and the percentage that is already reclaimed.	
Compliance	
Incidents of and fines for non-compliance with all applicable international declarations / conventions/treaties. And national, sub-national, regional, and local regulations associated with environmental issues	
Transport	
	Significant environmental impacts of transportation used for logistical purposes
Overall	
	Total environmental expenditure by type
SOCIAL PERFORMANCE INDICATORS	
Employment	
Breakdown of workforce, where possible, by region/country and status (employee/non-employee), employment type (full time/part time), and by employment contract (indefinite or permanent/fixed terms or temporary). Also identify workforce retained in conjunction with other employers (temporary agency workers or workers in co-employment relationships), segmented by region/country.	Employee benefits beyond those legally mandated
Net employment creation and average turnover segmented by region/country	
Labour / Management Relations	
Percentage of employees represented by independent trade union organisations of other bona fide employee representations broken down geographically or percentage of employees covered by collective bargaining agreements broken down by region/country	
Policy and procedures involving information, consultation and negotiations with employees over changes in the reporting organisations (eg restructuring)	Provision for formal worker representation in decision-making or management, including corporate governance.
Health and Safety	
Practices on recording and notification of occupational accidents and diseases, and how they related to the ILO Code on Recording and Notification of Occupation Accidents and Diseases.	
Description of formal joint health and safety committees comprising management and worker representative and proportion of workers covered by such committees	
Standard injury lost day and absentee rates and number of work-related fatalities (including subcontracted workers)	
Description of policies or programmes (for the workplace and beyond) on HIV/AIDS	
Training and Education	
Average hours of training per year per employee by category of employee	Description of programmes to support the continued employability of employees and to manage career endings
	Specific policies and programmes for skills management and lifelong learning
Diversity and Opportunity	
Description of equal opportunities policies or programmes as well as monitoring systems to ensure compliance and results of monitoring	
Composition of senior management and corporate governance bodies(including the boards of directors), Including female / male ration and other indicators of diversity as culturally appropriate.	
Social Performance Indicators: Human Rights	

Core indicators	Additional indicators
Strategy and Management	
Description of polices, guidelines, corporate structure and procedures to deal with all aspects of human rights relevant to operations, including monitoring mechanisms and results	Employee training on polices and practices concerning all aspects of human rights relevant to operations.
Evidence of consideration of human rights impacts as part of investment and procurement decisions, including selection of suppliers/contractors	
Descriptions of policies and programmes to evaluate and address human rights performance within the supply chain and contractors, including monitoring systems and results of monitoring.	
Non-Discrimination	
Description of global policy and procedures / programmes preventing all forms of discrimination in operations, including monitoring systems and results of monitoring.	
Freedom of Association and Collective Bargaining	
Description of freedom of association policy and extent to which this policy is universally applied independent of local laws, as well as description of procedures / programmes to address this issue.	
Child Labour	
Description of policy excluding child labour as defined by the ILO Convention 138 and extent to which this policy is visibly stated and applied as well description of procedures/ programmes to address this issue, including monitoring systems and results of monitoring.	
Forced and Compulsory Labour	
Description of policy to prevent forced and compulsory labour and extent to which this policy is visibly stated and applied as well description of procedures/ programmes to address this issue, including monitoring systems and results of monitoring.	
Disciplinary Practices	
	Description of appeal practices, including, but not limited to, human rights issues
	Description of non-retaliation policy and effective, confidential employee grievance systems(including, but not limited to, its impact on human rights)
Security Practices	
	Human rights training for security personnel
Indigenous rights	
	Description of policies, guidelines, and procedures to address the needs of indigenous people
	Description of jointly managed community grievance mechanisms/authority
	Share of operating revenues from the area of operation that are redistributed to local communities
Community	
Description of polices to mange impact on communities in areas affected by activities, as well as description of procedures/programmes to address this issue, including monitoring systems and results of monitoring.	
Bribery and Corruption	
Description of policy, procedures/management systems, and compliance mechanisms for organisations and employees addressing bribery and corruption.	
Political Contributions	
Description of policy, procedures/management systems and compliance mechanisms for managing political lobbying and contributions	Amount of money paid to political parties and institutions whose prime function is to fund political parties or their candidates
Competition and Pricing	
	Court decisions regarding cases pertaining to anti-trust and monopoly regulations
	Description of policy, procedures/management systems and compliance mechanisms for preventing ant-competitive behaviour
Social Indicators: Product Responsibility	
Customer Health and Safety	
Description of policy for preserving customer health and safety during the use of products and services, and extent to which this policy is visibly states and applied, as well as description of procedures /programmes to address this	Number and type of instance non-compliance with regulations concerning customer health and safety, including the penalties and fines assessed for these breaches

Core indicators	Additional indicators
issue, including monitoring systems and results of monitoring	
	Number of complaints upheld by regulatory or similar officinal bodies to oversee or regulate the health and safety of products and services
	Voluntary code compliance, product labels or wards with respect to social and /or environmental responsibility that the reporter is qualified to use or has received
Products and Services	
Description of policy, procedures/management systems, compliance mechanisms related to product information and labelling	Number and type of instance of non-compliance with regulations concerning product information and labelling, including any penalties of fines assessed for these breaches
	Description of policy, procedures / management systems and compliance mechanisms related to customer satisfaction including results of surveys measuring customer satisfaction. Identify geographical areas covered by policy.
Advertising	
	Description of polices, procedures/management systems , and compliance mechanisms for adherence to standards and voluntary codes related to advertising
Respect for Privacy	
Description of policy, procedures/management systems, and compliance mechanism for consumer privacy.	Number of substantiated complaints regarding breaches of consumer privacy.

APPENDIX NINE: EXAMPLE OF A COMPLETED LOG FRAME [1]

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Risks and Assumptions
Goal: Integrated community with happy children and adults	Number of stressed families decreases by 50% Other communities adopt similar ideas	Reports from village clinic and counsellors Newspaper articles	Birth rate continues
Purpose:			
Children have fun, are busy and safe because there are more recreational facilities in the village.	75% of young children use the swing at least once a month 90% young children using the swing feel happier	User survey Participatory evaluation with the children	Safe recreation leads to happiness and community integration Facilities don't create conflict
Outputs:			
1. Capacity within community to manage the building and long-term maintenance of the swing	6-monthly meetings after completion with >5 members. New members become involved at a rate of 2 a year. Swing maintained and in use over minimum 5 year period.	Minutes of meetings Ditto Maintenance and annual safety inspection records	People see the benefit of it Easy maintenance
2. A safe, well-built swing	Swing completed and in use in 12 months. Minimal number of minor accidents only. Minimal number of minor repairs needed.	Safety certificate on completion Accident records; bruises, minor cuts & hospitalisation Maintenance log	No vandalism Swing works Children like and use it Children don't fight
Activities			
1.1 Establish community committee	Planning team set up by x Committee chosen by x Monthly meetings during planning & building phase with >8 members.	Minutes of meetings Attendance records	Enthusiasm is maintained People support project
1.2 Set budget	Budget	Accounts	Low inflation
1.3 Raise funds	Enough money raised by x	Income/receipts	Money is raised
1.4 Set up systems for maintenance	Rota agreed amongst parents to maintain swing by x	Quarterly rota pinned on library notice board	Enough parents can be identified
2.1 Consult children	Ideas generated and incorporated in design	Plan discussed with designers	
2.2 Design it	Designed by x	Design in hand	

[1] Box 6, learning log frame principles, http://62.189.42.51/DFIDstage/FOI/tools/chapter_05.htm

2.3 Get planning permission	Planning permission by x	Permit in hand	Permission given
2.4 Commission builder	Tenders issued by x Contract awarded by x	Documentation	Good builder No strikes
2.5 Build it	Completion by x	Documentation	
2.6 Test it	Tested by builders by x	Verbal report	
2.7 Safety inspection on completion	Inspection by x	Certificate in hand	No accidents
2.8 Carry out user survey and participatory evaluation with the children	Survey carried out by x	Findings displayed in public library	

APPENDIX TEN: BUILDING AND CONSTRUCTION SUSTAINABLE DEVELOPMENT OBJECTIVES

Sustainable development objective: Size, productivity & biodiversity
Ensure that development conserves or increased the size, biodiversity and productivity of the biophysical environment

Ref: 1C
Building and construction objective: Locate building where it conserves or increase the size, biodiversity and productivity of the biophysical environment
Aspects: Already disturbed sites, urban areas

Ref: 1D
Building and construction objective: Site layout designed to conserve or increase the size, biodiversity and productivity of the biophysical environment
Aspects: Area of natural environment provided on sites, landscaping

Ref: 1E
Building and construction objective: Size and form designed to conserve or increase the size, biodiversity and productivity of the biophysical environment
Aspects: Building footprint, vegetated roofs

Ref: 1F
Building and construction objective: Building envelope designed to conserve or increase the size, biodiversity and productivity of the biophysical environment
Aspects: Plant boxes, balconies

Ref: 1H
Building and construction objective: Specify furniture and fittings which conserve or increase the size, biodiversity and productivity of the biophysical environment
Aspects: Use of grown materials in furniture and fittings

Ref: 1I
Building and construction objective: Specify services which conserve or increase the size, biodiversity and productivity of the biophysical environment
Aspects: Energy from biomass

Ref: 1J
Building and construction objective: Specify materials and components to conserve or increase the size, biodiversity and productivity of the biophysical environment
Aspects: Use of grown materials in materials and components

Ref: 1K
Building and construction objective: Construction process to conserve or increase the size, biodiversity and productivity of the biophysical environment
Aspects: Area of construction site, environmental impact of construction processes

Ref: 1L
Building and construction objective: Building operation to conserve or increase the size, biodiversity and productivity of the biophysical environment
Aspects: Energy sources, landscaping maintenance & management

Ref: 1M
Building and construction objective: Demolition and refurbishment to conserve or increase the size, biodiversity and productivity of the biophysical environment
Aspects: Area of demolition/refurbishment site, environmental impact demolition/refurbishment processes

Sustainable development objective: Resource management
Ensure that development supports the management of the biophysical environment

Ref: 2C
Building and construction objective: Locate building where it will support appropriate and effective management of the biophysical environment
Aspects: Building location

Ref: 2D
Building and construction objective: Site layout to support effective management of the biophysical environment
Aspects: Ecosystems, biological control

Ref: 2H
Building and construction objective: Ensure that all materials used in furniture and fittings come from managed sources
Aspects: Managed sources

Ref: 2I
Building and construction objective: Ensure that resources that are used for services come from managed sources

Aspects: Biomass, water

Ref: 2J
Building and construction objective: Ensure that materials and components come from managed sources
Aspects: Biomass

Ref: 2L
Building and construction objective: Ensure that building operation processes use materials from managed sources
Aspects: Cleaning, maintenance, energy

Sustainable development objective: Resource extraction and processing
Ensure that development minimises the use/support of environmentally damaging resource extraction and processing practices

Ref: 3H
Building and construction objective: Specify furniture and fittings that are produced in ways that minimises the use/support of environmentally damaging resource extraction and processing practices
Aspects: Resource extraction and processing

Ref: 3I
Building and construction objective: Specify services that that minimises the use/support of environmentally damaging resource extraction and processing practices
Aspects: Energy, water

Ref: 3J
Building and construction objective: Specify materials and components that minimises the use/support of environmentally damaging resource extraction and processing practices environmental damage.
Aspects: Resource extraction and processing

Ref: 3K
Building and construction objective: Design construction that minimises the use/support of environmentally damaging resource extraction and processing practices
Aspects: Use of mechanical equipment

Ref: 3L
Building and construction objective: Design building to operate in ways that minimises the use/support of environmentally damaging resource extraction and processing practices
Aspects: Energy sources

Ref: 3M
Building and construction objective: Design demolition / refurbishment so as to minimises the use/support of environmentally damaging resource extraction and processing practices
Aspects: Use of mechanical equipment

Sustainable development objective: Waste & pollution
Ensure that development manages the production of waste to ensure that this does not cause environmental damage

Ref: 4C
Building and construction objective: Location to support minimisation of waste and ease of recycling
Aspects: Local recycling service providers

Ref: 4D
Building and construction objective: Site to support minimisation of waste and ease of recycling
Aspects: Sorting and storage of waste, composting, links to agriculture/landscaping

Ref: 4G
Building and construction objective: Internal space to support minimisation of waste and ease of recycling
Aspects: Storing and sorting spaces, horizontal and vertical circulation

Ref: 4H
Building and construction objective: Furniture and fittings to support minimisation of waste and ease of recycling
Aspects: Packaging, recycled content, end of life strategies

Ref: 4I
Building and construction objective: Services to maximise to support minimisation of waste and recycling
Aspects: energy sources

Ref: 4J
Building and construction objective: Materials and components to support minimisation of waste and ease of recycling
Aspects: Packaging, recycled content, end of life strategies

Ref: 4K
Building and construction objective: Construction to support waste minimisation and ease of recycling
Aspects: Material storage and ordering, space for sorting and storage, packaging, training and awareness

Ref: 4L
Building and construction objective: Operation to support waste minimisation and ease of recycling

Aspects: Policy, programmes and monitoring, training and awareness, procurement policy: packaging, reuse

Ref: 4M
Building and construction objective: Demolition or refurbishment to support waste minimisation and ease of recycling
Aspects: Upgrading existing building to reduce waste production and improve recycling, material storage and ordering, space for sorting and storage, packaging, training and awareness, recycling and reuse of components and materials

Sustainable development objective: Water
Ensure that development manages the extraction, consumption and disposal of water in order not to adversely affect the biophysical environment

Ref: 5C
Building and construction objective: Location to support the efficient use of water, capture of rainwater and disposal of wastewater
Aspects: Rainfall, topography, geology

Ref: 5D
Building and construction objective: Site design to support the efficient use of water, capture of rainwater and disposal of wastewater
Aspects: Landscaping

Ref: 5E
Building and construction objective: Size and form to support the efficient use of water, capture of rainwater and disposal of wastewater
Aspects: Roof designs, water tanks

Ref: 5F
Building and construction objective: Envelope design to support the efficient use of water, capture of rainwater and disposal of wastewater
Aspects: Roof design

Ref: 5I
Building and construction objective: Services design to support the efficient use of water and capture of rainwater and disposal of wastewater
Aspects: Grey water, rainwater storage, water efficient delivery devices, non- water sanitation processes

Ref: 5J
Building and construction objective: Materials and construction to support efficient use of water and capture of rainwater and disposal of wastewater
Aspects: water consumption used in manufacture, source of water

Ref: 5K
Building and construction objective: Construction to support efficient use of water and capture of rainwater and disposal of wastewater
Aspects: Water consumption, dry construction

Ref: 5L
Building and construction objective: Operation to support the efficient use of water and capture of rainwater and disposal of wastewater
Aspects: Awareness, information, and communication

Ref: 5M
Building and construction objective: Demolition and refurbishment to support efficient use of water and capture of rainwater and disposal of wastewater
Aspects: Demolition / refurbishment processes

Sustainable development objective: Energy
Ensure that development manages the production and consumption of energy in order not to adversely affect the biophysical environment

Ref: 6C
Building and construction objective: Location to maximise energy efficiency and use of renewable energy
Aspects: Distance from generating source, local sources of renewable energy

Ref: 6D
Building and construction objective: Site layout to maximise energy efficiency and use of renewable energy
Aspects: Passive environmental control strategies, renewable energy sources

Ref: 6E
Building and construction objective: Size and form to maximise energy efficiency and use of renewable energy
Aspects: Passive environmental control strategies, renewable energy sources

Ref: 6E
Building and construction objective: Size and form to maximise energy efficiency and use of renewable energy
Aspects: Passive environmental control strategies, renewable energy sources

Ref: 6G
Building and construction objective: Internal space to maximise energy efficiency and use of renewable energy
Aspects: Passive environmental control strategies, renewable energy sources

Ref: 6H
Building and construction objective: Furniture and fittings to maximise energy efficiency and use of renewable energy
Aspects: Embodied energy, source of energy used for manufacture

Ref: 6I
Building and construction objective: Services to maximise energy efficiency and use of renewable energy
Aspects: Renewable energy, energy sources, energy efficient appliances

Ref: 6J
Building and construction objective: Materials and component to maximise energy efficiency and use of renewable energy
Aspects: Embodied energy, thermal efficiency

Ref: 6K
Building and construction objective: Construction to maximise energy efficiency and use of renewable energy
Aspects: Energy efficient construction methods, source of energy

Ref: 6L
Building and construction objective: Operation to maximise energy efficiency and use of renewable energy
Aspects: Energy consumption monitoring, passive environmental control systems, building management systems, programmes and procedures, awareness, training

Ref: 6M
Building and construction objective: Demolition and refurbishment to maximise energy efficiency and use of renewable energy
Aspects: Component and material recycling, upgrading existing building for better energy efficiency, energy efficient construction / demolition methods, source of energy

Sustainable development objective: Employment and self-employment
Ensure that development supports increased access to employment and supports self-employment and the development of small businesses

Ref: 7A
Building and construction objective: Briefing process should support employment and self-employment
Aspects: Local skills and small enterprise audit.

Ref: 7B
Building and construction objective: Design process should support employment and self employment
Aspects: Design team members

Ref: 7C
Building and construction objective: Building should be located where is will support employment and self employment
Aspects: Areas of high unemployment

Ref: 7D
Building and construction objective: Site layout should support employment and self-employment
Aspects: Labour intensive landscape maintenance, security

Ref: 7E
Building and construction objective: Building size and form should support employment and self-employment
Aspects: Maintenance and cleaning, type of maintenance/cleaning equipment required

Ref: 7F
Building and construction objective: Building envelope should support employment and self-employment
Aspects: Small product manufacturers

Ref: 7G
Building and construction objective: Internal space should support employment and self-employment
Aspects: Provision of low cost space, outsourcing, access to affordable facilities and services, support and training

Ref: 7H
Building and construction objective: Furniture and Fittings provided should support employment and self-employment
Aspects: Labour intensive, small product manufacturers

Ref: 7I
Building and construction objective: Services provided should support employment and self-employment
Aspects: Energy producers, water supply companies, telecommunications companies

Ref: 7J
Building and construction objective: Materials and components should support employment and self-employment
Aspects: Labour intensive materials and components, small product manufacturers

Ref: 7K

Building and construction objective: Construction process should support employment and self-employment
Aspects: Labour intensive construction processes, contractors

Ref: 7L
Building and construction objective: Building operation should support employment and self-employment
Aspects: Labour intensive maintenance and management systems, maintenance contractors

Ref: 7M
Building and construction objective: Building refurbishment or demolition should support employment
Aspects: labour intensive methods, contractors

Sustainable development objective: Efficiency and Effectiveness
Ensure that development (including technology specified) and is designed and managed to be highly efficient and effective, achieving high productivity levels with few resources and limited waste and pollution.

Ref: 8A
Building and construction objective: Briefing process should investigate how activities accommodated in building are as efficient as possible. The briefing process should be efficient and effective.
Aspects: Involvement of user group, comparative studies

Ref: 8B
Building and construction objective: The design process should investigate how activities accommodated in building are as efficient as possible. The design process should be efficient and effective.
Aspects: Involvement of user group, comparative studies

Ref: 8C
Building and construction objective: Location of the building should support efficiency and effectiveness
Aspects: Symbiotic partnerships, suppliers, consumers, transport links

Ref: 8D
Building and construction objective: Site layout should support efficiency and effectiveness
Aspects: Location and relationship between different functions and buildings

Ref: 8E
Building and construction objective: Building size and shape should support efficiency and effectiveness
Aspects: Area to volume ration, number of corners, access

Ref: 8F
Building and construction objective: Building envelope should support efficiency and effectiveness
Aspects: Multipurpose design, thermal, acoustic, structural efficiency

Ref: 8G
Building and construction objective: Space provided in building should support efficiency and effectiveness
Aspects: Amount of space, proportions of space, spatial configuration

Ref: 8H
Building and construction objective: Furniture and fittings should be provided to support efficiency and effectiveness
Aspects: Modular furniture, number of furniture types, multipurpose

Ref: 8I
Building and construction objective: Services should be support efficiency and effectiveness
Aspects: Location of services, controls for services, service runs

Ref: 8J
Building and construction objective: Materials and components should support efficiency and effectiveness
Aspects: Modular, coordinated

Ref: 8K
Building and construction objective: Construction processes should be efficient and effective
Aspects: Construction methods, programming and management

Ref: 8L
Building and construction objective: Building operation should support efficiency and effectiveness
Aspects: Monitoring, benchmarks, technology, motivation, awareness

Ref: 8M
Building and construction objective: Demolition or refurbishment should support efficiency and effectiveness
Aspects: Existing buildings upgraded to be more efficient and effective, construction and demolition processes

Sustainable development objective: Indigenous knowledge and technology
Ensure that development takes into account and draws on, where appropriate, indigenous knowledge and technology.

Ref: 9A
Building and construction objective: The briefing process should draw on indigenous processes, technology and knowledge
Aspects: Involvement of user group, comparative studies

Ref: 9B
Building and construction objective: The design process should draw on indigenous processes, technology and knowledge
Aspects: Involvement of user group, comparative studies

Ref: 9H
Building and construction objective: Specification and design of furniture and fittings should draw on indigenous processes, technology and knowledge
Aspects: Indigenous processes, technology and knowledge

Ref: 9I
Building and construction objective: Services strategies should draw on indigenous processes, technology and knowledge
Aspects: indigenous processes, technology and knowledge

Ref: 9J
Building and construction objective: Specification and design of materials and components should draw on indigenous processes, technology and knowledge
Aspects: indigenous processes, technology and knowledge

Ref: 9K
Building and construction objective: Construction processes should draw on indigenous processes, technology and knowledge
Aspects: indigenous processes, technology and knowledge

Ref: 9L
Building and construction objective: Building operation should draw on indigenous processes, technology and knowledge
Aspects: indigenous processes, technology and knowledge

Ref: 9M
Building and construction objective: Building demolition / refurbishment should draw on indigenous processes, technology and knowledge
Aspects: indigenous processes, technology and knowledge

Sustainable development objective: An enabling environment
Develop an enabling environment for sustainable development including the development of transparent and equitable supportive policies and processes and forward planning.

Ref: 10A
Building and construction objective: Briefing processes to support enabling environment for sustainable development
Aspects: Transparent and participatory policies, processes and planning

Ref: 10B
Building and construction objective: Design processes to support enabling environment for sustainable development
Aspects: Transparent and participatory policies, processes and planning

Ref: 10K
Building and construction objective: Construction processes to support enabling environment for sustainable development
Aspects: Transparent and participatory policies, processes and planning

Ref: 10L
Building and construction objective: Building operation processes to support enabling environment for sustainable development
Aspects: Transparent and participatory policies, processes and planning

Ref: 10M
Building and construction objective: Building refurbishment / demolition processes to support enabling environment for sustainable development
Aspects: Transparent and participatory policies, processes and planning

Sustainable development objective: Sustainable development accounting
Ensure that development is based on a scientific approach and measures and monitors social, environmental and economic impacts and that this is used to inform the development.

Ref: 11A
Building and construction objective: Briefing process should include clear building performance accounting systems
Aspects: Performance indicators, reporting, responsible parties

Ref: 11B
Building and construction objective: Design process should include evaluation and reporting points in terms of sustainable development objectives
Aspects: Assessment tools, indicators

Ref: 11C
Building and construction objective: Location selection should take into account social and environmental accounting
Aspects: Transport studies, environmental impact assessments

Ref: 10D

Building and construction objective: Site layout design should take into account social and environmental accounting
Aspects: Transport studies, pedestrian studies

Ref: 11E
Building and construction objective: Building form and size should take into account social and environmental accounting
Aspects: Volume to surface area, organisational studies

Ref: 11F
Building and construction objective: Building envelope should take into account social and environmental accounting
Aspects: Energy, light, ventilation modelling

Ref: 11G
Building and construction objective: Internal space design should take into account social and environmental accounting
Aspects: Organisational studies, pedestrian circulation studies

Ref: 11H
Building and construction objective: Furniture design and fittings should take into account social and environmental accounting
Aspects: Assessments, indicators

Ref: 11I
Building and construction objective: Services selection and design should take into account social and environmental accounting
Aspects: Lifecycle analysis, scenario planning, ecological accounting

Ref: 11J
Building and construction objective: Materials and components selection should take into account social and environmental accounting
Aspects: Lifecycle analysis, ecological accounting, assessment tools

Ref: 11K
Building and construction objective: Construction processes take into account social and environmental accounting
Aspects: Environmental management plans

Ref: 11L
Building and construction objective: Operation processes should take into account social and environmental accounting
Aspects: Existing buildings upgraded to be more efficient and effective, construction and demolition processes

Ref: 11M
Building and construction objective: Demolition or refurbishment should use social and environmental accounting and management plans
Aspects: Environmental management plans

Sustainable development objective: Small-scale, local and diverse economies
Ensure that development supports the development of small scale, local and diverse economies

Ref: 12A
Building and construction objective: Briefing processes designed to support the development of a small scale, local and diverse economy
Aspects: Local audits

Ref: 12B
Building and construction objective: Design processes designed to support the development of a small scale, local and diverse economy
Aspects: Design team members

Ref: 12C
Building and construction objective: Location designed to support the development of a small scale, local and diverse economy
Aspects: Local businesses

Ref: 12D
Building and construction objective: Site layout designed to support the development of a small scale, local and diverse economy
Aspects: Sites for small businesses

Ref: 12E
Building and construction objective: Building size and form designed to support the development of a small scale, local and diverse economy
Aspects: Local suppliers and manufacturers

Ref: 12F
Building and construction objective: Building envelope designed to support the development of a small scale, local and diverse economy
Aspects: Local small providers

Ref: 12G
Building and construction objective: Furniture and fittings designed to support the development of a small scale, local and diverse economy
Aspects: Local small providers

Ref: 12H
Building and construction objective: Internal space designed to support the development of a small scale, local and diverse economy
Aspects: Size, cost, spatial configuration

Ref: 12I
Building and construction objective: Services designed to support the development of a small scale, local and diverse economy
Aspects: Local small providers

Ref: 12J
Building and construction objective: Material and component selection designed to support the development of a small scale, local and diverse economy
Aspects: Local small providers

Ref: 12K
Building and construction objective: Construction designed to support the development of a small scale, local and diverse economy
Aspects: Number of tender packages, local contractors

Ref: 12L
Building and construction objective: Building operation designed to support the development of a small scale, local and diverse economy
Aspects: Outsourcing, local service suppliers

Ref: 12M
Building and construction objective: Demolition or refurbishment designed to support the development of a small scale, local and diverse economy
Aspects: Local contractors and service providers

Sustainable development objective: Access
Ensure that development support increased access to land, adequate shelter, finance, information, public services, technology and communications where this is needed.

Ref: 13A
Building and construction objective: Briefing processes to establish local needs in terms of access to land, adequate shelter, finance, information, public services, technology and communications
Aspects: Local audit

Ref: 13B
Building and construction objective: Design process to address local needs in terms of access to land, adequate shelter, finance, information, public services, technology and communications where possible
Aspects: Design processes, participants

Ref: 13C
Building and construction objective: Site location to support increased access to facilities
Aspects: Levels of access to facilities in location

Ref: 13D
Building and construction objective: Site design to support increased access to facilities
Aspects Access to productive land, adequate shelter, finance, information, public services, technology and communications

Ref: 13E
Building and construction objective: Building size and form to support increased access to facilities
Aspects: Access to productive land, adequate shelter, finance, information, public services, technology and communications

Ref: 13G
Building and construction objective: Internal space to support increased access to facilities
Aspects: Location of space, configuration, access and entrances, security

Ref: 13I
Building and construction objective: Services to support increased access to facilities
Aspects: Communications, electricity, water

Ref: 13L
Building and construction objective: Building operation to support increased access to facilities
Aspects: Management, security, agreements with government departments, service providers, non-governmental organisations, metering

Sustainable development objective: Education
Ensure that development improves levels of education and awareness, including awareness of sustainable development

Ref: 14A
Building and construction objective: Briefing process should be used to education building users about sustainable development and buildings
Aspects: Material, presentations, participants

Ref: 14B
Building and construction objective: Design process should be used to educate building users and mangers about the building and it's systems
Aspects: Building information, diagrams, models, participants

Ref: 14C
Building and construction objective: Building should be located where educational facilities provided in the building can be used easily
Aspects: Distance from users, location in terms of public transport

Ref: 14D
Building and construction objective: Site layout should support access to education
Aspects: Location and access to education facility, educational information about buildings, landscaping, ecosystems, sculpture

Ref: 14G
Building and construction objective: Space should be provide for education
Aspects: Amount, location, configuration

Ref: 14H
Building and construction objective: Furniture and fittings should be supplied that are support education
Aspects: Computers, TV, Video, projectors, books, posters, notice boards

Ref: 14I
Building and construction objective: Services should be provided to support access to facilities and services
Aspects: Telephone, electricity, Internet access

Ref: 14K
Building and construction objective: Construction process should provide appropriate education for construction workers
Aspects: Construction management, skills, health and safety

Ref: 14L
Building and construction objective: Operation should support easy access to education
Aspects: Hours of access, management system

Ref: 14M
Building and construction objective: Demolition or refurbishment of the building should support education
Aspects: Construction training, introduction of educational space in existing buildings

Sustainable development objective: Inclusive
Ensure that development processes and benefits are inclusive Ensure that development processes and benefits are inclusive

Ref: 15A
Building and construction objective: Briefing process should be inclusive
Aspects: Invitees to workshops, location of workshops, presentation media

Ref: 15B
Building and construction objective: Design process should be inclusive
Aspects: Selection of design team, presentation media of design ideas and information

Ref: 15C
Building and construction objective: Building should be located where everyone can easily access it
Aspects: Distance from users, Access to accessible public transport

Ref: 15D
Building and construction objective: Building site layout should be inclusive
Aspects: Paths, signage, distances, furniture, lighting, facilities

Ref: 15F
Building and construction objective: Building envelope should ensure that where possible everyone's needs and safety are considered
Aspects: Fenestration design, door and window controls, location and design of entrances, signage

Ref: 15G
Building and construction objective: Internal space provided should be able to be used easily by everyone
Aspects: Vertical and horizontal circulation, furniture layouts, room sizes and spatial configuration

Ref: 15H
Building and construction objective: Furniture and fittings should be able to be used easily by everyone
Aspects: Hand rails, stair nosings, contrasting edges, tables, chairs, equipment, specialised support equipment (ie hearing loops), sanitary and kitchen fittings

Ref: 15I
Building and construction objective: Services provided should be able to be easily used by everyone
Aspects: Internet access screens, service use instructions

Ref: 15J
Building and construction objective: Materials and components should ensure that the building can be used easily and safely
Aspects: Acoustic qualities, visual qualities, floor material slip resistance, ironmongery, clear door widths

Ref: 15K
Building and construction objective: Construction process should be as inclusive as possible
Aspects: Procurement process, monitoring process, health and safety, equipment

Ref: 15L
Building and construction objective: The building should be operated to ensure that the building can be used by everyone easily and safely
Aspects: Emergency egress plans, health and safety, facilities management and reception awareness training

Ref: 15M
Building and construction objective: Demolition or refurbishment of the building should be inclusive
Aspects: Upgrading for better access in existing buildings, procurement and monitoring processes

Sustainable development objective: Health, safety and security
Ensure that development considers human rights and supports improved health, safety and security.

Ref: 16C
Building and construction objective: Building should be located in an environment that is conducive to health in its users
Aspects: Environmental pollution, views, exercise

Ref: 16D
Building and construction objective: Site layout should be conducive to health in building users
Aspects: Views, natural light, landscaping, facilities for exercise, health and recreation

Ref: 16E
Building and construction objective: Building size and form should be conducive to human health
Aspects: Access to external space, views, natural daylight, natural ventilation

Ref: 16F
Building and construction objective: Building envelope should be conducive to human health
Aspects: Control over natural ventilation and lighting, access to outside spaces, Quality of light, sunlight, ventilation

Ref: 16G
Building and construction objective: Space provided should be conducive to human health
Aspects: Amount of space, privacy, configuration of space, acoustic quality

Ref: 16H
Building and construction objective: Furniture and Fittings used in the building should be conducive to human health
Aspects: materials used, production methods, ergonomics, computer screens

Ref: 16I
Building and construction objective: Services provided in the building should be conducive to human health
Aspects: Water quality, light quality, and air quality

Ref: 16J
Building and construction objective: Materials and components should be conducive to human health
Aspects: Materials and components used, production processes

Ref: 16K
Building and construction objective: Construction processes should be conducive to health
Aspects: Health and safety processes

Ref: 16L
Building and construction objective: The operation of the building should be conducive to human health
Aspects: maintenance of services ie water supply, HVAC, cleaning schedules and materials, health and safety procedures, awareness and education.

Ref: 16M
Building and construction objective: Demolition or refurbishment of the building should be conduce to human health
Aspects: Upgrading existing building for improved health, construction health and safety, removal of hazardous / toxic materials

Sustainable development objective: Participation
Ensure that development supports partnerships, interaction and involves, and is influenced by, the people that it affects.

Ref: 17A
Building and construction objective: Briefing process should support participation
Aspects: presentations, workshop formats, invitees

Ref: 17B
Building and construction objective: Design development should support participation
Aspects: Design presentations, format invitees

Ref: 17C
Building and construction objective: Location should support participation
Aspects: Community support for development, access to shared facilities

Ref: 17D
Building and construction objective: Site should support participation
Aspects: Shared facilities, recreational spaces, relationship between buildings and external circulation

Ref: 17E
Building and construction objective: Size and building form should support participation
Aspects: Informal and formal social interaction

Ref: 17F
Building and construction objective: Building envelope should support participation and control
Aspects: Opening windows, blinds

Ref: 17G
Building and construction objective: Internal space should support participation and control
Aspects: Privacy, information points, meeting spaces, shared spaces, location of shared support facilities, toilets, kitchenettes, recreational space, vertical circulation, design and location of horizontal circulation

Ref: 17H
Building and construction objective: Furniture and fittings should support participation and control
Aspects: Moveable furniture, pin boards easy social interaction, location of shared equipment (ie photocopiers)

Ref: 17I
Building and construction objective: Services should be support participation and control
Aspects: Building performance information on waste, energy

Ref: 17K
Building and construction objective: Construction should support participation and control
Aspects: Interaction between contractor and local community, construction management

Ref: 17L
Building and construction objective: Operation should support participation and control
Aspects: Information, communication

Ref: 17M
Building and construction objective: Refurbishment or Demolitions should support social cohesion
Aspects: Upgrading of existing building to support social cohesion, construction management, and interaction with local community

APPENDIX ELEVEN: BUILDINGS AND CONSTRUCTION SUSTAINABLE DEVELOPMENT OBJECTIVES ANALYSIS

Matrix ref	Objective	Addresses social and economic Priorities (as defined in the Millenium Goals)	Can be achieved with limited resources & technical capacity	Addresses other social/ economic/ environmental objectives	Objective rating	Included In SBAT? If so, under which criteria?	Comments
	Environmental						
1C	Locate building where it conserves or increased the size, biodiversity and productivity of the natural environment and ecosystems.	N	Y	Y	2	EN4.1	
1D	Size and form designed to conserve or increase the size, biodiversity and productivity of the the bio-physical environment	N	Y	Y	2	EN4.3	
1E	Building envelope designed to conserve or increased the size, biodiversity and productivity of the bio-physical environment	N	N	Y	1	EN4.3	
1H	Specify furniture and fittings which conserve or increase the size, biodiversity and productivity of the bio-physical environment	N	Y	Y	2	EN5.2	Refers to materials and components
1I	Specify services which conserve or increase the size, biodiversity and productivity of the bio-physical environment	N	N	Y	1	EN2.5	
1J	Specify materials and components to conserve or increase the size, biodiversity and productivity of the bio-physical environment.	N	Y	Y	2	EN5.2	
1I	Construction process to conserve or increase the size, biodiversity and productivity of the bio-physical environment	N	Y	Y	2	EN5.5	
1J	Building operation to conserve or increase the size, biodiversity and productivity of the bio-physical environment	N	Y	Y	2	EC EN SO	
1 m	Building demolition or refurbishment to conserve or increase the size, biodiversity and productivity of the bio-physical environment	N	Y	Y	2	EN 3.5 EN5.4 EN5.5	
2C	Locate building where it will support appropriate and effective management of the bio-physical environment	N	Y	Y	2		Partially addressed by EN4.4 EN4.5
2D	Site layout to support effective management of the bio-physical environment.	N	Y	Y	2		Partially addressed by EN4.4 EN4.5
2H	Ensure that all materials used in furniture and fittings come from managed sources within the bio-physical environment	N	N	Y	1		Partially addressed by EN5.2
2I	Ensure that resources that are used for services come from managed sources within the bio-physical environment	N	N	Y	1		Partially addressed by EN5.2
2J	Ensure that materials and components come from managed sources within the bio-physical environment	N	N	Y	1		Partially addressed by EN5.2
2L	Ensure that building operation processes use materials from managed sources within the bio-physical environment	N	N	Y	1		

Matrix ref	Objective	Addresses social and economic Priorities (as defined in the Millenium Goals)	Can be achieved with limited resources & technical capacity	Addresses other social/ economic/ environmental objectives	Objective rating	Included In SBAT? If so, under which criteria?	Comments
3H	Specify furniture and fittings that are produced in ways that minimises the use/support of environmentally damaging resource extraction and processing practices	N	Y	N	1		Partially addressed by EN5.2, EN5.3
3I	Specify services that that minimises the use/support of environmentally damaging resource extraction and processing practices	N	N	N	0	EN1 EN3	
3J	Specify materials and components that minimises the use/support of environmentally damaging resource extraction and processing practices environmental damage.	N	Y	N	1	EN5.3	
3K	Design construction that minimises the use/support of environmentally damaging resource extraction and processing practices	N	Y	N	1		
3L	Design building to operate in ways that minimises the use/support of environmentally damaging resource extraction and processing practices	N	Y	N	1	Particularly addressed by EC4.5 SO4.2	
3 M	Design demolition / refurbishment so as to minimises the use/support of environmentally damaging resource extraction and processing practices	N	Y	N	1		
4C	Location to support minimisation of waste and ease of recycling	N	Y	N	1		
4D	Site to support minimisation of waste and ease of recycling	N	Y	N	1	EN3.3	
4 G	Internal space to support minimisation of waste and ease of recycling	N	Y	N	1		
4H	Furniture and fittings to support minimisation of waste and ease of recycling	N	Y	N	1		
4I	Services to maximise to support minimisation of waste and ease of recycling	N	N	N	0		
4J	Materials and components to support minimisation of waste and ease of recycling	N	Y	N	1	EN5.4	
4K	Construction to support waste minimisation and ease of recycling	N	Y	N	1		
4L	Operation to support waste minimisation and ease of recycling	N	Y	N	1	EN3	
4 M	Demolition or refurbishment to support waste minimisation and ease of recycling	N	Y	N	1	SO4.2	
5C	Location to support the efficient use of water, capture of rainwater and disposal of wastewater	Y	Y	Y	3		
5D	Site design to support the efficient use of water, capture of rainwater and disposal of wastewater	Y	Y	Y	3	EN1.4 EN1.3 EN1.4	
5E	Size and form to support the efficient use of water, capture of rainwater and disposal of wastewater	Y	Y	Y	3	EN1.1	
5F	Envelope design to support the	Y	Y	Y	3	EN1.1	

Matrix ref	Objective	Addresses social and economic Priorities (as defined in the Millenium Goals)	Can be achieved with limited resources & technical capacity	Addresses other social/ economic/ environmental objectives	Objective rating	Included In SBAT? If so, under which criteria?	Comments
	efficient use of water, capture of rainwater and disposal of wastewater						
5I	Services design to support the efficient use of water and capture of rainwater and disposal of wastewater	Y	N	Y	2	EN1.1 EN1.3.3 EN1.2	
5J	Materials and construction to support efficient use of water and capture of rainwater and disposal of wastewater	Y	N	N	1		
5K	Construction to support efficient use of water and capture of rainwater and disposal of wastewater	Y	N	N	1		
5L	Operation to support the efficient use of water and capture of rainwater and disposal of wastewater	Y	N	Y	2	EN	
5 M	Demolition and refurbishment to support efficient use of water and capture of rainwater and disposal of wastewater	Y	N	Y	2		
6C	Location to maximise energy efficiency and use of renewable energy	N	N	Y	1	EN2.1	
6D	Site layout to maximise energy efficiency and use of renewable energy	N	N	Y	1	EN4.2	
6E	Size and form to maximise energy efficiency and use of renewable energy	N	N	Y	1	EN2.2 EN2.3	
6 G	Internal space to maximise energy efficiency and use of renewable energy	N	N	Y	1	EN2.2 EN2.3	
6H	Furniture and fittings to maximise energy efficiency and use of renewable energy	N	N	Y	1	EN5.1	
6I	Services to maximise energy efficiency and use of renewable energy	N	N	Y	1	EN2.2-5	
6J	Materials and component to maximise energy efficiency and use of renewable energy	N	N	Y	1	EN5.1	
6K	Construction to maximise energy efficiency and use of renewable energy	N	N	Y	1		
6L	Operation to maximise energy efficiency and use of renewable energy	N	N	Y	1	EN EC SO	
6 M	Demolition and refurbishment to maximise energy efficiency and use of renewable energy	N	N	Y	1		
7A	Briefing process should support employment and self employment	Y	Y	Y	3		
7B	Design process should support employment and self employment	Y	Y	Y	3		
7C	Building should be located where is will support employment and self employment	Y	Y	Y	3		
7D	Site layout should support employment and self-employment	Y	Y	Y	3	Partially E4.5	
7E	Building size and form should support employment and self-employment	Y	Y	Y	3		

Matrix ref	Objective	Addresses social and economic Priorities (as defined in the Millenium Goals)	Can be achieved with limited resources & technical capacity	Addresses other social/ economic/ environmental objectives	Objective rating	Included In SBAT? If so, under which criteria?	Comments
7F	Building envelope should support employment and self-employment	Y	Y	Y	3		
7 G	Internal space should support employment and self-employment	Y	Y	Y	3	EC1.4	
7H	Furniture and Fittings provided should support employment and self-employment	Y	Y	Y	3	EC1.3	
7I	Services provided should support employment and self-employment	Y	N	Y	2		
7J	Materials and components should support employment and self-employment	Y	Y	Y	3		
7K	Construction process should support employment	Y	Y	Y	3		
7L	Building operation should support employment	Y	Y	Y	3	PartiallyEC1.4	
7 M	Building refurbishment or demolition should support employment	Y	Y	Y	3		
8A	Briefing process should investigate how activities accommodated in building are as efficient as possible. The briefing process should be efficient and effective.	N	N	Y	1		
8B	The design process should investigate how activities accommodated in building are as efficient as possible. The design process should be efficient and effective.	N	N	Y	1		
8C	Location of the building should support efficiency and effectiveness	N	N	Y	1	SO3	
8D	Site layout should support efficiency and effectiveness	N	N	Y	1		
8E	Building size and shape should support efficiency and effectiveness	N	N	Y	1	EC5.2	
8F	Building envelope should support efficiency and effectiveness	N	N	Y	1		
8 G	Space provided in building should support efficiency and effectiveness	N	N	Y	1	EC2.1	
8H	Furniture and fittings should be provided to support efficiency and effectiveness	N	N	Y	1	EC3.2	
8I	Services should be support efficiency and effectiveness	N	N	Y	1		
8J	Materials and components should support efficiency and effectiveness	N	N	Y	1		
8K	Construction processes should be efficient and effective	N	N	Y	1		
8L	Building operation should support efficiency and effectiveness	N	N	Y	1		
8 M	Demolition or refurbishment should support efficiency and effectiveness	N	N	Y	1		
9A	The briefing process should draw on indigenous processes, technology and knowledge	N	Y	N	1		
9B	The design process should draw on indigenous processes, technology and knowledge	N	Y	N	1		
9H	Specification and design of furniture and fittings should draw	N	Y	N	1		

Matrix ref	Objective	Addresses social and economic Priorities (as defined in the Millenium Goals)	Can be achieved with limited resources & technical capacity	Addresses other social/ economic/ environmental objectives	Objective rating	Included In SBAT? If so, under which criteria?	Comments
	on indigenous processes, technology and knowledge						
9I	Services strategies should draw on indigenous processes, technology and knowledge	N	Y	N	1		
9J	Specification and design of materials and components should draw on indigenous processes, technology and knowledge	N	Y	N	1		
9K	Construction processes should draw on indigenous processes, technology and knowledge	N	Y	N	1		
9L	Building operation should draw on indigenous processes, technology and knowledge	N	Y	N	1		
9 M	Building demolition / refurbishment should draw on indigenous processes, technology and knowledge	N	Y	N	1		
10 A	Briefing process should include clear building performance accounting systems	Y	N	Y	2		SBAT, as a whole addresses this
10 B	Design process should include evaluation and reporting points in terms of sustainable development objectives	Y	N	Y	2		“
10 C							
10 D	Site layout design should take into account social and environmental accounting	Y	N	Y	2		“
10 E	Building form and size should take into account social and environmental accounting	Y	N	Y	2		“
10 F	Building envelope should take into account social and environmental accounting	Y	N	Y	2		“
10 G	Internal space design should take into account social and environmental accounting	Y	N	Y	2		“
10 H	Furniture design and fittings should take into account social and environmental accounting	Y	N	Y	2		“
10 I	Services selection and design should take into account social and environmental accounting	Y	N	Y	2		“
10 J	Materials and components selection should take into account social and environmental accounting	Y	N	Y	2		“
10 K	Construction processes should take into account social and environmental accounting	Y	N	Y	2		“
10 L	Operation processes should take into account social and environmental accounting	Y	N	Y	2		“
10 M	Demolition or refurbishment should use social and environmental accounting and management plans	Y	N	Y	2		“
11 A	Briefing processes to support enabling environment for sustainable development	N	Y	N	1		Partially covered by SBAT process
11	Design processes to support	N	Y	N	1		“

Matrix ref	Objective	Addresses social and economic Priorities (as defined in the Millenium Goals)	Can be achieved with limited resources & technical capacity	Addresses other social/ economic/ environmental objectives	Objective rating	Included In SBAT? If so, under which criteria?	Comments
B	enabling environment for sustainable development						
11 K	Construction processes to support enabling environment for sustainable development	N	Y	N	1		"
11 L	Building operation processes to support enabling environment for sustainable development	N	Y	N	1		"
11 M	Building refurbishment / demolition processes to support enabling environment for sustainable development	N	Y	N	1		"
12 A	Briefing processes designed to support the development of a small scale, local and diverse economy	Y	Y	Y	3		"
12 B	Design processes designed to support the development of a small scale, local and diverse economy	Y	Y	Y	2		"
12 C	Location designed to support the development of a small scale, local and diverse economy	Y	Y	Y	3		"
12 D	Site layout designed to support the development of a small scale, local and diverse economy	Y	Y	Y	3		"
12 E	Building size and form designed to support the development of a small scale, local and diverse economy	Y	Y	Y	3	EC1	
12 F	Building envelope designed to support the development of a small scale, local and diverse economy	Y	Y	Y	3	EC1	
12 G	Furniture and fittings designed to support the development of a small scale, local and diverse economy	Y	Y	Y	3	EC1	
12 H	Internal space designed to support the development of a small scale, local and diverse economy	Y	Y	Y	3	EC1	
12 I	Services designed to support the development of a small scale, local and diverse economy	Y	Y	Y	3		
12 J	Material and component selection designed to support the development of a small scale, local and diverse economy	Y	Y	Y	3	EC1.2	
12 K	Construction designed to support the development of a small scale, local and diverse economy	Y	Y	Y	3	EC1.1	
12 L	Building operation designed to support the development of a small scale, local and diverse economy	Y	Y	Y	3	EC1.4	
12 M	Demolition or refurbishment designed to support the development of a small scale, local and diverse economy	Y	Y	Y	3	EC1.1	
13 A	Briefing processes to establish local needs in terms of access to land, adequate shelter, finance, information, public services, technology and communications	Y	Y	Y	3		SBAT, as a whole addresses this

Matrix ref	Objective	Addresses social and economic Priorities (as defined in the Millenium Goals)	Can be achieved with limited resources & technical capacity	Addresses other social/ economic/ environmental objectives	Objective rating	Included In SBAT? If so, under which criteria?	Comments
13 B	Design process to address local needs in terms of access to land, adequate shelter, finance, information, public services, technology and communications where possible	Y	Y	Y	3		“
13 C	Site location to support increased access to faclities	Y	Y	Y	3	SO3, SO4.5	
13 D	Site design to support increased access to facilities	Y	N	Y	2	SO4.5	
13 E	Building size and form to support increased access to facilities	Y	N	Y	2	SO4.5	
13 G	Internal space to support increased access to facilities	Y	N	Y	2	SO4.5	
13 I	Services to support increased access to facilities	Y	N	Y	2	SO4.5	
13 L	Building operation to support increased access to facilities	Y	N	Y	2	SO4.5	
14 A	Briefing process should be used to educate building users about sustainable development and buildings	Y	Y	Y	3		SBAT process, addresses this
14 B	Design process should be used to educate building users and mangers about the building and it’s systems	Y	Y	Y	3		SBAT process, addresses this
14 C	Building should be located where educational facilities provided in the building can be used easily	Y	Y	Y	3		
14 D	Site layout should support access to education	Y	Y	Y	3		
14 G	Space should be provided to support education	Y	Y	Y	3	SO5.1	
14 H	Furniture and fittings should be supplied that support education	Y	Y	Y	3	SO5.1	
14 I	Services should be provided to support access to education	Y	Y	Y	3	SO5.1	
14 K	Construction process should provide appropriate education for construction workers	Y	Y	Y	3		
14 L	Operation should support easy access to education	Y	Y	Y	3	SO5.1	
14 M	Demolition or refurbishment of the building should support education	Y	Y	Y	3		
15 A	Briefing process should be inclusive	Y	Y	N	2		
15 B	Design process should be inclusive	Y	Y	N	2		
15 C	Building should be located where everyone can easily access it	Y	N	N	1	SO2.1	
15 D	Building site layout should be inclusive	Y	N	N	1	SO2.2	
15 F	Building envelope should be inclusive	Y	N	N	1		
15 G	Internal space provided should be able to be used easily by everyone	Y	N	N	1	SO2.2 SO2.3	
15 H	Furniture and fittings should be able to be used easily by everyone	Y	N	N	1	SO2.4	
15 I	Services provided should be able to be easily used by everyone	Y	N	N	1		
15 J	Materials and components should ensure that the building can be easily used by everyone	Y	N	N	1		
15	Construction process should be as	Y	y	N	2		

Matrix ref	Objective	Addresses social and economic Priorities (as defined in the Millenium Goals)	Can be achieved with limited resources & technical capacity	Addresses other social/ economic/ environmental objectives	Objective rating	Included In SBAT? If so, under which criteria?	Comments
K	inclusive as possible						
	The building should be operated to ensure that the building can be used by everyone easily and safely	y	N	N	1		
15 M	Demolition or refurbishment of the building should be inclusive	Y	N	N	1		
16 C	Building should be located in an environment that is conducive to health in its users	Y	Y	Y	3		
16 D	Site layout should be conducive to health in building users	Y	Y	Y	3		
16 E	Building size and form should be conducive to human health	Y	Y	Y	3		
16 H	Furniture and Fittings used in the building should be conducive to human health	Y	Y	Y	3	SO5.4	
16 I	Services provided in the building should be conducive to human health	Y	Y	Y	3		
16 J	Materials and components should be conducive to human health	Y	Y	Y	3	SO5.4	
16 K	Construction processes should be conducive to health	Y	Y	Y	3		
16 L	The operation of the building should be conducive to human health	Y	Y	Y	3		
16 M	Demolition or refurbishment of the building should be conducive to human health	Y	Y	N	2		
17 A	Briefing process should support participation	N	Y	N	1		SBAT process, addresses this
17 B	Design development should support participation	N	Y	N	1		SBAT process, addresses this
17 C	Building location should support participation	N	Y	N	1	SO4.5	
17 D	Site should support participation	N	Y	N	1		
17 E	Size and building form should support participation	N	Y	N	1		
17 F	Building envelope should support participation	N	Y	N	1	SO1.2	
17 G	Internal space should support participation	N	Y	N	1	SO4.3,4,5	
17 H	Furniture and fittings should support participation	N	Y	N	1		
17 I	Services should be support participation and control	N	Y	N	1	SO4.3,4,5	
17 K	Construction should support participation	N	Y	N	1		
17 L	Operation should support participation	N	Y	N	1		
17 M	Refurbishment or Demolitions should support participation	N	Y	N	1		

APPENDIX TWELVE: SUSTAINABLE BUILDING ASSESSMENT TOOL INDICATOR ANALYSIS

SBAT reference	Criteria and indicator	The indicator is easy to understand by all stakeholders	The information required for the indicator is readily available and easy to capture	The indicator requires minimal additional modelling, calculation or investigation	The method of measuring the indicators is objective	Have a target against which it can be compared	Rating
SO1.1	Lighting The main working spaces are well day lit. Effective daylight/solar control. Glare minimised. Criteria: Daylight factor 5%.	Y	Y	N	Y	Y	4
SO1.2	Ventilation Adequate clean air supply to each inhabitant. Supply taken from unpolluted source Criteria: All working spaces have equivalent of opening window area equivalent to 10% of floor area	Y	Y	Y	Y	Y	5
SO1.3	Noise Noise levels limited in teaching and learning spaces to acceptable levels. Criteria: Office type environment background noise not over 35-45dba, Working environment not over 50dba.	Y	N	N	Y	Y	3
SO1.4	Views Design to all working areas to have access to a view out. Criteria: All working spaces to be maximum of 6m from a window	Y	Y	Y	Y	Y	5
SO1.5	Thermal comfort Thermal comfort throughout year Criteria: Indoor environment maintained within temperature range (range dependent on activities etc)	Y	N	N	Y	N	2
SO2.1	Public Transport The building is can be access by the disabled using public transport. Criteria: Entrance located 100, or less metres to disabled accessible public transport	Y	Y	Y	Y	Y	5
SO2.2	Routes, Changes in level All routes between and within buildings can be easily navigated by the disabled. Critieria: Adequate width, turning circles. No changes in level between or within buildings or, all changes in level catered for with appropriate ramps of 1:12	Y	Y	Y	Y	Y	5

SBAT reference	Criteria and indicator	The indicator is easy to understand by all stakeholders	The information required for the indicator is readily available and easy to capture	The indicator requires minimal additional modelling, calculation or investigation	The method of measuring the indicators is objective	Have a target against which it can be compared	Rating
	fall, or lifts, routes surfaces have smooth and even surface						
SO2.3	Edges The visually impaired can move around and use the building easily Criteria: all edges i.e. between walls and floors and stair nosings clearly distinguished through the use of contrasting colour. Accessible signage provided.	Y	N	Y	Y	Y	4
SO2.4	Furniture and Fittings Furniture and fittings can be easily used by the disabled Criteria: Type and location of furniture and fittings specified	Y	N	Y	Y	Y	4
SO2.5	Toilets, Bathrooms and kitchens Toilets and bathrooms are or can be easily adapted for disable access Criteria: Access, and spatial configuration of spaces	Y	Y	Y	Y	N	4
SO3.1	Childcare Occupants of building can pick up / drop children easily, without having to make additional long distance car journeys. Criteria: distance between residential/work and schools/creches not more than 3km	Y	Y	Y	Y	Y	5
SO3.2	Banking Occupants have easy access to banking facilities. Criteria: Banking services (i.e. ATM) provided close by (within 3km) / internet service , mobile service provided.	Y	Y	Y	Y	Y	5
SO3.3	Retail Occupants have easy access to retail facilities for everyday items (ie groceries). Criteria: Relevant retail outlets provided within 3km / alternative internet / delivery service provided.	Y	Y	Y	Y	Y	5
SO3.4	Communication Occupants have easy access to communications facilities during their working day or on their route home. Criteria: Postal, telephone or email facilities close by	Y	Y	Y	Y	Y	5

SBAT reference	Criteria and indicator	The indicator is easy to understand by all stakeholders	The information required for the indicator is readily available and easy to capture	The indicator requires minimal additional modelling, calculation or investigation	The method of measuring the indicators is objective	Have a target against which it can be compared	Rating
	(within 3km).						
SO3.5	Work Occupants do not have to undertake long vehicular journeys to get to and from work. Criteria; Distance (20km)	Y	Y	Y	Y	Y	5
SO4.1	Environmental control Occupants of building have reasonable control over their environmental conditions Criteria: Level of control over environmental conditions by individuals; access to openable windows, blinds, control of light and temperature	Y	N	Y	Y	Y	4
SO4.2	User manual and training Occupants of the building understand the building and it's systems and work with these. Criteria; building user manual, induction for new occupants	Y	N	Y	Y	Y	4
SO4.3	Social spaces Occupants have access to spaces which enable formal / informal social interaction to take place easily. Criteria: design and location of spaces provided for informal / formal social interaction	Y	Y	N	N	N	2
SO4.4	Amenity Amenities easily accessible Criteria: design and location of amenities	Y	Y	N	N	N	2
SO4.5	Community involvement Spaces equipment shared with local communities Criteria: Accessibility of facilities by local communities	Y	N	N	N	N	1
SO5.1	Education Access to / support for learning provided. Criteria: Access to learning.	Y	Y	Y	N	N	3
SO5.2	Security Occupants are safe and feel safe in the building and on regularly used routes to and from the building. Criteria: Spatial configuration, visual links, lighting, technological and physical security systems	Y	N	N	N	N	1
SO5.3	Smoking Smokers do not affect health of building users Criteria: Avoidance of cross contamination	Y	Y	Y	Y	Y	5

SBAT reference	Criteria and indicator	The indicator is easy to understand by all stakeholders	The information required for the indicator is readily available and easy to capture	The indicator requires minimal additional modelling, calculation or investigation	The method of measuring the indicators is objective	Have a target against which it can be compared	Rating
SO5.4	Health Internal environmental conditions do not affect health of occupants Criteria: Materials, components and finishes screened for health hazards	Y	N	N	Y	N	2
SO5.5	Exercise and recreation Occupants have easy access to sport/recreational facilities Criteria: facilities within 3km	Y	N	N	Y	Y	3
EC1.1	Local contractors Building makes use of local contractors Criteria : Type and location of contractors used, percentage of total contractor cost spent on local contractors	Y	N	N	Y	N	2
EC1.2	Local building material supply Building uses local materials Criteria: Percentage of total construction materials such as cement, sand, bricks etc that are sourced locally	Y	N	N	Y	N	2
EC1.3	Local component, fittings and furniture manufacture Building uses component, fittings and furniture sourced locally Criteria: Percentage of building components i.e. windows and doors that are produced locally	Y	N	N	Y	N	2
EC1.4	Outsource opportunities Building creates opportunities small emerging businesses. This includes outsourcing catering, cleaning services and security as well as making space and equipment available for businesses to use for retail, education etc. Criteria: Design, location of spaces, management plan	Y	N	N	Y	N	
EC1.5	Repairs and maintenance Building maintenance and repairs can be carried out by users / local contractors. Criteria: Percentage of building and furniture and fittings that can be serviced locally	Y	N	N	Y	N	2
EC2.1	Space Use Buildings / layout should make good use of space Criteria: M2 / person	Y	Y	N	Y	N	3

SBAT reference	Criteria and indicator	The indicator is easy to understand by all stakeholders	The information required for the indicator is readily available and easy to capture	The indicator requires minimal additional modelling, calculation or investigation	The method of measuring the indicators is objective	Have a target against which it can be compared	Rating
EC2.2	Space Management Space should be managed efficiently Criteria: Effective space management systems	Y	N	N	N	N	1
EC2.3	Shared Use Facility shared between a number of users Criteria: Spatial, technological and managerial arrangements for shared use	Y	N	N	N	N	1
EC2.4	Use of technology Access to technology (ie email, internet, video conferencing) to reduce requirement for travel and space. Criteria: Access to technology, reduction in travel and space requirements	Y	N	N	N	N	1
EC2.5	Occupancy schedule Systems to ensure efficient use of space and services Criteria: Hours of the week that the building is occupied	Y	N	Y	Y	N	3
EC3.1	Spaces Spaces should be available should be readily adapted for different uses. For instance spaces may be required for work during the day, social activities in the evening and quite study during weekends and at night. Criteria: Spatial configuration	Y	Y	N	N	N	2
EC3.2	Furniture Internal spaces can be easily reconfigured to suite different organisation requirements / users Criteria: Configuration and shape of spaces, construction of partitions.	Y	Y	N	N	N	2
EC3.3	Services Services can configured to allow different internal arrangements and can be accessed easily to be extended / altered Criteria: Location and access to services	Y	Y	N	N	N	2
EC3.4	Structure Structure / load bearing elements configured to enable variety of different internal arrangements Criteria: Location and size of structural elements	Y	Y	N	N	N	2
EC3.5	Vertical Circulation and	Y	Y	N	N	N	2

SBAT reference	Criteria and indicator	The indicator is easy to understand by all stakeholders	The information required for the indicator is readily available and easy to capture	The indicator requires minimal additional modelling, calculation or investigation	The method of measuring the indicators is objective	Have a target against which it can be compared	Rating
	Service Cores Vertical circulation and service cores configured to enable range of different spatial arrangements Criteria: Location and size of vertical circulation and service cores.						
EC4.1	Maintenance Level of requirement for ongoing maintenance of the building considered and understood. Costs for this limited through design, and planned for. Criteria: Lifecycle costs considered in specification of materials, components, and equipment. Design items such as light bulbs can be easily reached and replaced without use of expensive equipment).	Y	N	N	N	N	1
EC4.2	Cleaning Building can be kept clean easily and safely Criteria: Window location and access, floor materials and access	Y	N	N	N	N	1
EC4.3	Security / care taking Building is reasonable secure without requiring large ongoing costs. Criteria: Spatial layout and visual supervision by neighbouring occupied buildings	Y	N	N	N	N	1
EC4.4	Insurance / water / energy / sewerage Ongoing costs of water, energy and insurance minimised. Criteria: Meters can be easily accessed. Building manual provides detail on when these should be read, to enable ongoing monitoring and improvement.	Y	N	N	N	N	1
EC4.5	User awareness Criteria: Highly visual information (sign boards or intranet) displaying current, previous and targeted consumption and waste performance	Y	N	Y	Y	Y	4
EC5.1	Consultant fees Consultant fees not just calculated on total project cost basis. Incentives provided to consultants to reduce capital cost and ongoing costs. Criteria: Professional fee	Y	N	Y	Y	N	3

SBAT reference	Criteria and indicator	The indicator is easy to understand by all stakeholders	The information required for the indicator is readily available and easy to capture	The indicator requires minimal additional modelling, calculation or investigation	The method of measuring the indicators is objective	Have a target against which it can be compared	Rating
	structure						
EC5.2	Build-ability Building design cost efficient to build and minimise waste Criteria: Building form simple. Replication of elements and components. Design / planning grid that relates to materials / component module sizes	N	Y	N	N	N	1
EC5.3	Initial costs Initial cost of building limited. Criteria: Building design which enables building to be built a minimal initial cost, allowing building to be developed and grow, over time, as additional funding becomes available – buildings designed as a set of independent, interrelated components, building built as shell first with finishes etc to be added later.	N	N	N	N	N	0
EC5.5	Sharing arrangements Capital costs of the building minimised: Criteria: Quantity of new space reduced through arrangements to use existing spaces and buildings	Y	N	N	N	N	1
EN1.1	Rainwater Water consumption reduced through use of rainwater Criteria: Systems for capturing, storing and using rainwater	Y	Y	Y	Y	Y	5
EN1.2	Water use Water consumption reduced through efficient delivery devices: Criteria: Specification of water efficient delivery devices.	Y	Y	Y	Y	Y	5
EN1.3	Grey water Water consumption reduced through reuse Criteria: Use of grey water systems	Y	Y	Y	Y	Y	5
EN1.4	Runoff Runoff and Storm water run off minimised Criteria: Design and specification to minimised runoff: Specification of pervious or absorbent materials for hard external surfaces. Design and management of runoff	Y	Y	N	Y	N	3
EN1.5	Planting	Y	N	Y	Y	Y	4

SBAT reference	Criteria and indicator	The indicator is easy to understand by all stakeholders	The information required for the indicator is readily available and easy to capture	The indicator requires minimal additional modelling, calculation or investigation	The method of measuring the indicators is objective	Have a target against which it can be compared	Rating
	Water consumption and existing ground water (water table etc) maintained. Criteria: Low water requirement landscaping/planting scheme.						
EN2.1	Location Building located to minimise transport energy requirements of users Criteria: Building located within 400m of public transport	Y	Y	Y	Y	Y	5
EN2.2	Ventilation System Ventilation design and management to minimised energy requirements Criteria : All ventilation requirements met through passive systems.	Y	N	N	Y	Y	3
EN2.3	Heating and Cooling System Environmental control system design to minimise requirement for non-renewable energy Criteria: Heating and cooling requirements met through passive environmental control design	Y	N	N	Y	Y	3
EN2.4	Appliances and Fittings Energy requirements of appliances, plant and fittings minimised Criteria: Specification of energy efficient fittings, appliances, plant and lighting	Y	Y	Y	Y	Y	5
EN2.5	Renewable Energy Energy consumption of building supplemented / sourced from renewable sources Criteria: Ten per cent of energy required for building obtained from renewable source	Y	N	N	Y	Y	3
EN3.1	Toxic waste Toxic waste processed safely and with minimal environmental impact Criteria: Design and management for the safe disposal / recycling of toxic/harmful substances such as batteries, printer toners and vehicle oil.	Y	N	N	Y	Y	3
EN3.3	Organic waste Organic waste recycled locally Criteria: Design and	Y	N	N	Y	Y	3

SBAT reference	Criteria and indicator	The indicator is easy to understand by all stakeholders	The information required for the indicator is readily available and easy to capture	The indicator requires minimal additional modelling, calculation or investigation	The method of measuring the indicators is objective	Have a target against which it can be compared	Rating
	management that ensures 100% of organic waste produced to be recycled and reused on site / arrangements made for local provider to carry this out.						
EN3.3	Inorganic waste Inorganic waste recycled locally Criteria: Design and management that ensures a minimum of 30% of inorganic waste produced is recycled – arrangements made to sort, store and transport waste	Y	N	N	Y	Y	3
EN3.4	Sewerage Contribution to mains sewerage minimised Criteria: Use of compost toilets, and other 'local' systems.	Y	Y	Y	Y	Y	5
EN3.5	Construction waste: Construction waste minimised Criteria: Design which minimises waste production ie prefabrication/using components planning grid. Requirement for construction waste minimisation detailed in tender documentation.	Y	N	N	N	N	1
EN4.1	Brownfield site Building occupies already disturbed site Criteria: Site has been previously built on / developed	Y	Y	Y	Y	Y	5
EN4.2	Neighbouring buildings Building does not have harmful affect on neighbouring buildings Criteria: No / minimal reduction to neighbouring buildings access to sunlight and natural ventilation	Y	Y	N	N	Y	3
EN4.3	Vegetation Building and site supports vegetation Criteria: Area of vegetation provided and maintained equivalent or greater than that of the footprint of the building and hard surfaces	Y	Y	Y	Y	Y	5
EN4.4	Habitat Building supports diversity of plant and animal life Criteria: Number and range of different species supported.	Y	N	N	N	N	1
EN4.5	Landscape inputs Landscapes designed to	Y	N	N	N	N	1

SBAT reference	Criteria and indicator	The indicator is easy to understand by all stakeholders	The information required for the indicator is readily available and easy to capture	The indicator requires minimal additional modelling, calculation or investigation	The method of measuring the indicators is objective	Have a target against which it can be compared	Rating
	function naturally Criteria: No or minimum artificial inputs (fertilizer, pesticides etc) required to maintain landscape.						
EN5.1	Embodied energy Majority of building materials and components used have low embodied energy. Criteria: Embodied energy of materials	Y	N	N	Y	N	2
EN5.2	Material / component sources Majority of building components used are from 'grown' or renewable (ie timber, thatch) sources. Criteria: Proportion of materials	Y	N	N	Y	N	2
EN5.3	Manufacturing processes Processes for processing / manufacturing materials has minimal negative impact on the environment. Criteria: No materials used whose production involves large-scale **direct** pollution of the environment, and **direct release** of greenhouse gas emissions.	Y	N	N	N	Y	2
EN5.4	Recycled / reused materials and components Materials and components used in the building are from recycled sources Indicator: 10% of 1 of the 5 main building materials (by volume) are from recycled sources.	Y	N	N	Y	Y	3
EN5.5	Construction processes Building design and construction developed to minimally affect the environment Criteria: Building and construction process designed to minimally impact the environment. Requirement for large-scale vegetation clearing and earth movement minimised.	Y	N	N	N	Y	2

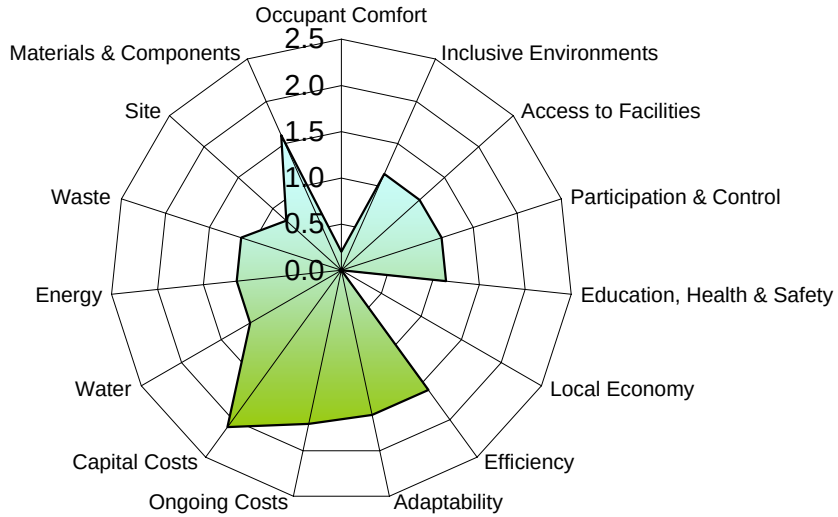
APPENDIX THIRTEEN: ASSESSMENT TOOL PRINCIPLES ANALYSIS OF SUSTAINABLE BUILDING ASSESSMENT TOOL

Principle	SBAT Compliance	Comments
Sustainable Development Principles		
Participatory: The process of development should involve local people and reflect their priorities and needs	Partially	The suggested process for using the SBAT is participatory. However it does not suggest that there is extensive involvement of local people or analysis of local needs.
Social exclusion: Development should take care not to exclude any groups such as women and disabled people from being fully involved.	Partially	The SBAT has a strong a set of inclusive environment criteria, however it does not indicate that the process of using the SBAT should be inclusive.
Transparent: The process for reaching decisions and carrying out actions should be as transparent as possible	Yes	The target setting process and reporting interface of the SBAT help ensure that the process and decision are easily and clearly understood.
Local resources: where possible development should draw on existing local skills, knowledge and resources	Partially	SBAT suggests drawing on local resources but does not place a heavy emphasis on local knowledge.
Precautionary principle: Development action and intervention should be guided by the precautionary principle and should not wait until there is a comprehensive understanding of an area**.**	Yes	Many aspects of the SBAT require action that are considered important for sustainable development, even though there may not be a full understanding of the area.
Top down and bottoms up: The structure of the tool should as far as possible ensure that users maintain a picture of the overall tool and building process while they work through the tool.	Yes	The reporting interface of the SBAT allows for holistic reports to be generated easily of all aspects being investigated.
Sustainability Assessment System Principles		
Hierarchical structure: Assessment frameworks should have a hierarchical structure consisting of the following elements: - Overarching goal - Objectives - Sub objective - Indicators	Yes	The SBAT has a hierarchical structure with objectives and sub objectives. However it does not provide an overarching goal.
Involve key stakeholders: The assessment process should involve the major stakeholders.	Yes	This occurs through the target setting workshops
Awareness: The assessment process should increase awareness about sustainable development amongst those affected or concerned by the development. This encourages a shared understanding to be developed, which in turn, enables sustainable development to be addressed more effectively	Yes	This should occur through the target setting workshops
Agreement: The assessment process should ensure that all those affected or concerned by the development are not only are involved, but also actively participate in designing and agreeing objectives and indicators.	Yes	This should occur through the target setting workshops
Monitor progress towards achievement of objectives: Indicators should be used as part of the assessment framework to monitor and evaluate progress towards the achievement of sustainable development objectives.	Yes	This should occur through the design development stages when the SBAT is used for decision support.
Support decision-making: The assessment frameworks should be used to inform decision-making. In order to check that appropriate decisions are being made, limited modelling may be necessary to check the performance of different options in order to ensure the most appropriate one is selected. The tool should support an iterative process where options can be tried and tested in order to develop, and evolve, the most appropriate solutions.	Yes	During design development stages.
Responsive: The tool should be able to respond to the local context, the users and the function of the building. It is therefore important that the tool is flexible enough to be used in different situations and care should be taken that the tool is not too prescriptive. In many situations, solutions and approaches may have to 'emerge' from an iterative design process.	Yes	The target setting stage should take into account and reflect the local context.
Tool development: A description of how and why the tool was developed should be provided.	No	

Logical: The tool must be structured in way that enables users to easily understand how the tool works and how this relates to buildings and sustainability.	Partially	
Linkages: The assessment process should encourage investigation into understanding of linkages and interdependencies in and between systems.	No	
Direction: The tool should provide a clear indication on the direction that the development of building should take.	Partially	A direction is indicated through the objectives, however this could be made more explicit through a description of an overarching goal those buildings and construction processes should aim for.
Justifiable: As far as possible the content and emphasis in the tool should be justifiable though reference to research and other information	No	
Strong and weak science: The tool should make distinguish in areas of where there is a strong knowledge and information base from where this does not exist. In order to address it may be appropriate to have a system of primary indicators and secondary indicators, where primary indicators are used to monitor progress in well developed areas, while secondary indicators are used to where areas may become more important in the future.	No	
Assumptions: where important assumptions are made these assumptions should be described.	No	
Reference materials: Where reference information has been material to the development of the tool this should be referred to.	No	
Definitions: Key definitions should be included in the tool	No	

SUSTAINABLE BUILDING ASSESSMENT TOOL (SBAT- P) V1

PROJECT		ASSESSMENT	
Project title:		Date:	
Location:		Undertaken by:	
Building type (specify):	Residential/Community/Commercial	Company / organisation:	
Internal area (m2):		Telephone:	Fax:
Number of users:		Email:	
Building life cycle stage (specify):	Design/Construction/Operation		



Social	1.0	Economic	1.4	Environmental	1.2

Overall	1.2

Building Performance - Economic

	Criteria	Indicative performance measure	Measured	Points
EC 1	**Local economy**	Explanatory notes		0.0
EC 1.1	Local contractors	% value of the building constructed by local (within 50km) small (employees<20) contractors	0	0.0
EC 1.2	Local materials	% of materials (sand, bricks, blocks, roofing material) sourced from within 50km	0	0.0
EC 1.3	Local components	% of components (windows, doors etc) made locally (in the country)	0	0.0
EC 1.4	Local furniture/fittings	% of furniture and fittings made locally (in the country)	0	0.0
EC 1.5	Maintenance	% of maintenance and repairs by value that can, and are undertaken, by local contractors (within 50km)	0	0.0
EC 2	**Efficiency**	Explanatory notes		1.6
EC 2.1	Capacity	% capacity of building used on a daily basis (actual number of users / number of users at full capacity*100)	80	0.8
EC 2.2	Occupancy	% of time building is occupied and used (actual average number of hours used / all potential hours building could be used (24) *100)	0	0.0
EC 2.3	Space per occupant	Space provision per user not more than 10% above national average for building type (100%)	80	0.8
EC 2.4	Communication	Site/building has access to internet and telephone (100%), telephone only (50%)	0	0.0
EC 2.5	Material & Components	Building design coordinated with material / component sizes in order to minimise wastage. Walls (50%), Roof and floors (50%)	0	0.0
EC 3	**Adaptability**	Explanatory notes		1.1
EC 3.1	Vertical heights	% of spaces that have a floor to ceiling height of 3000mm or more	0	0.0
EC 3.2	External space	Design facilitates flexible external space use (100%)	80	0.8
EC 3.3	Internal partition	Non loadbearing internal partitions that can be easily adapted (loose partioning (100%), studwall (50%), masonary (25%)	34	0.3
EC 3.4	Modular planning	Building with modular stucture, envelope (fenestration) & services allowing easly internal adaptaptation (100%)	0	0.0
EC 3.5	Furniture	Modular, limited variety furniture - can be easily configured for different uses (100%)	0	0.0
EC 4	**Ongoing costs**	Explanatory notes		1.7
EC 4.1	Induction	All new users receive induction training on building systems (50%), Detailed building user manual (50%)	0	0.0
EC4.2	Consumption & waste	% of users exposed on a monthly basis to building performance figures (water (25%), electricity (25%), waste (25%), accidents (25%)	80	0.8
EC 4.2	Metering	Easily monitored localised metering system for water (50%) and energy (50%)	56	0.6
EC4.3	Maintenance & Cleaning	% of building that can be cleaned and maintained easily and safely using simple equipment and local non-hazardous materials	34	0.3
SO 4.5	Procurement	% of value of all materials/equipment used in the building on a daily basis supplied by local (within the country) manufacturers	0	0.0
EC 5	**Capital Costs**	Explanatory notes		2.1
EC 5.1	Local need	Five percent capital cost allocated to address urgent local issues (employment, training etc) during construction process (100%)	0	0.0
EC5.2	Procurement	Tender / construction packaged to ensure involvement of small local contractors/manufacturers (100%)	80	0.8
EC 5.3	Building costs	Capital cost not more than fifteen % above national average building costs for the building type (100%)	50	0.5
EC5.4	Technology	3% or more of capital costs allocated to new sustainable/indigenous technology (100%)	80	0.8
EC 5.5	Existing Buildings	Existing buildings reused (100%)	0	0.0

Building Performance - Social

	Criteria	Indicative performance measure		Measured	Points	Quantified modelled or measured performance data
SO 1	**Occupant Comfort**		Explanatory notes		0.2	http://greenbuilding.ca/
SO 1.1	Daylighting	% of occupied spaces that are within distance 2H from window, where H is the height of the window or where there is good daylight from skylights		20	0.2	
SO 1.2	Ventilation	% of occupied spaces have equivalent of opening window area equivalent to 10% of floor area or adequate mechanical system, with upolluted air source		0	0.0	
SO 1.3	Noise	% of occupied spaces where external/internal/reverberation noise does not impinge on normal conversation (50dbA)		0	0.0	
SO 1.5	Thermal comfort	Tempreture of occupied space does not exceed 28 or go below 19oC for less than 5 days per year (100%)		0	0.0	
SO 1.5	Views	% of occupied space that is 6m from an external window (not a skylight) with a view		0	0.0	
SO 2	**Inclusive Environment**		Explanatory notes		1.1	
SO 2.1	Public Transport	% of building (s) within 400m of disabled accessible (20%) and affordable (80%) public transport		0	0.0	
SO 2.2	Information	Comprehensive signage provided (50%), Signage high contrast, clear print signage in appropriate locations and language(s) / use of understandable symbols / manned reception at all entrances (50%)		34	0.3	
SO 2.3	Space	% of occupied spaces that are accessible to ambulant disabled / wheelchair users		80	0.8	
SO 2.4	Toilets	% of occupied space with fully accessible toilets within 50m along easily accessible route		0	0.0	
SO 2.5	Fittings & Furniture	% of commonly used furniture and fittings (reception desk, kitchenette, auditorium) fully accessible		0	0.0	
SO 3	**Access to Facilities**		Explanatory notes		1.1	
SO 3.1	Children	All users can walk (100%) / use public transport (50%) to get to their childrens' schools and creches		0	0.0	
SO 3.2	Banking	All users can walk (100%) / use public transport (50%) to get to banking facilities		80	0.8	
SO 3.3	Retail	All users can walk (100%) / use public transport (50%) to get to food retail		34	0.3	
SO 3.4	Communication	All users can walk (100%) / use public transport (50%) to get to communication facilities (post/telephone/internet)		0	0.0	
SO 3.5	Exercise	All users can walk (100%) / use public transport (50%) to get to recreation/excercise facilities		0	0.0	
SO 4	**Participation & Contro**		Explanatory notes		1.1	
SO 4.1	Environmental control	% of occupied space able to control their thermal environment (adjacent to openable windows/thermal controls)		0	0.0	
SO 4.2	Lighting control	% of occupied space able to control their light (adjacent to controllable blinds etc/local lighting control)		80	0.8	
SO 4.3	Social spaces	Social informal meeting spaces (parks / staff canteens / cafes) provided locally (within 400m) (100%)		0	0.0	
SO 4.4	Sharing facilties	5% or more of facilities shared with other users / organisations on a weekly basis (100%)		34	0.3	
SO 4.5	User group	Users actively involved in the design process (50%) / Active and representative management user group (50%)		0	0.0	
SO 5	**Education, Health & Sa**		Explanatory notes		1.1	
SO 5.1	Education	Two percent or more space/facilities available for education (seminar rooms / reading / libraries) per occupied space (75%). Construction training provided on site (25%)		0	0.0	
SO 5.2	Safety	All well used routes in and around building well lit (25%), all routes in and around buildings visually supervised (25%), secure perimeter and access control (50%), No crime (100%)		34	0.3	
SO 5.3	Awareness	% of users who can access information on health & safety issues (ie HIV/AIDS), training and employment opportunities easily (posters/personnel/intranet site)		80	0.8	
SO 5.4	Materials	All materials/components used have no negative effects on indoor air quality (100%)		0	0.0	
SO 5.5	Accidents	Process in place for recording all occupational accidents and diseases and addressing these		0	0.0	

Building Performance - Environmental

	Criteria	Indicative performance measure	Measured	Points
EN 1	**Water**	Explanatory notes		1.1
EN 1.1	Rainwater	% of water consumed sourced from rainwater harvested on site	0	0.0
EN 1.2	Water use	% of equipment (taps, washing machines, urinals showerheads) that are water efficient	0	0.0
EN 1.3	Runoff	% of carparking, paths, roads and roofs that have absorbant/semi absorbant/permeable surfaces (grassed/thatched/looselaid paving/ absorbant materials)	80	0.8
EN 1.4	Greywater	% of water from washing/relatively clean processes recycled and reused	34	0.3
EN 1.5	Planting	% of planting (other than food gardens) on site with low / appropriate water requirements	0	0.0
EN 2	**Energy**	Explanatory notes		1.1
EN 2.1	Location	% of users who walk / cycle / use public transport to commute to the building	0	0.0
EN 2.2	Ventilation	% of building ventilation requirements met through natural / passive ventilation	34	0.3
EN 2.3	Heating & Cooling	% of occupied space which relies solely on passive environmental control (no or minimal energy consumption)	80	0.8
EN 2.4	Appliances & fittings	% of appliances / lighting fixtures that are classed as highly energy efficient (ie energy star rating)	0	0.0
EN 2.5	Renewable energy	% of building energy requirements met from renewable sources	0	0.0
EN 3	**Waste**	Explanatory notes		1.1
EN 3.1	Toxic waste	% of toxic waste (batteries, ink cartridges, flourescent lamps) recycled	0	0.0
EN 3.2	Organic waste	% of organic waste recycled	0	0.0
EN 3.3	Inorganic waste	% of inorganic waste recycled.	80	0.8
EN 3.4	Sewerage	% of sewerage recycled on site	34	0.3
EN 3.5	Construction waste	% of damaged building materials / waste developed in construction recycled on site	0	0.0
EN 4	**Site**	Explanatory notes		0.8
EN 4.1	Brownfield site	% of proposed site already disturbed / brownfield (previously developed)	0	0.0
EN 4.2	Neighbouring buildings	No neighbouring buildings negatively affected (access to sunlight, daylight, ventilation) (100%)	0	0.0
EN 4.3	Vegetation	% of area of area covered in vegetation (include green roofs, internal planting) relative to whole site	0	0.0
EN 4.4	Food gardens	Food gardens on site (100%)	80	0.8
EN 4.5	Landscape inputs	% of landscape that does not require mechanical equipment (ie lawn cutting) and or artificial inputs such as weed killers and pesticides	0	0.0
EN 5	**Materials & Componen**	Explanatory notes		1.6
EN 5.1	Embodied energy	Materials with high embodied energy (aluminium,plastics) make up less than 1% of weight of building (100%)	0	0.0
EN 5.2	Material sources	% of materials and components by volume from grown sources (animal/plant)	80	0.8
EN 5.3	Ozone depletion	No materials and components used requiring ozone depleting processes (100%)	80	0.8
EN 5.4	Recyled / reuse	% of materials and components (by weight) reused / from recycled sources	0	0.0
EN 5.5	Construction process	Volume / area of site disturbed during construction less than 2X volume/area of new building (100%)	0	0.0

Instructions

Objective

The objective of the tool is to provide an indication of the performance of a building or the design of a building in terms of sustainability

Scope

The tool should be ideally be used on a building that has just been completed.
It can be used at other stages of a building's lifecycle but some criteria may not be relevant
The tool can be used on most building types such as schools, housing and offices, conventionally used by people to live and work in

Instructions

Step One **Setting the Project Up**
Complete the *project* and *assessment* sections of the *A. Report* section
Refer to *definitions* below

Step Two **Entering Measurements**
Complete each of the sections *B. Social, C. Economic* and *D. Environmental*
Should you require a description of the broad criteria used refer to *Criteria Notes.*
Under the column *Measured* indicate the percentage compliance from 0 to 100 % for each of the relevant criteria
If you do not have the information required for the criteria enter O%
Should you have detailed modelled or measured quantified performance data relevant to the criteria enter this under *Quantified modelled or measured performance data.* Where possible ensure that this data aligns with protocols provided in the green building assessment methodology (see http:greenbuildings.ca)
Detailed technical performance information on your building should also be entered directly into the powerpoint accompanying this document

Step Three **Reading the Report**
On completion return to the A. Report section. The spidergraph should now have filled and values should have appeared in all boxes.

Social provides an indication of the social performance of the building in terms of sustainability
Economic provides an indication of the economic performance of the building in terms of sustainability
Environmental provides an indication of the environmental performance of the building in terms of sustainability
Overall provides an indication of the overall building performance in terms of sustainability

Definitions

Occupied Space: Space that is normally used by people for living or working in
User: People who regularly use the building

Contact

Should you wish to comment on this tool, please contact:

Jeremy Gibberd, FPM, CSIR
Tel: 012 841 2839 Fax: 012 841 3504
Email: jgibberd@csir.co.za

Criteria Notes

Reference	Criteria	Description	Examples of quantified performance indicators
SO1	Occupant Comfort	The quality of environments in and around buildings has been shown to have a direct impact on health, happiness and productivity of people. Healthier, happier, more effective people contribute to sustainability by being more efficient and therefore reducing resource consumption and waste.	
SO2	Inclusive Environments	Buildings should be designed to accommodate and be accessible to everyone, or specially designed buildings need to be provided. Ensuring that buildings are inclusive supports sustainability as replication is avoided and change of use supported. It also ensures that as legislation in this area tightens, expensive retrofits are not required in order to ensure compliance	
SO3	Access to Facilities	Conventional living and working patterns require regular access to a range of services. Ensuring that these services can be accessed easily and in environmentally friendly ways supports sustainability by increasing efficiency and reducing environmental impact.	
SO4	Participation & Control	Enablingusers to participate in decisions about their environment helps ensure that they care for and manage this properly. Control over aspects of their local environment enables personal satisfaction and comfort. Both of these support sustainability by promoting proper management of buildings and increasing productivity.	
SO5	Education Health and Safety	Buildings need to cater for the well-being, development, health and safety of the people that use them. Learning and access to information is increasingly seen as a requirement of a competitive work force. All of these factors contribute to sustainability by helping ensure that people remain healthy and economically active, thus reducing the 'costs' (to society, the environment and the economy) of unemployment and ill health.	
EC1	Local Economy	The construction and management of buildings can have a major impact on the economy of an area. The economy of an area can be stimulated and sustained by buildings that make use of, and develop, local skills and resources.	
EC2	Efficiency	Buildings cost money and make use of resources whether they are used or not. Effective and efficient use of buildings supports sustainability by reducing waste and the need for additional buildings.	
EC3	Adaptability and Flexibility	Most buildings can have a life span of at least 50 years. It is likely that within this time the use of the building will change, or that the feasibility of this will be investigated. Buildings, which can accommodate change easily, support sustainability by reducing the requirement for physical adaptation and associated disruption, energy consumption and cost as well as the need for new buildings.	
EC4	Ongoing Costs	Building cost money to operate. These costs include cleaning, maintenance, security and energy. These costs are often indicative of consumption and waste in the building. It is therefore important to monitor them. In addition operational budgets can be used to support the development of local economies.	
EC5	Capital Costs	Buildings are generally one of the most valuable assets that people, and often organisations and governments own. Money spent on buildings is not available for other uses such as health, education and business development. In addition,expensive buildings may mean that the services (i.e. health and education) they contain or the accommodation (for work and living) they provide is beyond the means of most users.	
EN1	Water	The large-scale provision of conventional water supply has many environmental implications. Water needs to be stored (sometimes taking up large areas of valuable land and disturbing natural drainage patterns with associated problems from erosion etc); it also needs to be pumped (using energy) through a large network of pipes (that need to be maintained and repaired). Having delivered the water, parallel efforts are then required to dispose of this after it is used in reticulation and sewerage systems. Reducing water consumption supports sustainability by reducing the environmental impact required to deliver water, and dispose of this after use. Maintaining natural ground water systems also supports sustainability through maintaining existing ecosystems and avoiding the environmental impact associated with for disposal of storm water and runoff.	
EN2	Energy	Buildings consume a large proportion of all energy produced. Conventional energy production is responsible for making a large contribution to environmental damage and non-renewable resource depletion. Using less energy or using renewable energy in buildings therefore can make a substantial contribution	
EN3	Waste	Raw materials and new components used in buildings consume resources and energy in their manufacture and processes. Buildings accommodate activities that consume large amounts of resources and products and produce large amounts of waste. Reducing the use of new materials and components in buildings and in the activities accommodated and reducing waste by recycling and reuse supports sustainability by reducing the energy consumption and resource consumption.	
EN4	Site	Buildings have a footprint and a size that take up space that could otherwise be occupied by natural ecosystems which contribute to sustainability by helping create and maintain an environment that supports life. (By, for instance, controlling the carbon dioxide and oxygen balance and maintaining temperatures within a limited range). Buildings can support sustainability by, limiting development to sites that have already been disturbed, and working with nature by including aspects of natural ecosystems within the development.	
EN5	Materials and Components	The construction of buildings usually requires large quantities of materials and components. These may require large amounts of energy to produce. Their manufacture may also require processes that are harmful to the environment and consume non-renewable resources. It is therefore important to carefully select materials and components and construction methods.	

Instructions

- This presentation should be completed after finishing the SBAT assessment (Excel document attached) of your building as it requires information from this.
- The *italic text* included in this document provides guidance please **delete** this as you complete presentation
- Ensure that the complete presentation is no larger than **2MB** if you want to send it by email and **10MB** if you send a CD. If it is larger than this substitute / reduce the resolution of information to reduce the size of the document.
- Submit this document with the completed SBAT (Excel document) report.

Project Title

Building Type (Residential/Community/Commercial)
Country
Date building completed / projected completion date

Images / drawings can be inserted on this page, however make sure that the text above can be read easily

Introduction

- *Provide brief description / background / objectives of the project*

Context

- *Provide description of context, with pictures / diagrams.*
- *In particular include aspects that have strongly influenced the design of the project*

Drawings

- *Include one or two simple plan / section or other drawings that explain the project*

Photographs

- *Include up to 6 photographs that help explain the project*

Overall Performance

Copy and paste spider graph from A. report of the SBAT (excel document) here.

In the boxes below, copy across the overall value and the classification also from A. report of the SBAT (excel document).

Overall Score	

Social Performance

Social Performance	*Paste Social Performance values from Report A of the SBAT (excel document)*

Aspects	Evidence of high performance
•*List key characteristics of building with high performance in terms of social aspects of sustainable development*	• *Provide evidence of performance ie quantitative measures. Include benchmarks (& references) that can be used for comparison purposes*

Economic Performance

Economic Performance	*Paste Economic Performance values from Report A of the SBAT (excel document)*

Aspects	Evidence of high performance
•*List key characteristics of building with high performance in terms of economic aspects of sustainable development*	• *Provide evidence of performance ie quantitative measures. Include benchmarks (& references) that can be used for comparison purposes*

Environmental Performance

Environmental Performance	*Paste Environmental Performance values from Report A of the SBAT (excel document)*

Aspects	Evidence of high performance
•*List key characteristics of building with high performance in environmental aspects of sustainable development*	• *Provide evidence of performance ie quantitative measures. Include benchmarks (& references) that can be used for comparison purposes*

Key Feature 1

- *Use the Key Feature slides to show innovative / excellent / exceptional aspects of your project in terms of support for sustainable development*

- *Insert text description / performance data here*
- *Insert photographs / drawings / diagrams / tables etc to the right*

Key Feature 1

- *Use the Key Feature slides to show innovative / excellent / exceptional aspects of your project in terms of support for sustainable development*

- *Insert text description here*
- *Insert photographs / drawings / diagrams / etc to the right*

Key Feature 1

- *Use the Key Feature slides to show innovative / excellent / exceptional aspects of your project in terms of support for sustainable development*

- *Insert text description here*
- *Insert photographs / drawings / diagrams / etc to the right*

Team & Contact Details

Insert development team details in these boxes (Add boxes as required)	
Insert contact details of person carrying out the assessment who will act as contact person. Include: Person, Organisation, Address,Telephone, Fax, Email	