SUSTAINABLE DEVELOPMENT:

THE ADOPTION OF PRINCIPLES OF SUSTAINABLE DEVELOPMENT BY THE ARCHITECTURE AND CONSTRUCTION INDUSTRY OF SOUTH AFRICA

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DECLARATION

I hereby declare that this dissertation is my own unaided work. It is being submitted to the School of Architecture, Town Planning and Housing, University of KwaZulu-Natal, Durban, for the degree of Master in Architecture, and has not been submitted before for any degree or examination at any other University.

Signed by me on this 26th day of September, 2006

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ABSTRACT

Sustainable development has been variously defined as: *"the simultaneous pursuit of economic prosperity, environmental quality, and social equity"* (Gissen 2002:185), and as society's ability to meet its current needs and fulfil its greatest potential without compromising its ability to address its needs and potentials in the future (WCED 1987). It is a far reaching concept which calls for action by the entire spectrum of society. It implies a focus on more than just financial profits, and is more holistic and systemic than simple environmentalism.

Approaches to the subject differ depending on the global context, that is, the North sees the issue as leaning more toward conscientious environmental resource use and rehabilitation, whereas the South sees sustainable development more in terms of providing for the basic needs of the poor, which often takes priority over doing so in an environmentally and economically sustainable manner.

Implementation of sustainable development tends to be implemented by governments in a number of ways, firstly by moving the indicators of development away from Gross Domestic Product and toward more holistic indicators such as Quality of Life indicators, in order to internalise factors that are typically considered external to normal economic pricing factors.

The implementation of sustainable development into the architecture and construction industry requires architects to be aware of the issues involved and the solutions available. Then clients need to be educated in their role in the process, with particular emphasis on the advantages available to them. These advantages include lower running costs, improved corporate image, and improved worker contentment and productivity.

Practical measures for sustainable architectural design are primarily environmental in nature, and include water, energy, and material resource efficiency, as well as indoor environmental quality. These can however, largely be validated in economic terms.

Existing literature that are intended as 'design guides', are however, lacking in practical measures in which to implement the more social and economic sides of sustainable development, and for that, the designer needs to look toward various architectural assessment tools, of which South Africa's Sustainable Building Assessment Tool is useful because of the broad scope of its approach.

Built examples have demonstrated greatly improved environmental performance in buildings, as well as improved worker and client satisfaction. In terms of architectural quality, they range from offices which look very similar to other 'non-sustainable' offices built in the North, to a more experimental and low-tech approach practiced by a number of architects from the South, which see this approach as an opportunity for a new architectural expression.

Sustainable architecture requires acknowledging sustainable development goals from the very start of the project. Following this, the interrelationship between different components of a design is examined, particularly with respect to allowing advantages attained from one component or system to benefit other systems. A holistic approach of concurrently focusing on environmental, social and economic factors will be shown to benefit all of these factors rather than just the one being designed for – for example, environmental interventions can have economic benefits. Because of the wide scope of factors that need to be considered, it will be found that often there are conflicting issues. This can be resolved through analyses such as life-cycle-analysis and value judgments can be made by comparing different solutions.

CONTENTS

INTRODUCTION

> *"Since the Industrial Revolution, the world has witnessed incalculable technological achievements, population growth, and corresponding increases in resource use. As we enter a new century, we are recognizing "side effects" of our activities: pollution, landfills at capacity, toxic waste, global warming, resource and ozone depletion, and deforestation. These efforts are straining the limits of Earth's "carrying capacity" - its ability to provide the resources required to sustain life while retaining the capacity to regenerate and remain viable."* (US Green Building Council 1996:1)

Although the concept of sustainable development has been the subject of much debate, there is still little consensus on the nature of the problem, and on the most effective implementation strategies. As such designers have no solid reference point on which to base a sustainable system of design. The affect of this is to paralyse them into inaction. Even if designers are sensitised to the principles and problems of sustainable development, the majority of the general public, and therefore the architect's client base, seem to have little knowledge of the subject. Therefore, even if an architect's practice is committed to sustainable development objectives, it also has to educate its clients to the same paradigm of thinking. Therefore, this is more a problem of client education and communication than it is specifically a question of sustainable design - the problem is with promoting sustainability, rather than of just practising it.

In order to synthesize sustainable development into architecture then a broader understanding of the subject is needed. Furthermore, for architects to play a positive role in the sustainable development debate they need to educate themselves and their clients on the advantages of sustainable development in the clients own terms. This typically means framing the sustainability debate in terms of financial profit, such as lower running costs, but also increasingly in advantages to the corporate image and increased end-user satisfaction, health and productivity.

The objective of this research project is to find practical ways to promote sustainable development within the architecture industry of South Africa, specifically focusing on clients' objectives and perceptions of sustainable development, and how to reduce the perceived gap between clients' objectives and those of sustainable development paradigms.

The data presented here is in 4 sections.

The first section, entitled, "The global issue", examines the issue of sustainable development, first in terms of its definitions and objectives which have evolved over 30 years of international debate. This goes on to examine the differences in the problems, and the approaches to solving those problems, between the developing and the developed world. This divide is dealt with in terms of contemporary theories of globalisation which talk of a "*hybridity*" of cultures that is developing. It goes on to look at the causes by which decision-makers make decisions, and looks at ways to synthesize sustainable development principals into their paradigms of thinking. This requires internalising *"exogenous"* factors – typically through government interventions which attempt to reflect the *"full-cost pricing"* of resource use.

The construction industry's relationship to this debate is related in Chapter 2. This involves those driving the construction of buildings, that is, corporate clients, and governments which holistically integrate three aspects into building design – social factors, economic factors and environmental factors. For corporate clients this requires taking a long view of the building investment and gaining "value" from a project in ways that are not purely financial.

Chapter 3 finds practical approaches and methods with which to achieve the goals that were defined in the chapter before. This is not intended to be a "design guide", of which there are many, but rather it discusses the concepts involved in sustainable architectural design, and examines the factors which need to be considered.

Chapter 4 looks at built examples which attempt to take the approach defined in Chapters 2 and 3. Both the NMB bank headquarters in Amsterdam and the Addison Wesley Longman building in Dorset, UK, are European examples which demonstrate how environmental concerns can be addressed while at the same time enhancing corporate and economic aspects. Eastgate in Harare is a more local example which exhibits the same methods and objectives. It is also a purely commercial venture, but

sits in a very different social, climatic and economic context. The Habitat Research and Development Centre in Windhoek by Nina Maritz Architects is not a commercial venture like the previous examples, and so has more room to experiment with innovative materials and devices.

An analysis of the literature on the subject is first used to define the problem and to define contemporary trends in the formulation of action plans to deal with the problem. This provides a structuralist definition of sustainable development, but also highlights a difference in approach between writers from developing and developed countries, as noted above. A bridging of the ideological and practical gap between the two realities will require discussion with key informers from the South African context.

Finally, a physical survey of local examples will provide the material for a comparative analysis with other precedent studies drawn from an international context.

Defining the problem appears to be one of the key stumbling blocks in addressing sustainable development.

The World Business Council for Sustainable Development defines sustainable development as follows: *"Sustainable development involves the simultaneous pursuit of economic prosperity, environmental quality, and social equity."* (Gissen 2002:185) Sustainable development is, obviously, development which is sustainable. Bartelmus describes development as *"the process of enlarging people's choices."* (1994:71-2) This includes a range of activities, from providing for basic needs such as food, health care, shelter and education, to providing capacity for a full range of human choices such as political and economic freedoms.

The next question then, is how to achieve this development sustainably. A number of international conferences have attempted to address this question over the past few decades, and their response will be discussed later. As an introduction however, the WCED of 1987 defines sustainability as society's ability to meet its current needs and fulfil its greatest potential without compromising its ability to address its needs and potentials in the future. This has come to specifically mean care and respect for the resources provided by the natural environment, in conjunction with human society and the economic system within which it operates.

Examining the "*needs*" involved in the definition of "*development*" above shows a clear distinction between the developing and developed world, in that the developed world already has its basic needs under control. This then, suggests a difference in priorities between each region's approach to sustainable development. Where the developing world must focus first on the provision of basic needs, and the developed world can focus instead on making its development less harmful to the natural environment. There is an important argument however, that states that if the developing world focuses solely on the provision of its basic needs, then it will soon run into the same problems that the North is facing now. Instead there should be a holistic approach to development which attempts to solve many of the long-term issues at the same time as it solves the short term issues.

This developed versus developing worldview sets up a clear division between different regions. This makes each region suspicious of the other's approach and technology because of a difference in context. What would be preferable is to acknowledge these differences and look for ways in which to hybridise one approach into another context. This will be discussed further under the heading of "*Globalisation*".

There are a number of questions which have directed the research in this paper. The primary, overarching issue is, how best to synthesise sustainable development into architecture? This can be divided into a set of secondary issues. They are:

- Given the amount of knowledge that already exists concerning sustainable architecture, why is the implementation of such knowledge so seldom seen?
- What enabling mechanisms are available for transferring sustainable development principles into the construction industry? And what can be done to motivate design professionals into more concerted action? Also, what methods are being implemented by the architecture industry most effectively?
- What are the differences between the priorities of developed and developing countries in terms of sustainable development, and how should this change the designer's approach to sustainable design?
- How to integrate social factors into environmental economics models?
- What is the best method of educating the client to change their priorities to those more in line with the sustainability paradigm? What/ how much action

needs to be taken in order to begin making a difference? How can we prove that our actions are making a difference?

In this research project I begin with a comparative analysis of theories of sustainable development. This led me to the recognition of fundamental differences in thinking between developing and developed countries, which can be seen in the different approaches taken by Cole and Lorch (2003) and Schmidheiny (1992) from the North and Du Plessis (2002) from the South. Therefore, various approaches are analysed within a framework of globalisation, which uncovers post-structural relationships between these approaches and the contexts in which they are formed (Cole and Lorch 2003 and Schmidheiny 1992). This then, is synthesized into the debate on the drivers or motivators of architectural design and construction. This is achieved by examining the drivers behind architectural clients, particularly governmental and corporate clients, specifically in economic terms. These drivers are compared with sustainable development goals, and an argument is constructed whereby the overlapping issues are highlighted. In order to achieve practical results, the theory discussed is then applied to a number of precedent studies from around the world. These are critically analysed in terms of theories of sustainable architectural design.

CHAPTER 1: The Global Issue

SUSTAINABLE DEVELOPMENT POLICY

HISTORICAL CONTEXT

The issue of sustainable development is a complex one. A number of international conferences have occurred over the last 20 years, and in that time the concept has gone through a number of incarnations. The idea began with the oil crisis of the 1970s when the governments of the world realized that their current source of energy wouldn't last forever, and something needed to be done about it. This derived what is probably the primary concern of the sustainability debate, which is energy efficiency as it relates to natural resource depletion. Following the oil crisis, the green movement began to gather public interest. Still today, the most quoted definition of sustainability comes from the World Commission on the Environment and Development (WCED) of 1987, also known as the Brundtland report, which decided that,:

> "*Humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs ... sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs.*" (Williamson *et al* 2003: 4)

Although this is an apparently simple definition, it encompasses some of the most important concepts to an understanding of sustainable development. The notions of intergenerational equity, needs and limits, have all drawn a large amount of debate, but all are key to an understanding of the goals of sustainable development as a whole. (Elliot 1999) Williamson agrees with the concept of needs, highlighting the basic needs required for human life. These needs are not such an issue to the world's rich, but to the world's poor there are issues such as food, clothing, and shelter which are essential to human life. The concept of needs is often expanded

from this simple definition of basic needs however, to include other *"needs"* to allow for a fairly comfortable quality of life. (Williamson et al 2003)

The first concept, that of '*needs*' is clearly one which will be constantly disputed in contemporary consumer society. The basic needs of the world's poor for food, shelter and water, is a need that everyone can sympathize with, and in principle won't have any problem of supporting so long as it doesn't cost too much to their own quality of life. However, it has been said elsewhere that for sustainability to work might require that "*the rich must live simply, so that the poor may simply live*" (Author Unknown), which is an idea that the world's rich would not easily adapt to. This disparity of development, and the effect it has on the environment, has been described as both the "*pollution of poverty*", and "*the pollution of affluence*". The issue that is raised around the concept of 'needs' is that everyone will have a different definition of what their needs are – for example, the 'need to live comfortably' would to some people require television and air-conditioning, while to other people it would simply mean food and shelter. Indeed, "*needs*" in the 21st century are often derived at the whim of marketing and advertising campaigns.

Williamson also points out the phrase *"making consistent"* from the Brundtland report. It is said in a context to mean *"making consistent"* the resource demands of technology and society with the environments ability to meet these demands, both now and in the future. That is, the current generation will not use more resources than it replaces as well as not compromising the environmental "*sinks*" which deal with our waste, thus allowing "*future generations*" the same opportunities and available resources as the current one, and therefore not leave these 'future generations' with problems of resource deficiency that we have been left by previous generations. (Williamson et al 2003)

This raises a third difficult concept of the sustainability argument – the concept of "*future generations*". The term "*intergenerational equity*" was coined by Parfit in 1984 (Williamson 2003: 52). To illustrate he provides the following example: If, to continue existence, the human race was required to deplete a certain resource, which would make the quality of life better the next 300 years, but subsequently the resource be unavailable. In 300 years time, the population would firstly, not even exist had we not taken the original action, and secondly, would be an entirely different population, with new technologies and needs to the current one, and would therefore not necessarily need the resource that we are saving. Thus it may be better for this future generation

if the current one were to use their resources how they saw fit, and let future generations deal with their own (new) problems. However, it does not take a great jump of logic to see that whoever these future generations are, they will still have a need for clean air and water. The destruction of biological diversity would place a limit on future potential growth by removing some potential resources. As such, the semantics of *"future generations"* is not as important as is accepting the idea that depleting the Earth's resource base is damaging and limiting to the long term sustainability of humans on the planet.

Following the Brundtland report there have been a number of international congresses on sustainable development. Probably the most famous was the Rio summit of 1992, from which a number of important governmental declarations were declared, including the still highly influential Agenda 21. Rio +10 was held in Johannesburg in 2002, and is valuable for providing more detail to various policies, particularly those of water management and poverty alleviation.

Agenda 21 highlights human settlements as its main concern, and specifically improving the quality of these in terms of social, economic and environmental factors. It sets out 8 objectives for sustainable development. These are:

- *"providing adequate shelter*
- *improving management of urban settlements*
- *promoting sustainable land-use planning and management*
- *providing environmentally sound infrastructure facilities*
- *promoting energy-efficient technology, alternative and renewable energy sources and sustainable transport systems*
- *enabling disaster-prone countries to plan for and recover from natural disasters*
- *promoting sustainable construction industry activities*
- *human resource development*" (Williamson et al 2003: 5)

Many of these issues relate to construction, and highlight the importance of the construction industry's response to sustainable development. Many of these elements (particularly *"improving management of urban settlements"; "promoting sustainable land use planning and management"; and "providing environmentally sound infrastructure facilities"*) appear primarily to relate to governments and municipalities approach to the built environment. Their response however, will inform

architects' efforts. And, to a large degree, the policies and systems derived by governments will be carried out by the construction industry.

"Promoting sustainable construction industry activities" is an obvious objective, but the problem then becomes a definition of what "sustainable construction activities" are, and an action plan for the implementation of them.

The first point - that of "providing adequate shelter" - is often held as a driving force of sustainable development in developing countries, where the lack of adequate shelter is a huge problem. Throughout the literature on the subject of sustainable development however, there is constant reference to a holistic approach. By focussing on poverty alleviation and the provision of housing, developing countries have a tendency to ignore other factors.

The most recent international conference was held in Johannesburg in 2002. The Johannesburg declaration which resulted stated that "*poverty eradication, changing consumption and production patterns and managing the natural resource base for economic and social development*" (2002: 11) are the prime concerns for sustainable development. It goes on to describe the long term perspective needed to achieve these goals, as well as a "*broad based participation in policy making, decision making and implementation at all levels.*" (2002:26) In this respect, regional co-operation initiatives such as NEPAD are advantageous. These initiatives cannot be confined to government. The private sector has just as important a role in the "*evolution of equitable and sustainable communities and societies.*" (2002:27) This provides an environment of social participation at all levels which enhances those stakeholders' interest and feeling of responsibility towards issues with which they are involved.

The inability to reach consensus on everything from a definition of sustainable development to implementation strategies, as well as the uncertainty relating to the real effects of climate change and environmental damage appear to be the main stumbling blocks to widespread action. But the issues are getting clearer and clearer all the time, and surely a first step can be taking without understanding the full extent of the problem.

THE DEVELOPED / DEVELOPING WORLD DIVIDE

The Johannesburg declaration highlighted the problem of a clear and growing divide between "developed", industrialised nations and those which are at earlier stages industrial development. (2002: 12)

The implementation of sustainability policy is necessarily quite different in nations which are already developed, and those which are developing. The citizens of developed nations already have their basic needs provided for, and so sustainability initiatives are more able to focus their attention on ecological issues. Developing countries however, have more pressing problems in terms of providing for the basic needs of its people. Of course, the concept of "*basic needs*" means different things to different people.

> "*There is therefore a sense of urgency about introducing sustainable construction practices into the developing world. Firstly, the developing world is still largely under construction and every minute means the construction of a building, road or dam that will in all likelihood not be sustainable. Secondly, the pressures on resources in these countries mean that they cannot afford to make mistakes and have to make sure that what is being constructed now will be sustainable.*" (Du Plessis 2002: 21)

Sustainable development in developing countries also has the opportunity to be more all-encompassing than efforts from the North. In the South these developments will be happening for the first time, offering the opportunity for development to be sustainable right from the start, rather than having the North's problem of having to retrofit for 200 years of unsustainable development which industrialization brought.

A problem that exists with including environmental concerns in development thinking is that the South cannot achieve development by the same means that the North used, because then the South would simply end up with the same problems that the North's problems – which are a major cause of global climate-change.

> "*The developing nations are today following the developed nations' policy of achieving economic growth through macro-industrial production, which revolves around the concept of large-scale production and high-consumption patterns. The consequent environmental and social impact is often overlooked. The adoption of the new Western "sustainable" construction*

methods and city patterns requires questioning to ensure these reflect the specific requirements of the developing nations and incorporate their value systems." (Du Plessis 2002:12)

Implicit in this statement is the idea that there is another way of development which is not based on large-scale macro-industrial production and consumption. The fact is that, over the past two centuries the industrialised nations of the North focuses their efforts on maximising production with little concern over efficient resource use. New efforts in the North however, focus instead on maximising quality and improving the efficiency of these processes in order to achieve development. As Schmidheiny describes, development is "*more than just growth, or quantitative change. It is primarily a change in quality.*" (1992:6)

However, developing countries have to contend with problems of both quantity and quality, and so,:

> "*Societies and governments faced with the extreme survival issues prevalent in the developing world tend to adopt a crisis-management approach to development, with little regard for the long-term impact their actions will have on both the environment and society. In regions marked by poverty and economic problems, it is very difficult to establish environmental sustainability as a national priority. Consequently sustainability actions are focused on poverty, democracy, improving infrastructure, and nature conservation to support ecotourism.*" (Du Plessis 2002: 21)

The danger of this short term view is that, in the longer term, these initiatives will begin to create their own problems, which will take more resources to fix in the future. The alternative is surely to put a little more thought into these initiatives now, so that they instead create valuable new resources in the longer term. Of course, global climate change is one of the central themes that are driving the sustainable development movement. The effect of doing nothing, and continuing development in the current way, would probably be catastrophic, but the problem is that the effects are only evident in the long-term. British scientists are now saying that the recent spate of hurricanes ravaging southern USA is a direct result of global warming.

There is more to environmental damage than the global effects that the North tends to concentrate on. Environmental damage is also more regional in effect such as the

effects of water scarcity and desertification, as well as on a local level, such as smog and degraded farming land.

Bartelmus defines "*development*" as the process of enlarging the range of people's choices. The above environmental damages are seriously inhibiting, or threatening to inhibit, humanity's ability to survive, or at least develop. Therefore, environmental factors are critical to development. However, it is in the nature of the natural environment to operate on a much slower, longer term timescale to the day to day lives of people. This means that we are feeling the effects of some time of cumulative damage of our unsustainable actions, and also highlights why the decision making involved in sustainable development thinking is necessarily quite long-term.

Because of the seeming desperation of the situation in developing countries, effort tends to focus on simply providing for the immediate needs of the poor, such as housing and poverty alleviation. Although this in itself would undoubtedly help in the development of a nation, many development initiatives are environmentally damaging and socially and economically unsustainable and so are not necessarily beneficial in the long-term (sustainable).

GLOBALISATION

The term "*globalisation*" is used to describe the current moment or era. It has been defined as "*a social process in which the constraints of geography on economic, political, social and cultural arrangements recede, in which people become increasingly aware that they are receding and in which people act accordingly.*" (Cole and Lorch 2003:19) Historically it has been seen primarily in a negative sense and with a certain inevitability to it. Kenneth Frampton sees globalisation as "*the spreading of a mediocre civilization which is the absurd counterpart of elementary culture.*" (Frampton 1983:16)

However, this view has been criticised for depicting cultures as static and as following a clearly demarcated path of development which has already been cleared by Western civilization. Contemporary thought has moved away from this dualistic view of either the "*local*" or the "*global*", and instead sees the new world as a "*pattern of hybridity and adaptation.*" (Cole and Lorch 2003:18) This means that, on being imported into a culture, influences keep some aspects of their home culture, and are hybridised and naturalised to take on aspects of their new context. Thus, even as imported influences keep their association with the "*other*", they also become

integrally part of the "*local*". It should also be noted that imported influences are seldom seen as something "*global*", but rather as coming from a different local context.

Where a global homogenisation can be seen however, is where "*traditions and forms do not accommodate for new uses and activities.*" (Cole and Lorch 2003:29) This can be seen in the forms of global transport and communications, such as airport terminals. Although it is argued that these forms "*provoke a crisis in understandings of the spatialization of buildings, of the "fit" between function and location*" (Cole and Lorch 2003:29), they do offer the advantage of being legible to everyone who uses them. That is, a European tourist in China will be able to navigate through an international airport terminal as easily as a Chinese tourist in Europe, despite differences in language and culture which would cause problems elsewhere.

The implications of globalisation on the sustainable development debate have to do with the transfer of knowledge and technology from one context to another. As Cole and Lorch describe, "*almost all sustainability and environmental building concepts are universal in their validity. However, if these are to be successful then the specific interpretation and manifestation in design should reflect the local context.*" (2003:6) In too much contemporary green design a literal transfer of technological strategies occurs without any serious consideration of either their local validity or engagement by building occupants.

The issue of technology transfer is thus a very complex one, not least because of the political aspect. The problem, from a political perspective, is that ""*technology transfer" is often seen as a euphemism for the transfer of capital.*" (Schmidheiny 1992:118) Schmidheiny defines technology transfer as "*the movement of technology from where it exists to where it is needed.*" (1992:118) However, he neglects to approach the subject of how this technology should be adapted to its new context.

VALUE SYSTEMS

A key assumption in the sustainable development debate is that society will have to change the values that are taken into account when making decisions. "*This includes the ethical and moral codes we adopt, the value we assign to an action and its outcome, and the rewards we seek and award.*" (Du Plessis 2002: 54)

Du Plessis describes the problem that,:

> *"Currently, the value of something, be it a plant, object or person, is measured in monetary terms, as is the means through which people are rewarded. However, we are rediscovering that most things in life that determine quality of life (as opposed to standard of living) have an intrinsic value far greater than their monetary value. This understanding is central to the value system that underlies sustainability. We need to learn the value of the environment and the community also for the non-material wealth they provide."* (2002:55)

Here an important stumbling block to the sustainable development problem presents itself – that of moving people away from using capitalism and financial profit as the prime motivator for their actions. Especially in architecture, where the decision to build is undoubtedly going to cost a large amount of money, how is it possible to motivate for something that is not going to reap a financial return. At the very least, even if the building provides non-material wealth during one term of ownership, it should have a resale value (in monetary terms) which would compensate for the initial resource use.

ENVIRONMENTAL ECONOMICS

Strategies for adopting sustainable development evolve along with an understanding of the broadness of concept. This starts with the idea of meeting humanities needs in a way that can be maintained (sustained). Analysis tools such as Gross Domestic Product (GDP) and the Human Development Index (HDI) are used to assess this sort of development in terms of a national economy. Although there is a criticism of GDP that it fails to take into account environmental and social concerns, "*economic growth remains a fundamental ingredient within development thinking.*" (Elliot 1999:12) However, even while making a distinction between quantitative and qualitative growth, it is clear that, for developing countries at least, quantity is also a vital aspect and will remain so for quite some time.

It can be assumed that humans are not going to stop development in the sense stated above, as it seems integral to the human condition to "try to improve our lot in life." However, a distinction can be made between quantitative and qualitative development. Especially in developing countries, the "*nature of growth is critical to ensuring that the benefits do not fall solely to a minority of the population*". (Elliot 1999:12)

However, Bartelmus argues that improving the environment would be massively and immediately helped by developing the developing countries, that is, eradicating poverty and improving quality of life. "*Improving the quality of human capital through health, information and education policies and programmes has immediate effects on the sustainability of economic growth – provided human capital is a limiting factor of production. Such limitations include not only the quantitative supply of labour but also the skills required for particular production processes and technologies.*" (Bartelmus 1994: 109) This idea will be elaborated on later as it provides a way for the construction industry as a sector of the economy to integrate an element of sustainable development. This explains why sustainable development focuses on more than just the environment. That is, social sustainability can be beneficial to environmental and economic sustainability, and vice versa.

Therefore it is necessary for sustainable development efforts to be more holistic in nature, and take into account economic, environmental and social sustainability if it is to be successful in the long term. Much sustainable development thinking focuses on governmental policy changes and economic mechanisms that are designed to make environmentally sustainable design profitable, and therefore desirable. The problem is that "*Standard economic models do not engage with 'non-economic' categories. The word 'exogenous' is often used in this respect.*"(Clark et al 1995: 9) Therefore a key area has been to introduce measures that force companies to internalise these 'non-economic' categories, such as the natural environment and social welfare concerns, into the economic system.

These 'non-economic' categories include the biosphere as a waste sink for pollution, and its capacity to do so; natural resources that are exploited such as for mining, forestry and fishery. There are also important social systems to take into account, such as community health and safety.

Bartelmus proposes that there is a logical approach to dealing with these external influences. That is to internalise them into the *"price-cost structure"* of the economy through the means of taxes, subsidies and market incentives. This would force the pricing system to be revised in a way which would ensure the reallocation of resources in an optimal way. For example, polluter- and user-pays principles advocate the use of market incentives to internalise environmental costs.

Furthermore, accounting for environmental costs and benefits is a way of quantifying the degree of accountability surrounding these factors. (Bartelmus 1994)

Many efforts have been made to integrate all three of these concerns into the National Accounts of countries in order to better reflect their sustainability, for example the UN's 'System of Integrated Environmental and Economic Accounting'. However, it is clear that all of these efforts have a variety of flaws. These systems attempt to assign a monetary value to non-economic assets, such as natural assets. The advantage of monetary aggregates is that they appeal to policy makers because of the inherent comparative evaluation capability, making the benefits and costs of diverse economic activities directly comparable. (Bartelmus 1994) However, there are many problems associated with assigning a monetary value to factors which are not economic in nature.

Although these new accounting methods are effective in including the natural environment into National Accounts, social aspects are significantly harder to apply a monetary value to. The problem is that "*human 'assets' (beings) are not owned and traded and thus valued in the markets as is the case for produced assets. Investment in human capital is thus not recorded as capital formation, and therefore has a relatively low visibility in categories of consumption expenditure for education or health.*" (Bartelmus 1994: 108) However, "*in the face of widespread failures of national and international development strategies, human resource development has now become the latest battle-cry of growth based development.*" (Bartelmus 1994: 108)

CHAPTER 2: An Architectural Response

> *"Sustainable development concepts, applied to the design, construction, operation of buildings, can enhance both the economic well-being and environmental health of communities." (US Green Building Council 1996:14)*

To understand the mechanisms that are needed within the construction industry, it is necessary to understand what actions are hoped for – the intention is to make buildings which are less environmentally damaging, more socially inclusive, and yet still economically profitable. Less environmentally damaging buildings will use less energy, get their energy from renewable sources, pollute less or recycle their pollution.

The construction industry is, by definition, integrally involved in development, and so therefore it should be integrally involved in sustainable development. This is best done by analysing the objectives of sustainable development and relating these to similar aspects of architecture and construction.

> *"The simplest point at which to begin evaluating the impact of the construction industry is to look at its consumption of energy and greenhouse gas emissions." (Du Plessis 2002: 13)*

The biggest culprits in terms of climate change are the materials that form the basis of modern construction – concrete and steel. Twice as much concrete is used in formal construction around the world than the total of all other building materials – including wood, steel plastic and aluminium. Cement production is, after the burning of fossil fuels, the biggest anthropogenic contributor to greenhouse gas emissions. Construction activities, whether through the manufacturing of construction materials, or through the operational activities of actual construction, also lead to a number of other environmental problems. These include noise pollution, dust, and hazardous contamination through toxic waste. (Du Plessis 2002)

Thus it is clear that the construction industry is a contributing cause to the problem of sustainable development, in particular to the environmental issues involved, however there are other issues such as social and economic factors that need to be examined.

Those dealing with the social side of sustainable development in the construction industry in the developing world tend to focus their efforts toward the alleviation of poverty and its associated symptoms. The economic side of sustainable development has two different faces: those trying to use economics (both traditional capitalist and with new methods) as a catalyst for large scale adoption of environmentally sustainable development; and those trying to change the (economic) value-systems that drive our decision making.

There are three ways to introduce environmentally sustainable concerns into building design and construction. The easiest method is to introduce technologies which have been shown to use less resources or energy, and which are available at a better price. These will have obvious advantages for a client's financial concerns as well as benefiting the natural environment. The requirement however, is that the skills, resources and technology have to be available, and this is often not the case for new technologies in the developing world.

The second option is to take a long term view of the building investment. In this view, environmental technologies which cost more at the time of construction but pay themselves off with lower running costs, can now be seen in a more positive light.

Finally, there are options which, although they have environmental advantages, are more expensive even when considered over the long term. These measures can only be introduced in one of two ways. Either clients need to fully integrate sustainability priorities into their objectives, or they need to be forced to do so by government regulations and charges.

The obstacles to the adoption of green building measures include *"general confusion as to what the measures entail, how to select high-environmental-performance products, and what overall economic and associated benefits can result."* (US Green Building Council 1996:15) Obviously educating both the design team and the client are central to overcoming these obstacles, because there is already a large body of research on the above topics. The problem appears to be that there are not enough

local examples which prove the literature. Thus a typically client does not want to risk his investment on something which appears to be experimental.

ENVIRONMENTAL AND DEVELOPMENT ISSUES

Developing countries often have infrastructural problems which is why so much development money is spent on it. (See for example, the effort that is being put into building roads, electricity and services and generally upgrading the infrastructure in the Cato Manor development, which is seen as an important first step to redevelopment.) Sustainable development concepts such as self-sufficiency would reduce the need to provide the services. This sounds like a harsh idea, which may be why there seems to be suspicion between developing and developed countries. This suspicion can be seen in Schmidheiny (from the North) describing how *"technology transfer is often seen a euphemism for the transfer of capital"* (1992:118) or du Plessis (from the South) describing that *"There is skepticism about the ability of the West to provide the real solutions to problems that were essentially created by their development model."*

"The first set of tensions [surrounding sustainable development] is mainly between the concerns of the North and those of the South, and is expressed in terms of the Brown and Green Agendas." (Du Plessis 2002:9) The key differences between these two approaches to sustainable development are highlighted in Figure 1. The Green agenda highlights the damage being done to the environment, and attempts to counteract this through efficient resource use. The Brown agenda is a more social concern. It acknowledges that the environment is critical to development and human well-being, but only as part of a framework involving social, environmental and economic concerns.

	BROWN	**GREEN**
Key Concern	Human well-being	Ecosystemic well-being
Timeframe	Immediate	Delayed
Scale	Local	Local to global
Concern about	Low income groups	Future generations
View of Nature	Manipulate and use	Protect and work with
Environmental services	Provide more	Use less

Fig. 1. Comparison between Brown and Green Agendas (Du Plessis 2002:9)

The issue is that the brown view has more immediate and pressing problems, but if they ignore the holistic side of it, which includes concerns for the natural environment, then they'll have to spend more later on solving those environmental problems that they've now created.

This unfortunately becomes a political issue. The environmental problems being faced today are of a global nature, and why should the North spend time and money on solving a global problem while the South deals with its own additional set of problems. The thing is, although the South does have these immediate problems to deal with, there is also a more formal side to the construction industry in these countries, which is able to bypass sustainable development regulations and goals because government is more focused on the "Brown" issues.

ARCHITECTURAL ASSESSMENT TOOLS AND THEIR WORTH.

There are a number of sustainable building assessment tools which have been developed. These tools help architects and developers throughout the design process to make and assess their decisions. These assessment programs also have the advantage of certifying the sustainability of a project, which can enhance the reputation of both the architect and the developer.

In the United Kingdom there is the BRE Environmental Assessment Tool (called BREEAM)

BREEAM offers the following benefits

- *"developers can improve sales by promoting the high environmental performance of their buildings*
- *designers can demonstrate the environmental achievements of their work*
- *landlords can audit the property from an environmental point of view*
- *managers can reassure employees that the working environment is healthy and of high quality."* (Edwards 1998:14)

The BRE have also developed the BRE toolkit, which is used by the facilities managers and building users once the building has been completed. This ensures that technologies employed in the design and construction of the building are carried through into its use, but also focus on ways which the company runs itself, such as

paper use and waste management, as well as indirect environmental impacts, such as commuting and internal air quality. (Edwards 1998:15)

The CSIR in South Africa has developed the Sustainable Building Assessment Tool (SBAT). While not specifying the techniques and technologies to be used, it does specify a number of performance based objectives which can guide a design and be used to assess its performance once complete. The SBAT system divides criteria into social, economic and environmental criteria.

Under social concerns there are objectives which apply specifically to the South African developing world context, and as such focus on empowering the community, and ensuring that the profits of development benefit the surrounding community as well as the developers themselves.

The criteria that SBAT chooses as important to social sustainability are:

Occupant Comfort
Inclusive Environments
Access to Facilities
Participation and Control
Education, Health and Safety (Gibberd 2004: 9)

Occupant comfort and health is directly affected by the building. This is the subject of much technical research, particularly from developed countries, and is one of the most obvious ways to make sustainable development desirable to the client. Improved health and comfort has been shown to increase productivity and worker satisfaction. Issues such as indoor air quality; views out; natural ventilation; thermal comfort; and occupants' perceived control over their environment all contribute to occupant comfort and health.

Designing inclusive environments ensures a *"loose fit"* for a building, meaning that *"replications are avoided and change of use is supported."* (Gibberd 2004:9) This has a dual advantage of being socially inclusive, but also ensures the long term economic viability of a scheme, as it will be easier to sell, or re-lease, in the future.

The concept of "Access to Facilities" is perhaps most closely allied to the Agenda 21 objective of promoting sustainable land-use planning and management, as well as the urban design concepts surrounding compact city development. That is,

encouraging mixed-use development of a fine-grained nature can reduce a reliance on highly polluting automobile use.

"Participation and Control", particularly in the design phase, creates a sense of ownership for a building. As the example of the Addison Longman Wesley building shows later, this can once again improve user productivity and satisfaction. Local control over their environment by the user is often a sought after product of green design, as opposed to a typical closed-system air-conditioned building, although its implementation can cause complications and extra complexity to the environmental control system of a building.

"Education, Health and Safety" fits into the third category of implementation measures listed above in that it will be difficult to motivate for in terms of financial profit or lower cost. As such, it becomes the responsibility of government regulations to enforce in order to benefit the wider population.

The Sustainable Building Assessment Tool's economic criteria are

Local Economy
Efficiency of Use
Adaptability and Flexibility
Ongoing Costs
Capital Costs (Gibberd 2004:10)

An interest in the local economy is critical to the growth of developing countries. Gibberd states that: *"the construction and management of buildings can have a major impact on the economy of an area [which] can be stimulated and sustained by buildings that make use and develop local skills and resources."* (2004:9-10) Using local resources can save on financially and environmentally costly transportation of those resources and also contribute to the "genius loci" of the building, connecting it symbolically to its context.

Efficient use of buildings supports sustainability in that buildings cost money and consume resources whether they are in use or not. Thus, a building which is constantly in use, or used to its maximum potential, is more efficient, and more sustainable, than one which is only partly occupied, or only occupied at certain times. This supports the idea of mixed-use development in order to make fuller diurnal use of a building.

Adaptability and flexibility is a related idea. A building is designed for a certain use, but once that use is no longer needed the building needs to be either decommissioned in some way, or adapted to a new use. Designing the building so that the possibility of adaptation at a later date is easier and will require the least alteration supports sustainability objectives *"by reducing the requirement for physical adaptation and associated disruption, energy consumption and cost as well as the need for new buildings"* (Gibberd 2004:10) In economic terms, the building will be easier to sell once the original owner no longer has a use for it if it is suitable for a variety of different uses rather than solely for its original intended purpose.

A focus on reducing the ongoing running costs of a building is self-explanatory in its advantage to the economic sustainability of a building. This can be achieved by using environmental methods of building design such as passive solar design to minimize the need for air-conditioning. However, achieving lower ongoing costs may require a higher initial cost, and so an analysis of the savings which can be achieved in the long term by spending more on the initial construction of a building must be conducted.

Especially in developing countries, where financial capital is desperately needed for other activities, the initial capital cost of a building is an important consideration. Although it was noted in the previous paragraph that a long-term view of a building's life will show that higher initial cost can achieve a more economical building in the long-term, that higher initial cost is often unavailable, and so a building must, out of necessity, be designed and constructed in as economical a way as possible. This does not negate the opportunity for a sustainable approach to construction, as many environmentally sustainable building methods cost little or no more than conventional building approaches.

For environmental criteria, SBAT chooses the following:

Water
Energy
Location
Waste
Site
Materials and Components (Gibberd 2004:10 -11)

Environmental criteria are the most often cited characteristics of sustainable design, and so there are many different options as to the approach to be taken to maximize environmental sustainability.

Gibberd notes that, *"the large-scale of provision of conventional water supply has many environmental implications."* (2004:10) These implications include the energy consumed through the purification of water, the environmental impacts associated with the construction of large dams, and the infrastructural requirements of transporting this municipal water supply to individual homes and businesses. Although cheap access to water is almost always supplied by governments, this requires massive investment. As water supplies become scarcer it cannot be assumed that this discounted value will continue to apply. The low economic value applied to water is akin to that of other natural capital. That is, if water were to be subject to the same economic pressures as the rest of the economy then it would be significantly more expensive. Water is also a vital part of the natural ecosystem, and the disruption of water as it travels through the water-cycle can cause damage to the surrounding natural environment.

There are a number of ways in which energy consumption can be addressed. *"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."* (Gibberd 2004:11) Therefore using less energy or using energy from renewable sources can make a significant contribution to the overall sustainability of a building. The various kinds of energy that are associated with building construction and operation are discussed in more detail later in the chapter on "Technologies".

Location is closely related to energy use in both the construction and operation of a building. During construction, the location of a building, and more importantly, the location of the materials used in construction, contributes to transport energy that is consumed. Thus, sourcing materials from nearby to the site can result in significant energy savings. In terms of the operation of a building, being located closer to worker populations will reduce the transport energy, and associated pollution, consumed as workers commute daily.

"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." (Gibberd 2004:11) Reducing waste will reduce the load on environmentally damaging landfills, as well as reducing the quantity of resources consumed. This is can be achieved both in the construction and the operation of a building. This is achieved by using resources efficiently the first time around, and also by reducing waste by recycling or reuse. There are often favourable economic advantages to this. For example, reducing construction waste will result in less material being bought and lower cost in disposing of the waste that is produced.

A building's use of its site impacts on the natural ecosystem that would otherwise occupy the space. Gibberd states that, *"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"* (2004:11) Incorporating aspects of natural ecosystems can also have a positive effect on the users' perception of, and connection with, their environment. This can improve occupant productivity and contentment, further improving the buildings economic viability.

Finally, materials and components need to be carefully chosen. Factors which need to be considered are the energy required to produce the material, and to incorporate it into the building fabric, thus effecting the energy consumption of a construction project. Materials may also emit harmful chemicals or odours, for example "volatile organic compounds", which can adversely affect the health of building users. Also, choosing components which are manufactured precisely and merely need to be assembled on site can greatly reduce the amount of construction waste involved.

GOVERNMENT INTERVENTIONS

Governments are in a key position to initiate sustainable development. However, *"given that production and pollution are influenced by the daily patterns of billions of people, sustainable development cannot be secured efficiently by government decisions alone. Governments should instead provide the framework in which it can happen."* (Schmidheiny 1992:14)

A top-down approach to implementation suggests that governments would agree on sustainability targets from international conferences and then implement policies which would make their citizens change their behaviours in a similar way.

These types of policies are the best way in which to adopt those measures which cannot be shown to be beneficial to the developer, but rather will only be beneficial to society at large. Governments have a number of options available to them for this type of coercion. They include "command and control mechanisms", "economic instruments" and encouraging self-regulation by corporations or sectors of industry. (Schmidheiny 1992:19)

There are a variety of tools which governments can use to force companies and individuals to internalise these costs. 'Command and control' measures include taxes and charges which force companies to meet certain standards or pay higher taxes. 'Economic mechanisms' are generally incentives to move away from unsustainable practices. For example, making unleaded petrol cheaper than leaded petrol encourages the consumer to upgrade their cars to ones which are more environmentally friendly. (Schmidheiny 1992:19)

Governments also have the ability, through the above mechanisms to ensure the correct prices of resources. This goes back to the idea of "externalities" raised earlier, as well as theoretical ideas such as "full cost pricing", which is the basis for internalizing these externalities.

However, all of these are mechanisms that are initiated by government in order to change the behaviours of corporations and consumers. Bottom-up initiatives are those which start from the consumers and corporations themselves.

Bartelmus adds that the analysis of development needs to be changed, by the introduction of standards and targets, from the focus on maintaining capital in economic growth to a focus on examining development programmes in terms of their compliance with minimum desirable standards of living and maximum standards of natural resource consumption and allowable environmental degradation. (Bartelmus 1994)

However, most of the above strategies deal with macro-level economic behaviour, the micro-level also needs to be addressed. "*The market-driven sector is likely to continue ignoring socio-economic and biophysical considerations unless there is a significant change in legislation/ incentives and the capacity of governments to implement them.*" (Du Plessis 2002: 25)

Edwards (1998) suggests that even with the current "*traditional*" economic system, buildings designed with the environment benefit the user and client in a number of ways. As a selling point for developers, corporate tenants in office buildings are beginning to see a "*green*" building as good for the corporate image, and therefore command higher prices. Or that the increased user health that is promoted by using less toxic materials and natural ventilation increases productivity and decreases absenteeism, which obviously improves profits.

It has been recognised that building projects must be undertaken with due care for the building user as well as for the surrounding community. Therefore most governments have introduced building regulations that set out minimum standards for structural stability, fire resistance, supply of clean water and evacuation of wastes. (Cole and Lorch 2003:141)

Some governments prefer a more *laissez-faire* approach to policymaking, in which regulations are kept to a minimum which just covers the health and safety of users and the surrounding public, in the belief that other factors will be self-regulated by the market. Should something go wrong in this situation, there is legal recourse to rectify the situation.

On the other hand, governments which prefer a stricter approach believe that due to the complex nature of a building project, the client or developer is not likely to have the requisite expertise to make informed decisions, (Cole and Lorch 2003:142) as such these governments attempt to regulate as much of the building as possible to ensure the best possible product. An example of this is the increasingly complex building regulations in the United Kingdom which specify performance objectives for everything from disabled access to thermal performance.

In the South African context, the SABS 0400-1990 defines the government's intentions with regard to building regulations:

"*The National Building Regulations ... set out, in the simplest and shortest way possible, requirements to ensure that buildings will be designed and built in such a way that persons may live and work in a healthy and safe environment.*" (1990:3)

The National Building Regulations also state that their aim is to keep the number of regulations as small as possible, and in this regard the regulations are concerned

only with the health and safety of people in a building. The intention being that this would assist rather than impede innovation in building systems and designs. (SABS 0400-1990)

MOTIVATING THE ARCHITECT

Moving from a conventional mode of business to one which is guided by the objectives of sustainability is an important move for architects to make, but one which has a number of difficulties associated. However, as Edwards notes, this move "*will keep the practice at the leading edge, which may attract further work as well as exposure in journals.*" (1998:38.) To be at this leading edge will require constant attention. To achieve this competitive edge architects need to offer "*differentiated, value-creating new products*" (Cole and Lorch 2003:133) and continuously utilise and develop best-practice examples.

It may be said that any environmental or social targets for a project would be set by the client. However, clients and developers may be ignorant as to the possibilities available and so it is the architect's duty to inform and educate them. For a successful green building, the client must be willing to invest his money in new unfamiliar technology, aim for higher standards than regulations require, and take a longer term view of the building investment. (Edwards 1998: 34)

Sustainable development, especially in South Africa, suffers from a lack of performance standards and benchmarks, as well as a lack of well known exemplar projects. This lack of precedent and government guidance will result in the need for more time to design, which is clearly a problem in an era of competitive fee scales. (Edwards 1998:35) Also implied from the lack of local precedent is that designs are of a prototype nature, in that they attempt to find new solutions to traditional design problems. There is clearly a risk attached to this, but it can be minimized in a number of ways.

Firstly, architects no longer work in isolation as designers but as part of a team of professionals. This has the effect of spreading the responsibility, but also of enhance the base of expertise on which the design team can draw.

Secondly, a project of this nature will require, or at least be greatly helped by, the participation of stakeholders in the design process. Cole and Lorch note that "*customer-supplier*" relationships are moving away from "*traditional design-bid-build*

practice into more open, trusting, risk sharing relationships of joint ventures, alliances or partnerships." (2003: 133) Aside from achieving a higher standard of design, Edwards believes that this enhances the "*forgiveness factor*" of these stakeholders if the building fails to perform exactly as expected. (1998:51)

A client will require "*measurable benefits*" (Edwards 1998:38) from an increased focus on sustainable development. However, these benefits need not only be financial. Aspects such as increased health, comfort and productivity all contribute to the attractiveness of a design solution.

An important factor to consider in the design and construction of office buildings is the changing nature of office behaviours and client preferences. Brendan O'Niell states that "*2 principal issues arising as a reaction against the deep-plan, anonymous floorplates typical of speculative offices have been their lack of a framework, from which the social structure of the organization could develop, and the impact of environmental systems on occupants' physical well-being and productivity.*" (AJ 1996:29)

MOTIVATING THE CLIENT

At the beginning of this project I set out an objective to find means with which to convince clients to integrate the objectives of sustainable development into their objectives when defining the brief and commissioning a new building.

Firstly, defining what the client's objectives are will depend on what kind of building they need. In this respect, client's can be divided up into 3 categories:

1. Domestic
2. Corporate
3. Institutional

This paper is primarily interested in clients of a corporate nature, although many of the points raised will overlap into different categories.

To create a sustainable building it is first necessary to educate the client on the opportunities and possibilities, and advantages and disadvantages of sustainable architecture.

According to a study by the US Green Building Council, "*several parties-including owners, tenants, and the general public – bear the cost of building construction. The*

main direct cost expenditures fall within the categories of building construction, renovation, operation, and building-related infrastructure. Indirect cost expenditures stem from building-related occupant health and productivity problems as well as external costs such as air and water pollution, waste generation, and habitat destruction." (US Green Building Council 1996:14) Thus, in order to design a building that is economically viable in the long term, those who are paying for the building need to consider more than just the initial construction cost of the design. The study goes on to qualify this by stating that, *"viewed over a 30-year period, initial building costs account for approximately just two percent of the total, while operations and maintenance costs equal six percent, and personnel costs equal 92 percent."* (US Green Building Council 1996:14) This can be proven by using life-cycle cost analysis, which reveals that low up-front expenditures, though easier to finance at building inception, can result in much higher costs over the life of a building.

Clients of architecture are primarily concerned with gaining "*value*" from their new acquisition. This value can be achieved through a "*reasonable balance between capital costs and running costs, while also achieving high performance and functionality.*" (Cole and Lorch 2003:138) In these financial terms, sustainable buildings are advantageous in drastically reducing running costs through savings in energy bills. That is, although many features of green design will add to the initial cost of a building, Edwards notes that: "*the extra construction costs are retrieved through reduced running costs within the first 8 to 10 years.*" (1998:2) The US Green Building Council reiterates this view by stating that, *"returns on investment for energy-efficiency measures can be higher than rates of return on conventional and even high-yield investments."* (US Green Building Council 1996:18)

However, not all the benefits of sustainable design are financial. A "*green*" building can enhance the corporate image of a company by demonstrating an environmental awareness and interest on the part of the company. Also, "*green*" buildings often have striking visual features that make the building stand out from its neighbours, thereby further showing off the building. (Edwards 1998: 6 and 26)

Another critical advantage to environmentally conscious design is that the buildings are healthier to use. Natural ventilation; natural sources of light; less toxic, more organic materials and finishes and a sense of connection with nature through views outside and breezes from openable windows all make the building a healthier place to inhabit. In an office this has the effect of reducing illness and absenteeism, which

in turn improves productivity and allows for a better continuity of work. (Edwards 1998: 6)

In the business world, a concept has been evolving called "corporate social responsibility" (hereafter CSR). The World Business Council for Sustainable Development defined CSR as *"the commitment of business to contribute to sustainable economic development, working with employees, their families, the local community and society at large to improve their quality of life."* (Harrison *et al* 2004:41) It reflects a progression in corporate responsibility to include not only a narrow set of stakeholders which are typically financially motivated, to a wider set of stakeholder groups. Harrison *et al* define the stakeholder groups as including "*external parties such as governments, customer groups, the investment community, local community and civil society groups. Internal stakeholders are typically those directly connected to the company as contractors, suppliers, employees, unions and non-executive board members."* (Harrison *et al* 2004:41)

In terms of the built environment of the corporate world, it is now believed that, *"to be effective in the longer term, workplaces must contribute to the health and well-being not only of the organization but of its staff, its business colleagues (clients, suppliers and business partners) and the wider economic and social environment."* (Harrison *et al* 2004:40)

A number of factors have been driving this shift in corporate mentality. External factors include an increasing demand for transparency and accountability of corporate affairs. This has led to mandatory corporate reporting of their activities. Stakeholders' expectations regarding products and services are also increasing, and many industry sectors are adopting voluntary self-regulation plans in order to pre-empt government regulation. Influencing factors originating internally from within corporations include the desire to attract and retain staff, enabling a company to be an employer of choice; maintaining staff morale; managing staff diversity to reflect the markets in which the company operates and enhancing brand and corporate reputation; and improving relations with stakeholders. (Harrison *et al* 2004:41-42)

Harrison notes three trends that appear to have brought about this change about. Firstly there is an increasing empowerment of employees due to *"increased mobility, independence, and a redefinition of value from skills to knowledge."* Second is a growing ethical awareness amongst customers who are recognizing the value of their

purchasing power. Thus they are demanding a greater level of accountability from companies. Finally, *"the interventionist state is in retreat and rather than abandon the social objectives and goods that it previously guaranteed, it is increasingly relying on corporations to fill the vacuum – a form of back door privatization."* (Harrison *et al* 2004:121-122)

Although there is an apparent conflict between the responsibility of publicly-traded organizations to produce profits for shareholders, and to observe these wider obligations it is perceived to provide benefits such as value creation through enhanced reputation, brand strengthening, retaining employees, and attracting investment from ethical funds and other socially responsible investment. CSR also protects against value erosion resulting from community action, adverse publicity and liability arising from business practices. (Harrison *et al* 2004)

To improve a companies brand and corporate image requires the advertising of their activities to the wider public. In this regard "triple bottom line accounting" is gaining credibility. The purpose is to show that a company is multifaceted, and in order to present a coherent, full profile it is necessary to describe the social and environmental performance of a business in addition to its financial performance. Thus corporations no longer simply report their financial position, but have increased their reporting to include non-core business activities, that is, those activities that are implemented to *"demonstrate their commitment to sustainability and a more transparent relationship with stakeholders."* (Harrsion *et al* 2004:42)

The World Business Council for Sustainable Development defines triple bottom line accounting as follows: *"Sustainable development involves the simultaneous pursuit of economic prosperity, environmental quality, and social equity. Companies aiming for sustainability need to perform not against a single, financial bottom line, but against this triple bottom line."* (Gissen 2002:185)

Practical measures have been developed for the implementation of quantitative triple bottom line accounting. These include "Economic value added", which is a *"measurement technique developed asses whether companies are adding or destroying value. The company profits are adjusted for the cost of capital employed, and a linked concept Market Value Added (MVA) calculates how much value has been created since the company was founded."* "Environmental value added" is an adjustment to this which subtracts allowances for the amount of natural capital used

(renewable resources), as well for the non-renewable resources that have been consumed, and the one-off benefit derived from that resource. "Social value added" accounts for the knowledge and skills which have been developed or lost. (Harrsion *et al* 2004:42)

To help in implementing these ideas, a number of guidelines, initiatives and principles have been published. For example "The Global Reporting Initiative" is a voluntary international standard for organizations to report environmental, social and economic issues related to their activities products and services. The main emphasis is to raise sustainability issues to a level equivalent to financial reporting by developing a generally accepted reporting framework, based on reporting principles, characteristics and indicators. It provides specific indicators and an overall reporting structure that is interdependent with stakeholder engagement. (Harrsion *et al* 2004:167) The "Principles for Global Corporate Responsibility: Benchmarks for Measuring Business Performance" is a standard which contains approximately 60 principles and benchmarks with which stakeholders can evaluate corporate codes of conduct, policies and practices related to corporate social responsibility expectations. (Harrsion *et al* 2004:168)

ACQUIRING KNOWLEDGE

Although there is a large body of literature on methods of environmental design, this is only the first step to tacit knowledge on the subject. Cole and Lorch describe information as the raw data which can be stored. Tacit knowledge on the other hand is the more practical know-how, which is "*acquired through practice, and its transfer requires person to person contact.*" (2003:2)

In a globalised environment it must be remembered that all of this information comes a specific place, with a specific climate, culture and economy. Any information on the implementation of sustainable development must therefore be critically analysed and adapted to the local context.

CHAPTER 3: Technologies

It is of course, up to the architect to devise practical measures with which to implement the goals stated in the previous chapters. The process required to achieve this is first to examine the principles of sustainable development, and then analyse each step of the design process, and the final building product, to find methods of implementation. Although it is not within the scope of this project to compile a "design guide" for the architect, it is useful to understand the broad concepts of sustainable environmental design. So if we now understand that sustainable development is advantageous for a number of reasons, it is necessary to have practical ways of achieving it. It is worth noting that, *"strategies that have been considered "cutting-edge" in the recent past – such as passive solar design, environmentally sensitive design, and design that emphasizes indoor environmental quality – are now becoming prominent and economically feasible."* (US Green Building Council 1996:86)

A basic tenet of practising environmentally sustainable development is resource efficiency. Categorizations of resources overlap in a number of cases, such as embodied energy and material resources. What all these categorizations do however, is provide a list of factors which need to be incorporated into the design and functioning of a building. Firstly resources can be divided into those that provide, and those that act as "sinks" for waste. A further categorization breaks this group up into renewable and non-renewable resources. Non-renewable resources are seen as those which will not renew themselves in the foreseeable future are compared with renewable resources which can be managed so that the amount used is equal to, or less, than the amount of that resource which can be produced.

Lovins divides resources (which he refers to as *"capital"*) into manufactured capital, natural capital, social capital, and financial capital. (Lovins et al 1999) They claim that all versions of capital need to be taken into account in order to achieve the best real productivity.

The resources used can be (somewhat artificially) broken up into energy, water, material resources and biodiversity. These categories then need to be analysed throughout the design process in order to achieve maximum environmental sustainability.

ENERGY

Namibian architect Nina Maritz divides energy use into a number of different types, as shown in table 1.

Type of Energy	**Use of Energy**
Embodied Energy	Manufacture of building materials, components and systems.
Grey Energy	Distribution and transportation of materials.
Induced Energy	Consumed during construction
Operating Energy	Used to run the building and the equipment housed inside
Added Energy	Building maintenance, alteration and final disposal

Fig. 2 Classification of energy types
(Adapted from Maritz 2005:8)

Examining each of these types of energy during the design phase of a project can provide means of reducing the use of these types of energy. For example, choosing materials which do not require much processing in their manufacture would reduce embodied energy, as would re-using materials found on the site. Sourcing materials from close to the site of construction, or even using materials that are found on site, reduces the need for transportation energy to be consumed. Operating energy is of particular concern to the designer, and can be reduced by a number of methods such as passive solar design to reduce HVAC energy use, or by incorporating natural lighting through building design in order to reduce the need for artificial lighting. Added Energy is also critical to consider during the design phase and can be reduced through designing in flexibility or adaptability of function, as well as considering the eventual recycling or decommissioning of the building.

Passive solar design is the most common approach to reducing the energy consumption of a building. The US Green Building Council defines it as, *"a broad term used to encompass a wide range of strategies and options resulting in energy-efficiency building design and increased occupant comfort. The concept emphasizes the architectural design approaches that minimize building energy consumption by integrating conventional energy-efficient devices, such as mechanical and electrical pumps, fans, lighting fixtures, and other equipment, with passive design elements, such as building siting, an efficient envelope, appropriate amounts of fenestration, increased daylighting design, and thermal mass."* (US Green Building Council 1996:87) The basic idea is to allow daylight, heat, and airflow into a building only when beneficial. The objectives are to control the entrance of sunlight and air flows into the building at appropriate times and to store and distribute the heat and cool air so it is available when needed. Many passive solar design options can be achieved at little or no additional cost. Others are economically viable over a building's life-cycle.

Areas which need to be considered with respect to passive solar design include thermal protection; the sizing and orientation of windows; maximizing daylighting while still controlling solar heat gain. Heat gain from internal sources also needs to be factored while considering passive solar heating and passive cooling with natural ventilation. (US Green Building Council 1996:89)

Practical strategies for maximizing daylighting efficiency include maintaining a favourable room aspect ratio, that is, the ratio of ceiling height and window height to

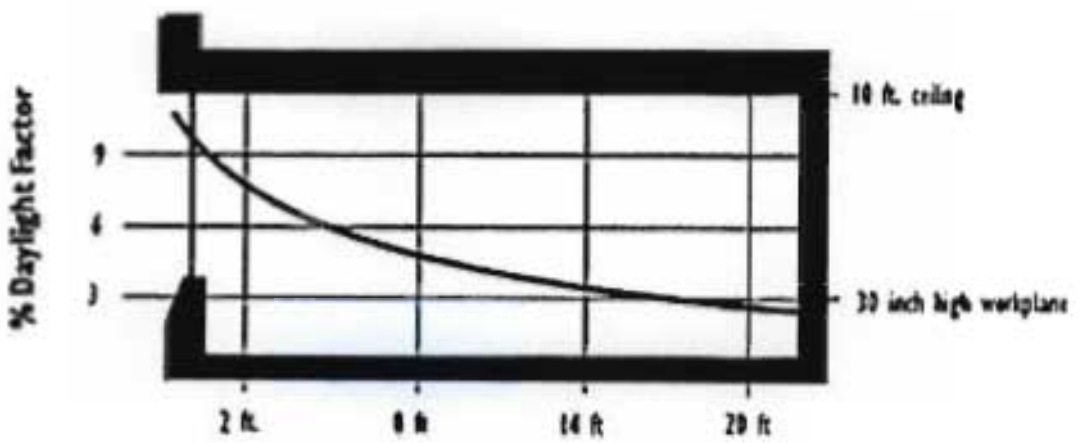

Fig. 3 Illumination relative to distance into room from window
(US Green Building Council 1996:95)

the depth of the room from the windows. Establishing an appropriate building footprint to allow for sufficient lighting, for example, Frank Lloyd Wright prescribed the ideal width of a wing for daylighting as 13 meters. Sloped or curved ceiling planes, especially in conjunction to light shelves on the windows, and optimized overhangs based on window height and latitude will also all improve daylighting. (US Green Building Council 1996:96-102)

WATER

In terms of sustainability, water is important first because it is a finite resource that is being used up and secondly because "[It] *requires energy to be processed into clean drinking water and to be pumped uphill.*" (Maritz 2005:8) The US Green Building Council states that, *"since 1980, global water use has more than tripled and is currently estimated at 4,340 cubic kilometers per year."* (1996:58) Thus minimizing the use of water, especially potable water which has already been through the energy-intensive process of purification is important, as is minimizing the amount and intensity of polluted water that is returned back into the natural environment.

There is also the aspect of a building affecting the path of water from its natural course through the water cycle. In this respect, *"Every building site is in a watershed, and everything people do on a site has an impact on the watershed's condition."* (US Green Building Council 1996:53) For example, sediment from soil disturbance, oil leaks, and fertilizers all pollute streams; excessive runoff aggravates flooding and erosion; and deflection of rainwater from its natural path dries out streams and wetlands in summer. However in a protected watershed, or where the architect makes the effort to counteract these defects, soils can absorb rain and make it part of the ecosystem; pollutants can be transformed as they filter through porous, humus-rich soil; and soil moisture can percolate to the groundwater, which drains slowly out to streams long after the rain has fallen.

The architect has a number of areas in which to examine water use. For example, the production of materials such as aluminium and concrete require a lot of water; sanitary fittings such as sinks, basins and showers create grey water as effluent; toilets are flushed with clean water, but create black water as sewerage. In addition buildings require water to clean them during maintenance and rainwater is channelled off roofs into the storm-water system, and thus does not replenish ground water. (Maritz 2005:9)

So in order to minimize the use of this resource the architect can do a number of different things. Rainwater can be harvested and used. The quality of the rainwater must be considered, as rainwater in urban areas may already be quite badly polluted and thus only suitable for irrigation or for non-potable purposes. However, rainwater in rural areas, or where the quality of rainwater is pure enough, it may be suitable for potable use after filtration or treating. Planting of native or well-adapted plant species can use less water than exotic plants, and preserving existing native plant populations on the site can help in filtering run-off water into the water table and groundwater. (US Green Building Council 1996: 53 – 58)

In terms of water that is used in the building the objective is first to reduce overall water use. Following this, dual plumbing lines installed in building interiors can divide grey- and black-water for separate treatment. Grey-water can be reused for non-potable purposes such as irrigation and toilet flushing. When possible, black-water should be treated on-site, in order to minimize the load on municipal sewerage systems, and the effluent can be applied to gardens. Black-water reuse does however require that site-specific monitoring procedures are implemented to monitor the chemical composition in soils. There are also toilet systems available which minimize water use, or which do not require any water at all for their flushing, and instead rely merely on air to decompose sewerage into a non-volatile substance which can then be used as fertilizer on gardens. However, it must be remembered that all of these systems require extra maintenance than the conventional water and sewerage system of a building.

MATERIAL RESOURCES

> *"Materials are renewable or non-renewable – they can either be replenished through natural processes (such as timber), or they are finite resources such as mined minerals."* (Maritz 2005:10)

An architect can limit the use of non-renewable resources to a minimum in building design, trying instead to use renewable resources. However, even materials that are generically renewable, can be harvested in non-sustainable ways, and are therefore not sustainable. For example, tropical hardwoods that are harvested from old-growth forests which destroys those ecosystems, rather than from managed plantations. Thus Maritz argues that *"the damage to the environment when extracting a resource is also a factor."* (Maritz 2005:10)

A practical method for evaluating material resource use can be found in the concepts of *Life-cycle assessment (LCA)* and *life-cycle-costing (LCC)*. Life-cycle assessment is a concept *"based on the belief that all stages in the life of a material generate environmental impacts and must therefore be analysed, including raw materials extraction and processing, intermediate materials manufacture, material manufacture, installation, operation and maintenance, and ultimately recycling and waste management."* (US Green Building Council 1996:26)

There is a five step process involved in this method. The first step is goal identification and scooping in order to define boundaries for the assessment. Next, an inventory analysis step identifies and quantifies environmental inputs and outputs of a specific material over its entire life-cycle, from raw material extraction to its eventual disposal or recycling. Third is an impact assessment which characterizes these inputs in relation to a set of environmental impacts, for example, relating carbon dioxide emissions to global warming. These environmental impacts then have to be synthesized with stakeholder values, in order to make value judgments as to which are most critical. Finally, an improvement assessment identifies and evaluates ways for making changes in the product life cycle which can improve its cradle-to-grave environmental performance. (US Green Building Council 1996:26 - 28)

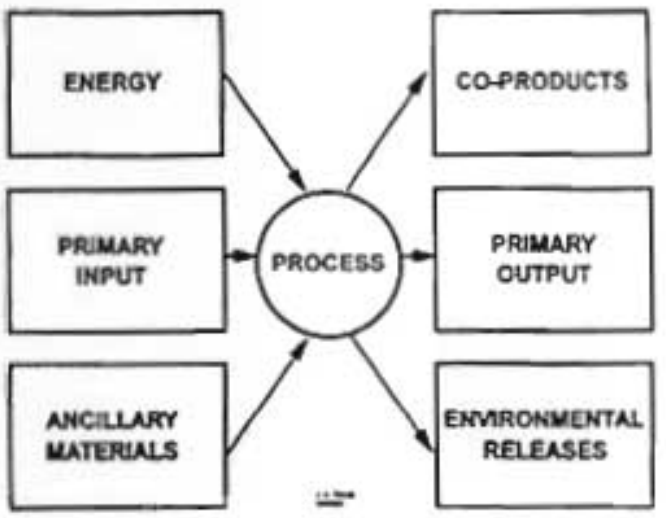

Fig. 4 Framework for Input-Output Analysis
(US Green Building Council 1996:171)

Life-cycle-costing measures a material's economic performance throughout the material's association with the building. That is, *"the life-cycle-cost method includes the costs over a given study period of initial investment (less resale or salvage value), replacements, operations, maintenance and repair, and disposal."* (US Green Building Council 1996:29) It is important to differentiate between LCA and LCC concepts. The environmental life cycle of a building begins with raw materials extraction and ends with recycling, reuse, or disposal of the material. The building life cycle of a building material begins with its installation in the building and lasts for the

duration of the LCC study period, which is determined in part by the useful life of the material and in part by the time horizon of the investor. Finally then, the environmental and economic performance must be balanced, and a value judgment made as to the best choice for the specific application.

LIFE-CYCLE OF A BUILDING

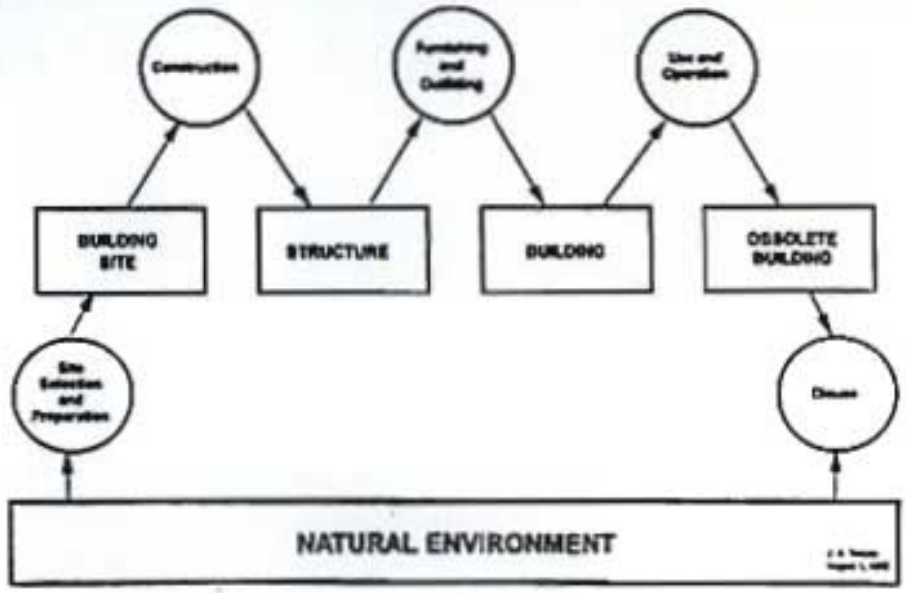

Fig 5. The Life-Cycle of a building
(US Green Building Council 1996:171)

INDOOR ENVIRONMENTAL QUALITY

Improving the quality of the indoor environment of a building is critical to the concept of improving worker productivity through improving the sustainability of a building. Indoor air quality is defined by providing sufficient ventilation to a space, as well as reducing emissions from the materials, people, and equipment that occupy a space. However, *"with potentially hundreds of different contaminants present in indoor air, identifying indoor air quality (IAQ) problems and developing solutions is extremely difficult."* (US Green Building Council 1996:142)

Factors which need to be considered in improving indoor air quality include the building envelope which controls infiltration of outside air and moisture. The ventilation system flushes air through the building, but can also move damaging or toxic chemicals through the building. Maintenance of the building will determine whether dust, molds and bacteria are allowed to build up, and this is also determined by the choice of materials. Finally the number of occupants and the amount of equipment can also contribute to indoor air pollution.

DESIGN PROCESS

In order to factor all of these issues into the design process, the architect needs to consider them from the start. The US Green Building Council provides a practical guideline in its *Sustainable Building Technical Manual: Green Building Design, Construction and Operations*. It states that, *"integrated building design is a cornerstone for developing sustainable buildings, which are efficiently combined systems of coordinated and environmentally sound products, systems, and design elements. Simply adding or overlaying systems will not result in optimal performance or cost savings."* (US Green Building Council 1996:33) Thus it is critical to consider how different environmental measures will interact as a system in the final building.

At the pre-design stage of the design process, a vision statement should be established that embraces sustainable principles and an integrated design approach. From this vision statement, green building goals can be extrapolated, and green design criteria can be established, as well as priorities for the project. At this stage the budget would be established and a "green" team of various consultants assembled. A review of laws and standards as they relate to green design should be undertaken, although it should clearly be an objective to surpass mandatory minimum standards. This is also the time to conduct research into building materials and systems, as well as to select a site.

The design stage would be used to confirm the green design criteria; develop green solutions; test green options; and finally select the most viable one. It is also critical to keep a constant watch over the project budget, although this should take into account life-cycle costing as mentioned earlier. Construction documentation for a sustainable building may be more complex than in a conventional building due to the inclusion of innovative or new materials and systems which are not well known to building contractors.

Once the building has been occupied it is necessary to commission the systems, that is, to test them as well as provide operations and maintenance manuals for building managers and users. Ongoing maintenance will be required to ensure that all the systems continue to work as originally designed, and a post-occupancy evaluation should be conducted to understand any problems with the building that possibly were not envisaged during design.

Although this approach is very useful, and should be incorporated into the design process, it must be noted that it is a "developed" country response to the problem of sustainability. As noted above, the divide between the developed and developing world leaves the South with a whole set of additional factors to take into account. These are primarily social factors related to social equity and the provision of basic resources and opportunities to the entire population.

CHAPTER 3: Precedent

Precedent on the subject of "Promoting Sustainable Development" must focus on more than just "green" buildings. Instead it must look at buildings which are "green", but also show a financial profit, or some other sought after advantage.

The first two are "developed" country examples. They illustrate office buildings which improve productivity through happier workers, this is a byproduct of a number of environmental technologies, such as natural light and ventilation and passive climatic building forms, as well as from end-user participation in the design process. They also show the North's environmental focus which tends to leave out developing the surrounding community as an objective as is done in the South. The final example is the Habitat Research and Development Centre in Windhoek by architect Nina Maritz. It is not a commercial venture like the previous examples, and so as more room to experiment with innovative materials and devices.

Fig. 6 Overall view of NMB Bank Headquarters
(Vale & Vale 1991:54)

NMB AMSTERDAM

The brief called for a building that would "*permit group working and encourage interaction between staff, and would also be energy efficient.*" (Vale and Vale 1991:56)

The building is comprised of 10 T-shaped towers arranged into a series of U-shaped courts. Each tower has a central atrium running down its centre which contains a stair linking it to a winding internal street connecting the towers at ground level. These atria have 3 effects: firstly they mean that all of the office space is within 7m of a window, second, the stairs rather than the lifts become the predominant means of vertical circulation, "*giving more opportunity for people to meet, saving energy and providing exercise.*"

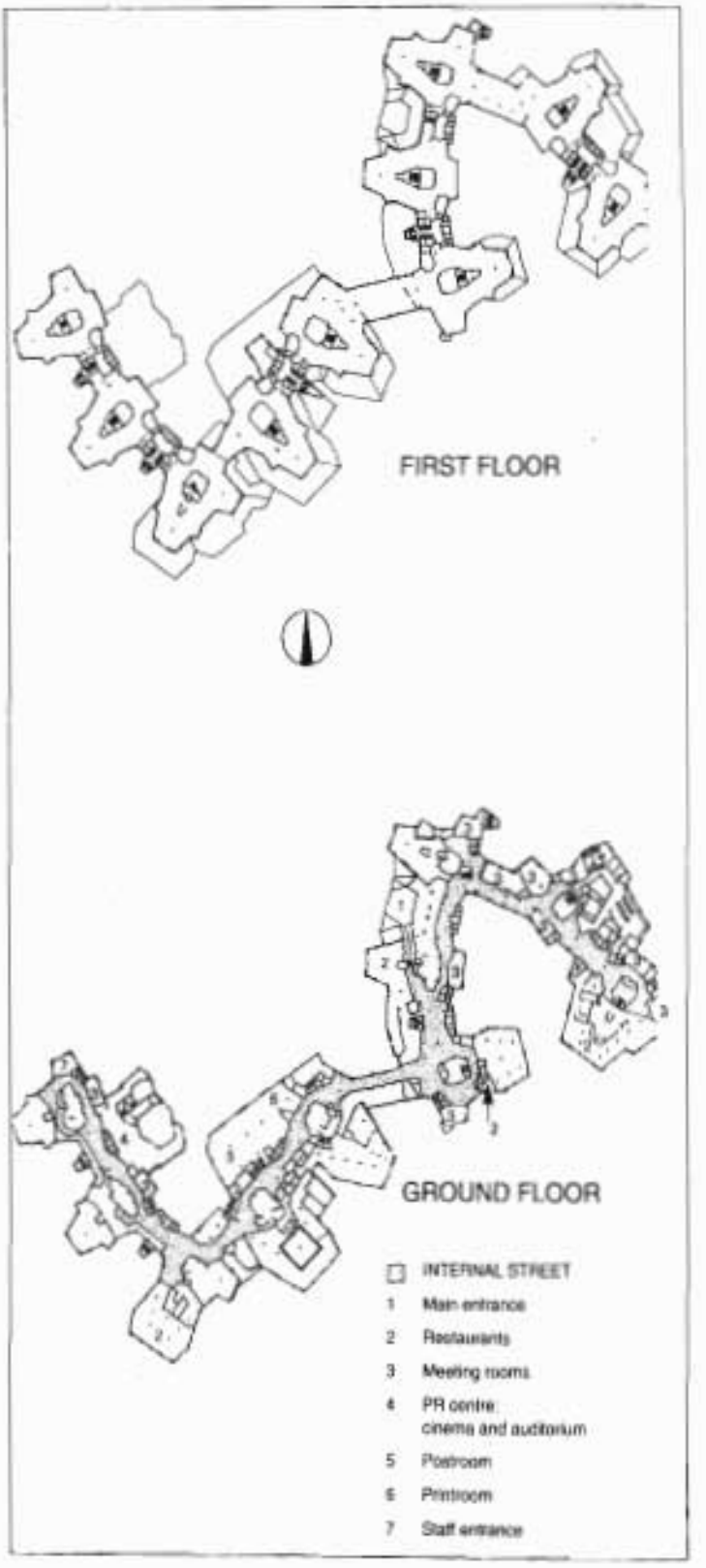

Fig. 7 Ground and First floor plans (Vale & Vale 1991:55)

(Vale and Vale 1991:56) Finally, these atria also provide ample light to the offices and the street floor below.

The U-shaped courts have been landscaped into lush green gardens, which the office look onto. To enhance the feeling of a connection with nature, rainwater is collected and distributed to the various internal and external plantings. There are water sculptures in many of the atria and one of the stairs incorporates a water handrail in precast bronze concrete. The effect is to "*permeate the entire building with the sound of running water.*" (Vale and Vale 1991:57)

In terms of natural light and ventilation, about 20% of the wall area is glazed, as well the atrium roofs. At the top of each window is a glazed panel backed by reflective louvers which bounce light off the white ceiling deep into the space. The rest of the window is sheltered by motorized external blinds which operate when the temperature outside rises above a certain level to control solar gain. These work in conjunction with user operated internal blinds.

Fig. 8 Planted Atria which also accommodate the vertical circulation.
(Vale & Vale 1991:58)

Fig. 9 The large internal street is the principle means of circulation
(Vale & Vale 1991:59)

Fig. 10 The public square at the entrance
(Vale & Vale 1991:53)

Because it is not sealed the whole building functions without air-conditioning. Fresh air enters the building through a solar collector which heats it up, and some exhaust air is passed across a heat wheel which extracts its heat and recirculates it into the building. Also, the exposed areas of water around the building have the effect of naturally regulating the humidity to improve indoor air quality.

Aside from the environmental measures put into place, Dutch legislation "*ensures that representatives of those who will work in a new building have input into the design process, and the result is a much greater degree of user consultation than would be the norm in the UK or the United States.*" (Vale and Vale 1991:58)

There are a number of important results to this kind of focus on environmental issues, particularly with respect to the buildings running costs and worker productivity. The bank has managed to save more than £300 000 a year in energy costs, and now has an energy consumption which is 1/12 that of the banks former building, meaning that the additional cost of equipment and plant was paid for within 3 months. In terms of worker productivity, a study based on data from the banks own health insurance scheme shows that absenteeism and health problems are down by 15%. (Edwards 1998:4)

The NMB Bank demonstrates how a green building "*can be all the things that an organization wants from a commercial point of view. As well as providing healthy working conditions for the Bank's employees and saving money on fuel bills, the new building functions as an advertisement for the Bank, whose list of customers is growing rapidly ... Investment in this quality of architecture has proved profitable and has linked the greening of buildings directly with capitalist goals.*" (Vale and Vale 1991:63)

In the context of this research, the NMB building demonstrates a link between economic efficiency and environmental quality through the means of passive environmental systems lowering running costs. There is also a link apparent between these environmental systems and the quality of the social environment created – for example in the informal meeting spaces that appear in the atria, or the soothing effect of collected rainwater passing over water statues as it permeates the building.

ADDISON WESLEY LONGMAN BUILDING

The Addison Wesley Longman building is another such an example. Marilyn Standly, who was in charge of the project from the client's side, explains that although sustainability was not a priority from the start, it became one after consulting with the stakeholders involved. That is that *"by giving prominence to staff needs, the green dimension arose naturally."* (Edwards 1998: 50)

Fig. 11 View of Addison Wesley Longman From adjacent park.
(Architects' Journal 2006:25)

The need for the new building arose when Addison Wesley Longman, which is an international publishing company outgrew its existing headquarters in the late 1980s, and so built this new office building.

The brief evolved in two parts. Firstly, the needs and preferences of existing staff were considered paramount, and secondly, the perceptions of the property market in terms of sub-let tenancy requirements had to be considered. Standly states that the

Fig. 12 Front Elevation, across car park
(Architects' Journal 2006:26)

initial design brief was minimal, that the company, *"wanted to produce a building which would foster greater communication and creativity in staff, would facilitate the increasing use of IT, would be easy to maintain and cheap to run and which would be a pleasure to work in."* (Architects' Journal 2006:26)

The solution is an example of corporate environmental sustainability, but its clear motivation is better economic profits, or a better business. The building is of a very conventional construction in that it has concrete slabs and double glazed windows. It takes a few carefully chosen passive environmental devices, such as light shelves; a narrow floor plate; connection to the environment through views over the park and openable windows, and uses these features for maximum economic benefit. In 1993, a BREEAM assessment gave the building 20 out a maximum of 21 possible credits, thus emphasising its focus on environmental performance.

It shows a "developed" country response to social sustainability, which is quite different to the pressing issues of our developing world. Particularly the response includes stakeholder input into the design process, for example, that the decision to choose a naturally ventilated building was chosen because 80% of staff consulted had a preference for openable windows. The roof plan shows a roof garden and restaurant for the company employees to enjoy.

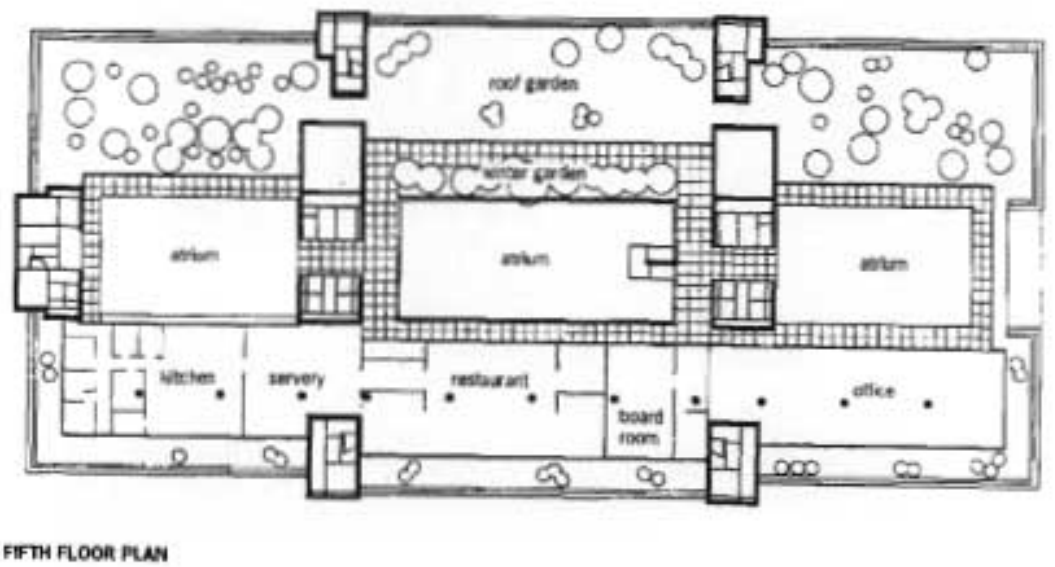

Fig. 13 Roof plan
(Architects' Journal 2006:27)

TYPICAL FLOOR PLAN

Fig. 13 Typical plan
(Architects' Journal 2006:27)

The typical floor plan shows the narrow floor-plates surrounding an atrium. This simple measure allows for improved daylighting and cross-ventilation. The concrete structure, *"gives thermal mass to regulate temperature. In warm weather the windows can be opened; in winter when they are closed fresh air is drawn in through the raised access floor."* (Architects' Journal 2006:32) Other environmental design features include generous floor-to-ceiling heights; external solar shades and internal blinds to help control summer heat gain.

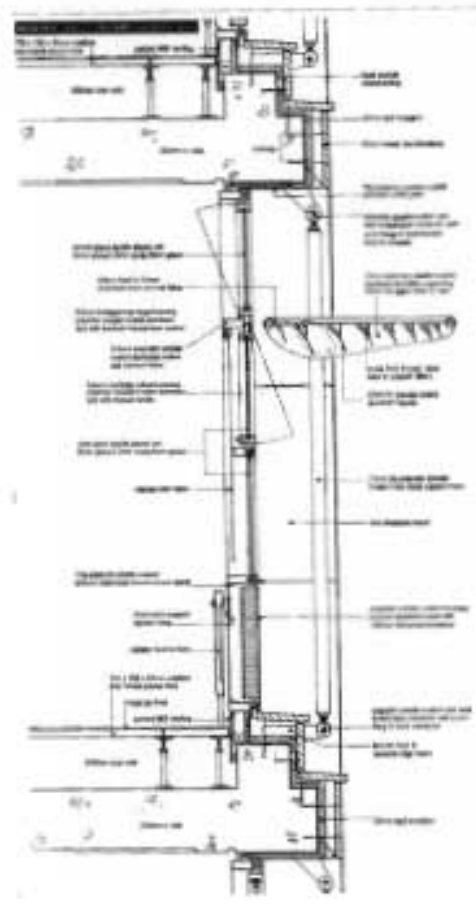

Fig. 14 Skin Section
(Architects' Journal 2006:32)

The skin section shows the more technical devices. It also illustrates that the building focuses on some, more directly profitable, features such as light shelves to improve daylighting and at the same time prevent overheating, while ignoring other issues – the light shelves are made of aluminium, which,

although inherently recyclable, requires a very high amount of energy in its initial production. Although this may seem like a contradiction of objectives, it can be validated through the use of a life-cycle-assessment of the component.

It is also valuable to compare the benefits of the components to their disadvantages, and how they interact with the building system as a whole. For example, the accuracy with which the aluminium louvers can be produced would minimize waste and the pollution caused during construction to the surrounding environment and community. During the design process, this product would be measured against its alternatives, such as concrete which requires just as much embodied energy in its manufacture, and creates more waste and pollution on site; or timber, which could be harvested from sustainably grown forests, but would need to be replaced over time and therefore which would raise its running cost, and therefore life-time cost, compared to the aluminium ones which would last a very long time and would be able to be reused or recycled once the building gets decommissioned.

THE HABITAT RESEARCH AND DEVELOPMENT CENTRE, WINDHOEK

This building has a different set of objectives to the previous ones. It is not a commercial venture, but rather is an NGO. As such it has the opportunity to take a more experimental approach to environmentally sustainable architecture. It should be noted that most environmentally sustainable examples of architecture from the North take a high-tech approach, and achieve energy efficiency through precisely engineered and manufactured materials and components. Those in the South are more prone to a low-tech approach using natural materials, which have little embodied energy, and will decompose rather than have to be recycled or sent to landfill sites. The centre uses a wide variety of natural and innovative recycled materials, from wattle laths used as solar control devices; stone gabion walls using stone collected from around the site; soil-cement bricks; and even old soft-drink cans for a feature screen.

In terms of an environmental response certain criteria were established. Interference with natural storm-water runoff was minimized by not diverting existing watercourses, but instead emphasising them as a feature running through the main courtyard, and diverting roof runoff into the course to further enhance the connection to the environment. Established trees and other vegetation on the site were kept in as natural a state as possible, with the courtyard being designed around existing trees.

In order to further this respect to natural water, the surfaces around the site, specifically parking areas, are made of raked and compacted natural ground and are therefore largely permeable.

The building takes careful note of the country's hot, dry climate and addresses this with thermally massive stone and brick construction to act as thermal sinks, as well as making much of the public space as outdoor, shaded areas. The green spaces between the buildings showcase an indigenous garden and can be used as an outdoor classroom. A number of towers have been placed around the building to act as wind-scoops and channel fresh air into the interior.

In social terms, the design was kept to a single storey so that simple "labour-based" construction techniques could be used with a combination of both skilled and un-skilled labour. The design also includes ramps to move between all the changes in level, making the building fully accessible to the disabled. (Namibian Digest 2005)

CONCLUSION

A number of principles can be drawn from these examples which can be used in the design of a building. Most important among them is the relationship between the *"three pillars of sustainability"*, that is, environmental, social and economic factors is clearly illustrated, particularly in the first example of the NMB Bank in Amsterdam. However, as noted while discussing the differences between developed and developing country responses to sustainable development, the developed countries view social concerns in terms of user contentment, 'healthiness' of the building, and access to facilities for all sorts of disabled persons. While these issues are important, even to developing countries, the developing countries view social concerns more in terms of providing for the poor. As such the Habitat Research and Development Centre in Windhoek uses "labour-based" construction methods, thereby providing employment to more people than would a typical highly-engineered example from the North.

The AWL building reviewed here illustrates that, even while clients may not have direct knowledge of sustainable development issues, a participatory approach to design can lead to both a sustainable building, and a building that is highly successful in the eyes of the client.

CHAPTER 5: Conclusions

The aim sustainable development is, *"the simultaneous pursuit of economic prosperity, environmental quality, and social equity."* (Gissen 2002:185) It is the intention of this project to show that there are a number of ways to initiate sustainable development within the architecture and construction industry of South Africa. This disputes the public perception described by Phil Macnagten that "*individual action was seen as largely ineffective, both due to the global scale of the problems and to the perception of powerful commercial interests intractably embedded in systems of self-interest antithetical to global sustainability.*" (Abley and Heartfield 2001:88)

Sustainable development initiatives come either from the government either as "command and control" mechanisms or "economic instruments." However, government initiatives may have a negative connotation to them as being restrictive to progress rather than promoting it. Client- or developer-initiated schemes have a number of advantages for the client, but will tend to neglect areas that are not clearly profitable, such as social or community enhancing features. These can only be initiated by government coercion. Corporate clients who seek a sustainable and environmentally friendly building are often those who have realized the benefits of sustainable development throughout their business. This is largely focused around ideas of resource and energy efficiency, that is, by reducing the amounts of these used in production, and wasted in production, a company can become more competitive. Environmentally conscious building design can be shown to be beneficial to a client/ developer in purely financial terms if a long term view of the building investment is taken. However, there are also advantages in terms of improved worker productivity and contentment and decreased absenteeism, which can be an important advantage in an age when a large portion of many companies' expenses will go to personnel. In non-economic, but still corporate, terms, many companies are showing an increasing interest in the concept of Corporate Social Responsibility. This involves allowing moral or ethical decisions a valid place

corporate decision making, and is the prime motivator for corporate social sustainability.

There are obvious infrastructural and capacity issues which make the transfer of sustainable technologies from the North to the South a complex issue. In addition to this are the politics of aid which can cause animosity on both sides. Also important are issues of context, such as climate and available resources, which require that any imported technology must be adapted to its context. Schmidheiny (1992) suggests that the best way to achieve this is via the involvement of business in the process because they will best know the constraints of their context, and will be most motivated to make sure that the deal is advantageous for all parties involved.

As architects are at the head of the design team it is up to them to inform clients of the options available to them. Although this would obviously involve advice on profitable technologies in building design as shown above, it should also include advice into sustainable development as it applies to the corporation's ideologies as a whole, as the building within which a company is based can effect their behaviour patterns, and therefore provide more than just a healthy building, but a more sustainable corporate culture throughout.

Sustainable architecture requires acknowledging sustainable development goals from the very start of the project. Following this, the interrelationship between different components of a design is examined, particularly with respect to allowing advantages attained from one component or system to benefit other systems. A holistic approach of concurrently focusing on environmental, social and economic factors will be shown to benefit all of these factors rather than just the one being designed for – for example, environmental interventions can have economic benefits. Because of the wide scope of factors that need to be considered, it will be found that often there are conflicting issues. This can be resolved through analyses such as life-cycle-analysis and value judgments can be made by comparing different solutions.

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