Developing a Sustainability Benchmarking System:

A Case Study of the Provincial Government Western Cape's Immovable Asset Assessment Pilot Project

by

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Declaration

By submitting this study electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Date: 20 February 2014

Abstract

Building structures have a major impact on the quality of the macro-climates of the world, in particular in terms of pollution and environmental costs associated with their creation, operation and maintenance. Emerging global trends to make buildings more efficient, effective and sustainable, led to the question *can one establish how sustainable existing buildings are?* Building rating tools like LEED, BREEAM and Green Star, can already be used to rate and certify buildings in terms of their environmental performance and sustainability, but seem to fall short of establishing true overall building performance sustainability.

As an architect, the researcher was involved in a project to develop a process for the Provincial Government Western Cape to comply with the Government Immovable Asset Management Act, Act no.19 of 2007 (GIAMA). The problem statement of this study links to the objective to comply with GIAMA, which requires that all government buildings be assessed in terms of their sustainability. This led to a number of research questions being asked. The first of these questions are what can be learnt from currently available rating systems and would it be possible to track and monitor the sustainability performance of a building over time.

This triggered a series of related questions: What role can benchmarking play in establishing and tracking a building's sustainability over time? How can benchmarking help to identify which part of a building's overall sustainability is most in need of resourcing, to bring it closer to overall sustainability? How can capital and maintenance expense budgets associated with the building life-cycle be effectively utilised to bring buildings closer to overall sustainability? How can the availability of detailed information pertaining to the costs and benefits of green investments in existing buildings help building owners to identify the best initiatives to invest in?

The methodology used in this study to answer the above questions is based on two research approaches. The first part made use of a literature review to establish and define the knowledge framework to be used in the second case study portion of the study. The methodology used for the case study was based on applied research, where the real life problems associated with the development of a suitability benchmarking process for the PGWC was documented and assessed.

The results of the study found that there exist a missing link between theoretical knowledge of sustainability benchmarking and the legislative requirement of GIAMA and that this missing link is the standardised accurate and verifiable data required for the benchmarking process. In addition to this it was also found that the social aspects of buildings are generally neglected. A universal standard for collection of the required data is also needed. The study also highlighted that a general misperception exist that *Environmental Sustainability* is synonymous with the *Sustainability* paradigm.

Opsomming

Bou strukture het 'n groot impak op die gehalte van die makro-streke van die wêreld. Veral in terme van besoedeling en die ekologiese koste wat verband hou met die ontwikkeling, werking en onderhoud daarvan. Globale opkomende tendense om geboue meer doeltreffend en volhoubaar te maak, het gelei tot die vraag: Hoe kan 'n mens die volhoubaarheid van 'n bestaande gebou vasstel? 'n Aantal bou-graderings-stelsels, soos LEED, BREEAM en Green Star, kan reeds gebruik word om geboue te gradeer en sertifiseer in terme van hul omgewingsvolhoubaarheid, maar skiet te kort ten opsigte van algehele volhoubaarheid van ’n gebou.

As ’n argitek was die navorser betrokke by ’n projek om ’n proses te ontwikkel vir die Provinsiale Regering van die Wes-Kaap (PGWK) om te voldoen aan die Wet op die Bestuur van Onroerende Regeringsbates, Wet no. 19 van 2007. Die probleemstelling van hierdie studie koppel aan die vereiste om te voldoen aan Wet 19 van 2007, wat vereis dat alle regeringsgeboue geassesseer word ingevolge hul volboubaarheid . Dit het gelei tot 'n aantal navorsingsvrae: Eerstens, watter lesse kan geleer word uit die bestaande bou-graderings-stelsels en tweedens, is dit moontlik om op die volhoubaarheid van 'n gebou te monitor en gradeer oor tyd?

Dit het tot verwante vrae gelei, naamlik: Watter rol die stel van *maatstawe* kan speel om die volhoubaarheid van ’n gebou te monitor? Hoe kan die stel van *maatstawe* bepaal watter aspekte van 'n gebou die meeste hulpbronne benodig, ten einde dit nader aan algehele volhoubaarheid te bring? Kan die kapitaal- en instandhoudingsbegrotings, wat verband hou met die lewens-siklus van die gebou, effektief gebruik word om ’n gebou nader aan volhoubaarheid te bring? Hoe kan die beskikbaarheid van inligting met betrekking tot die koste en voordele van groen beleggings van bestaande geboue, gebou-eienaars help om die beste inisiatiewe te identifiseer om in te belê?

Die metode wat in hierdie studie gebruik is om bogenoemde vrae te antwoord, is gebaseer op twee navorsings benaderings. Die eerste deel van hierdie studie het gebruik gemaak van 'n literatuuroorsig om ’n kennisraamwerk te definieer en te vestig, wat dan in die tweede deel van die studie, ’n gevallestudie, gebruik word. Die metode wat gebruik is vir die gevalle studie is gebaseer op toegepaste navorsing, waar die werklike probleme wat verband hou met die ontwikkeling van 'n geskikte volhoubaarheid *maatstawings* proses vir die PRWK gedokumenteer en geassesseer is.

Die resultate van die studie was die bevinding dat daar 'n vermiste skakel bestaan tussen die teoretiese kennis ten opsigte van ‘n maatstawings stelsel vir volhoubaarheid en die wetlike vereiste van Wet 19 van 2007. Die vermiste skakel is dat gestandariseerde, accurate en verifieerbare data bemodig word vir die maatstawings proses. Daar is ook gevind dat die sosiale impakte van geboue verwaarloos word.

Die studie stel voor dat ’n universele standaard benodig word vir die versameling van die vereiste data. Die studie het ook n belangrike observasie gemaak dat daar 'n algemene wanopvatting in die industrie bestaan dat *Omgewingsvolhoubaarheid* sinoniem is met die *Volhoubaarheid* paradigma.

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vi. Finally, to all those who share our passion for the field of sustainability and who will continue to fight for the greater good.

"We don't inherit the earth from our ancestors,

we borrow it from our children"

Native American Proverb

Also credited to David Brower

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List of Acronyms

BBP	Better Building Partnership
BCA	Building and Construction Authority
BEAM	Building Environmental Assessment Method
BREEAM	Building Research Establishment Environmental Assessment Method
C-AMP	Custodian Asset Management Plan
CASBEE	Comprehensive Assessment for the Building Environmental Efficiency
DGNB	German Sustainable Building Council
ESGB	Evaluation Standard for Green Building
GBCI	Green Building Certification Institute
GBCSA	Green Building Council of South Africa
GBI	Green Building Index
GIAMA	Government Immovable Asset Management Act, Act no.19 of 2007
GOBAS	Green Olympic Building Assessment System
GPS	Global Positioning System
GRIHA	Rating for Integrated Habitat Assessment
HQE	High Quality Environmental
IPD	IPD Occupiers [Originally a company providing real estate performance and risk analysis data, now a brand as a subsidiary of

	MSCI Inc.]
IPWEA	Institute of Public Works Engineering Australia
JSBC	Japan Sustainable Building Consortium
LEED	Leadership in Energy and Environmental Design
LEED-EB	Leadership in Energy and Environmental Design – Existing Buildings
LiderA	Leadership for the Environment in Sustainable Building
MTEF	Medium Term Expenditure Framework
NABERS	National Australian Built Environment Rating System
PGWC	Provincial Government Western Cape
SAPOA	South African Property Owners Association
SPM	SPM Assets
U-AMP	User Asset Management Plan
USGBC	United States of America's Green Building Council

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Chapter 1: Introduction

1.1 Background

"Buildings are substantive - what they are made of is very much part of their character."

(Roaf, et al., 2003, p. 100)

Building structures have a major impact on the quality of the macro-climates of the world. In particular in terms of pollution and environmental costs associated with their creation, operation and maintenance. They also impact greatly on the micro-climates in which humans work, live and 'play'. The spaces defined by these buildings, impacts on the physical as well as the psychological wellbeing of the people who use, work and live in them on a daily basis (Roaf, et al., 2003, p. 100). These spaces constitute the areas that people spend their time and personal energies in and should generally be shaped in such a way that they can provide comfortable environments in which persons can effectively and efficiently execute their daily activities. It thus stands to reason that people expend a huge amount of their personal energy, in the creation and upkeep of these spaces created by buildings (Roaf, et al., 2003, p. 100).

Globally an efficiency, effectiveness and environmentally sustainable 'trend' has emerged in building design, which are predominantly focused on water and energy conservation and waste reduction (Bannister & Chen, 2012, p. 8). The resultant effect is that there is a marked reduction in energy and water consumption, not to mention an overall reduction in carbon emissions worldwide (Bannister & Chen, 2012, p. 8).

A number of building rating tools, like for instance NABERS, Energy Star, LEED, BREEAM and Green Star have developed in different parts of the world, to enable buildings to be rated and certified in terms of their environmental performance, within the confines of specific countries or regions in the world. These rating tools have been developed independently, as country/regional specific tools, which has resulted in significantly different methodologies being used, in the development of these tools, to measure different building efficiencies (Bannister & Chen, 2012, p. 8).

Preliminary research on the subject of monitoring a building's performance (in particular existing buildings) in terms of its sustainability did identify two very distinct types of rating tools being employed. These rating tools make use of either a design or performance based approach to rating and certifying efficiencies, effectiveness and environmental sustainability in buildings. The design based tools certifies designs that are perceived to be efficient in terms of their design documentation and is the more prevalent of the two approaches, and is specifically employed in new buildings or buildings undergoing major renovation. Performance based tools on the other hand focus on comparing matrixes such as measured energy consumption and productive outputs and facilities, and seems to be more appropriate for existing buildings (Bannister & Chen, 2012, p. 8).

These two different approaches for rating and certifying building performance are predominantly focused on environmental sustainability of buildings in particular, a building's efficiency relating to water and energy consumption as well as waste generation. The result is that the majority of the tools developed and employed are focused predominantly on economic and environmental concerns. This ecological approach is understandable as buildings are expensive to create and consume vast amounts of energy, water and other resources during their creation and subsequent life cycle. What does seem to be lacking from these building performance assessment tools is a focus on the people who invest vast amounts of their personal time and energies in the creation, maintenance and upkeep of these buildings. Should it not be fundamental that one should take into account more than just the ecological concerns, when evaluating a building in terms of its efficiency, effectiveness and ultimate sustainability? Incorporating human needs assessments, which systematically can evaluate the current status quo and compare it to what it should be (Kusy, 1995), is essential to establish and monitor how comfortable and sustainable the built environment is.

The ecological design paradigm does seem to provide a great framework according to which the human world can be redesigned. This is because the ecological design paradigm focuses on the interactions between people and the natural world. It links the energy, water, food, manufacturing and waste systems through the landscapes, buildings and cities to the people that live in these spaces (Van der Ryn, 1996). An ecological design approach is ideal when one designs a new building, or a building is undergoing extensive renovations. But what about all the existing buildings that exist in the world, how can one access the linkages that exist between these building structures and their energy, water, food, manufacturing and waste systems as well as the people that use them on a daily basis? It just does not seem feasible, nor does it seem sustainable to re-engineer, re-create and or re-build all the existing built stock in the world.

1.2 Research rationale

> ***GIAMA*** *(Government Immovable Asset Management Act, Act no. 19 of 2007) require, that all government immovable assets, be assessed and reported on in terms of their condition, compliance, conformance, efficiency, effectiveness and sustainability.*

I have, in my professional capacity as an Architect over the past 2 years, been part of the professional consultancy team GAPP GIBB TILANI, who has been appointed to develop a process, which will enable the Provincial Government Western Cape (PGWC) to comply with

GIAMA. The successful implementation of this process, which is currently being refined and implemented as a pilot project, will align the PGWC with international 'best practices' in terms of public building asset management. It will also provide a robust basis for maintaining targeted levels of service delivery within the available budgets.

My involvement in the above mentioned project was to research and develop a system which would be able to establish and ultimately enable reporting in terms of the efficiency, effectiveness and the sustainability of the PGWC's immovable assets as required by the GIAMA. This provided me with an ideal opportunity to document the processes, difficulties and lessons learned.

1.3 Research problem statement and objectives

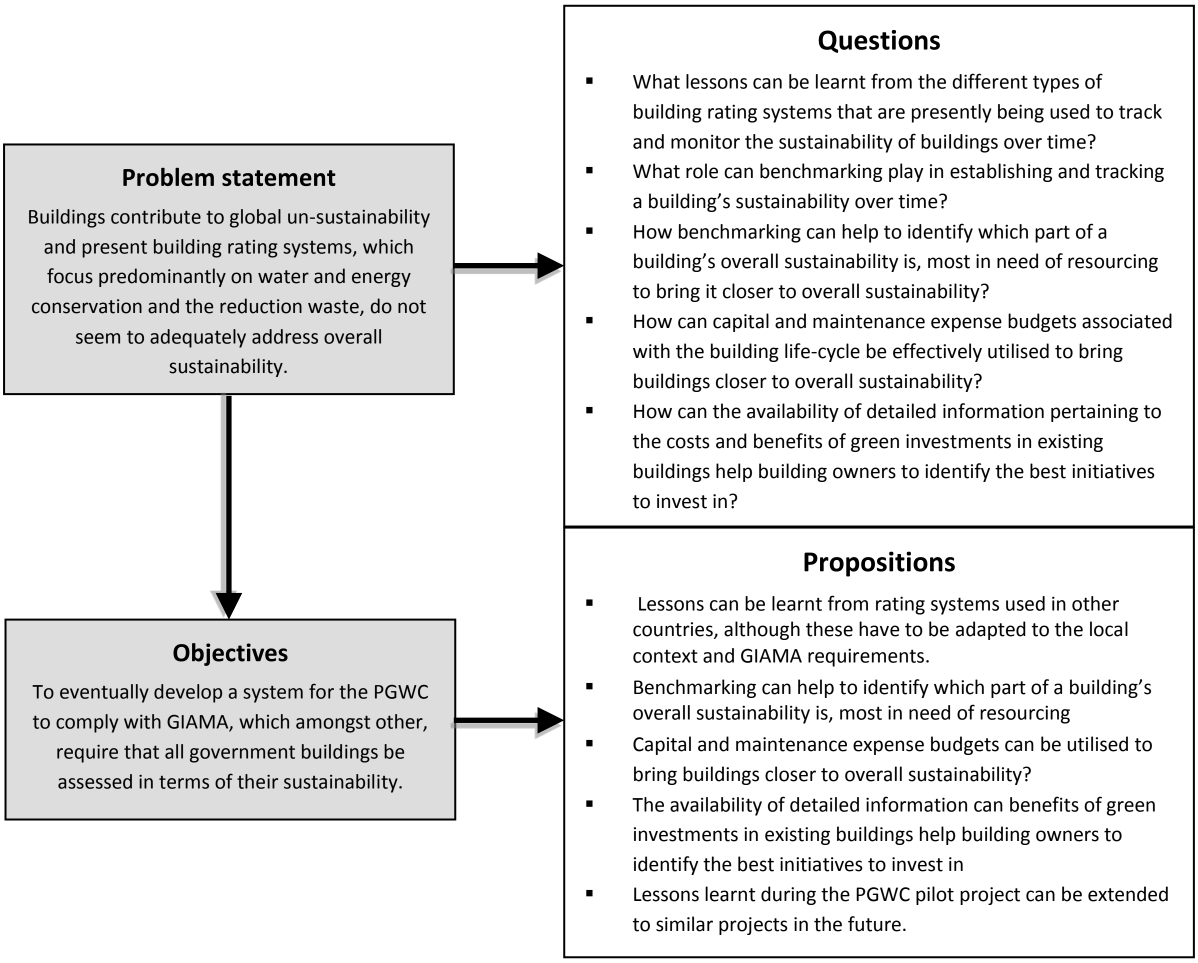


Figure 1: Research problem statement and objectives

1.3.1 The problem statement

The primary concern of this study relates to what is to become of the all the existing buildings currently in existence in the world today, as it does not seem feasible nor does it seem sustainable to re-engineer, re-create or re-build all of the existing built stock in the world. Coupled with this primary concern was the need that the Provincial Government Western Cape (PGWC) had to comply with GIAMA. This combined concern and need, created the problem that this study will aim to address.

The primary research question of this study is ***to establish if there exist is a means by which to establish how sustainable an existing building really is?*** This primary research question will be investigated in terms of the GIAMA requirements. Keeping this constraint in mind, a number of secondary research questions will also need to be answered in order to provide an answer to the primary question.

These secondary research questions are:

i. What lessons can be learnt from the different types of systems that are presently being used to track and monitor the sustainability of buildings over time?
ii. What role can benchmarking play in establishing and tracking a building's sustainability over time?
iii. How benchmarking can help to identify which part of a building's overall sustainability is, most in need of resourcing to bring it closer to overall sustainability?
iv. How can capital and maintenance expense budgets associated with the building life-cycle be effectively utilised to bring buildings closer to overall sustainability?
v. How can the availability of detailed information pertaining to the costs and benefits of green investments in existing buildings help building owners to identify the best initiatives to invest in?

In addition to these secondary questions above, this study will also provide clarity to a number of associated tertiary questions, which are:

i. How can the general assumption that energy and water efficiencies should take preference over the other aspects of the sustainability challenge be changed?
ii. How can one begin to implement, existing theoretical sustainability challenge aspects, into existing buildings?

1.3.2 Research objective

By investigating the above research questions, the objective of this research study is to develop a system for the PGWC to eventually comply with GIAMA, which amongst other, require that all government buildings be assessed in terms of their sustainability. This requires that one assess, in terms of the sustainability challenge, the processes and procedures relating to the sustainability benchmarking of the PGWC's immovable asset pilot project. The outcome of this study will provide an overall report that will increase the knowledge base on the subject and provide wisdom for the improvement sustainable benchmarking process in the future.

1.3.3 Limitations and importance of the research problem

Due to the scale of the research problem, the proposed study will focus on the preliminary efficiency, effectiveness and environmental sustainability benchmarking of a selected sample of schools and office buildings, associated with the research problem. The final outcome of this research study will be the processes and procedures developed for the PGWC's immovable asset pilot project, which will provide the knowledge base that can be used for the improvement of the benchmarking process in terms of the rest of the PGWC's immovable asset portfolio as well as similar projects in the future.

An in depth search of the NEXUS database as well as Google scholar has revealed that there are no other research projects of this kind currently proposed. The closest research project to this one was for the benchmarking of energy use only. The IPD codes are the only internationally based benchmarking system that seems to be relevant to this research proposal (IPD was originally an independent company, now a brand as part of MSCI Inc, which provides real estate performance and risk analysis data and have developed standards, guidelines and codes)

1.3.4 Ethical implications and permissions

There are no direct ethical implications associated with this research topic, as the research would predominantly be focused on observations and analysis of available data obtained from the PGWC immovable asset assessment pilot project. Permission for the use of the data within this study has been obtained from the PGWC as well as the professional team (GAPP GIBB TALANI) who has been tasked with the PGWC immovable asset assessment pilot project. As the data has only been used to for assessment purposes, no major risk relating to the use of the data is perceived.

1.4 Research approach and research strategy

The first part of this study will make use of non-empirical research in the form of a literature review to establish and define the knowledge framework in terms of which, the second part of the research study will be conducted. This initial research, as well as the knowledge gained through the BPhil in Sustainable Development, which I did through Stellenbosch University, the extensive experience gained over the last 15 years working as a Professional Architect and my involvement in the PGWC immovable asset assessment pilot project, will form the basis by which the second empirical portion of this study will be assessed and analysed.

"...that to think anything at all, humans have to ground their thinking on assumptions that are ultimately unfounded."

(Sachs, 2002, p. 224)

The literature review will be divided into two parts. The first part will consist of a comprehensive body of literature that will clarify and frame currently held world views on sustainability and ecological design. The second part will consist of a critical analysis of currently available literature relating to GIAMA, building rating tools and benchmarking of existing buildings.

The second section of this study will be in the form of a case study of the PGWC immovable asset assessment pilot project. Here a brief contextual history will be provided of the PGWC immovable asset assessment pilot project, which will be assessed in terms of the sustainability principles established during the first section of the literature review, while any lessons learnt will be reported. The methodology of case study portion of this study will be in the form of applied research, where the real life problems associated with the development of a suitability benchmarking process will be documented.

Finally the conclusion will provide a breakdown of the research outcomes in terms of the research questions and provide feedback on the lessons learned. It will also put forward recommendations that can be applied and incorporated into future benchmarking projects for existing buildings.

1.5 Preliminary literature analysis

The theory and literature applicable to this study consist of literature relating to sustainability, ecology, building rating tools, benchmarking and asset management as well as governmental acts and policies. In addition to the literature topics listed above, literature associated with minimum norms and standards and standardization of government buildings may also have an impact on the research topic. The primary aim of this study is thus to investigate the benchmarking process of public buildings in terms of their effectiveness, efficiency and sustainability challenge.

Contemporary literature on sustainability and ecological design would be used to provide background information in terms of the understanding concept like sustainability, sustainable development and ecological design. On the topic of sustainability and sustainable development, particular reference would be made to authors like **Blewitt** 'Understanding Sustainable Development' (2008); **Merbratu** 'Sustainability and Sustainable Development: Historical and Conceptual Review' (1998) and **Sneddon** 'Sustainable development in a post-Brundtland world' (2006) to provide greater clarity and understanding of these concepts. On the subject of ecological design, literature like **Van der Ryn's** 'An introduction to Ecological Design' (1996); **Birkland's** 'Design for sustainability: A sourcebook of integrated ecological solutions' (2002) and **Goodall's** 'Ten Technologies, To Save the Planet, (2010), will help to explain and clarify the different concept related to ecological design.

The contemporary documentation on building rating tools, benchmarking and asset management, will be analysed in terms of on how far removed these concepts are from the sustainability challenge as clarified and defined in the first part of the literature review of this study. IPD's Environmental, Cost and Space Codes (IPD, 2010) (IPD, 2009) (IPD, 2008) will provide reference on how buildings can be measures in terms of environmental, spatial and financial performance of a building. One Planet Action Plan sustainability tool kit (2012) and The Better Building Partnership (2010) will provide information relating to best practice principles in terms of benchmarking sustainability. The likes of Buchanan (2011)**,** will highlight facilities management and compliance features and provide information on how to achieve greening of existing buildings and integrating sustainability into capital planning process. Publications by the Green Building Council of South Africa (2012) and Aurecon South Africa (2012) will provide some guidance in conjunction with IPD on how to benchmark specific key performance indicators, like for instance energy and water.

Building condition & performance assessment guidelines will be sourced form works published by IPEWEA and NAMS (2006) in Australia and New Zealand and reports like the United Kingdom's State of the Estate Reports (HM Government, 2012). Better measurement - better management (OMC and IPD, 2010) will provide guidance on how to report sustainability for government building.

Preliminary research on building rating tools currently available in the world, indicate that greater emphasis are being placed on the rating of new buildings and buildings undergoing major renovation than existing buildings, though this seems to be changing, as most of the rating tools worldwide is introducing rating tools for existing buildings, like for instance the NABERS rating system in Australia, the LEED-in use rating system in the USA, BREAM-in use Europe and the newly released GBCSA Pilot tool for existing buildings in South Africa. These rating tools also seem to be predominantly focused on environmental sustainability, in particular energy and water with some reference to waste production. There seems to be a general assumption that energy and water efficiencies should take preference over the other aspects of the sustainability challenge. Is this perceived assumption founded, or is it just driven by a general shortage in energy and water resources currently experienced in South Africa and the world as a whole? The sustainability challenge does indicate that there is an abundance of academic knowledge available on the different aspects that make up the sustainability challenge as well as how this theoretical knowledge might be implemented into existing buildings, but so far very few of these theories have been implemented.

Ackhoff (1989) proposes a hierarchy of understanding in the human mind based on four categories, namely data, information, knowledge and wisdom. The first three relates to past experiences, with the last one being the only one dealing with the future, as it incorporates vision and design. Through wisdom one can create the future, rather than just grasp what was the past and is the present. To ultimately achieve wisdom, one must move successively through all the other categories. It is therefore only through understanding of the principles, patterns and relationships associated with something, that one can obtain the wisdom one seeks. This basic systems theory process illustrated in *Figure 2* below can form the basis by which to ultimately unlock the wisdom of how one can bring existing buildings closer to sustainability.

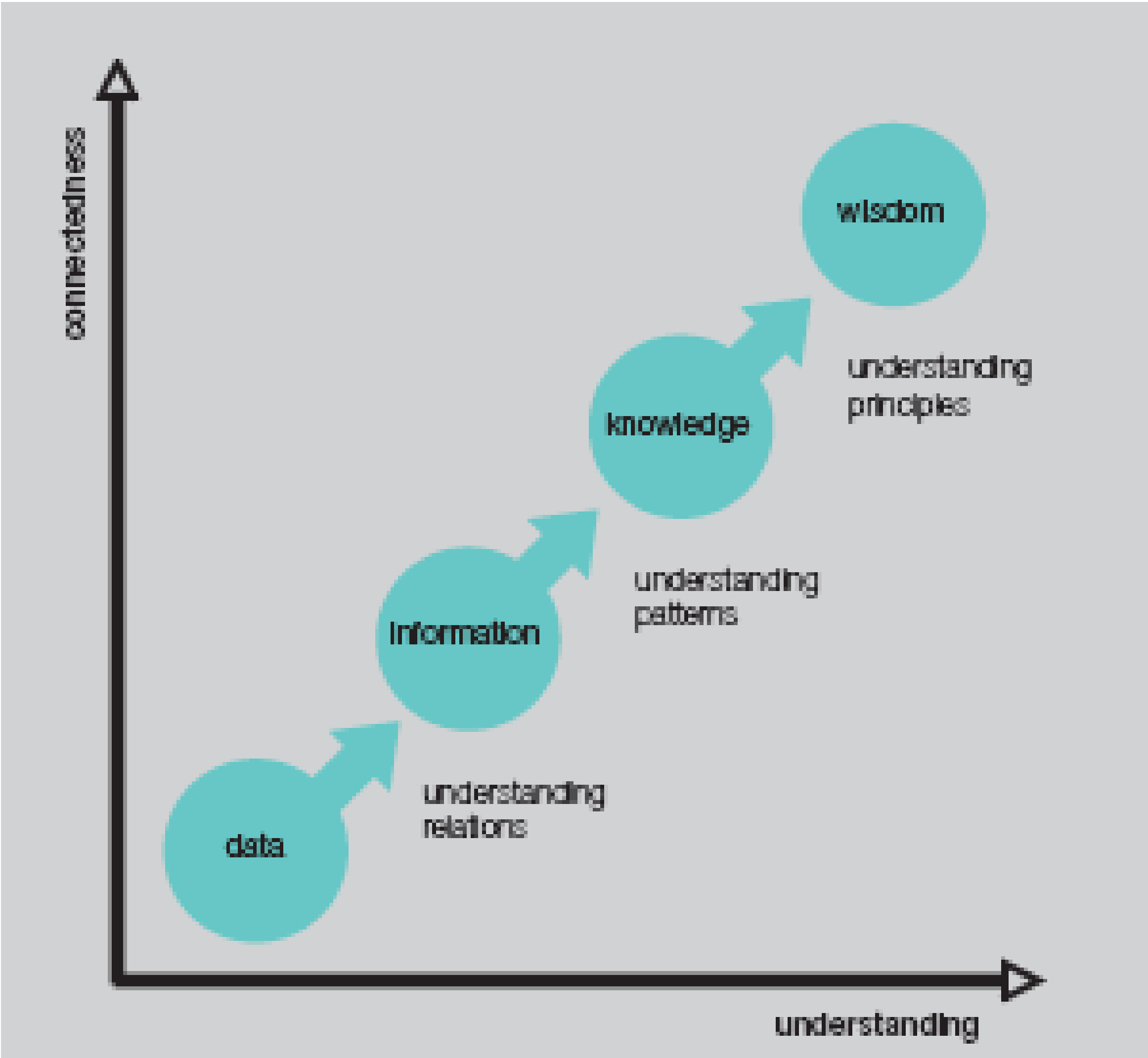


Figure 2: From Data to Wisdom

(Ackoff, 1989)

1.6 Chapter Outline

As chapter 1 provided the structural framework for this study, so will chapter 2 establish a theoretical framework of sustainability. This chapter will explore what the core concepts relating to of sustainability are before it looks at what ecological and sustainable design means and what these theoretical concepts can contribute to the understanding of rating systems for the sustainability of buildings.

Chapters 3 and 4 will investigate what different international building rating tools and benchmarking systems that are available and identify what lessons can be learnt from these rating tools and systems. With chapter 5 examining the benefits and challenges of sustainability benchmarking

In chapter 6 the case study of the development of a sustainable benchmarking system is explored in two parts. The first part provides an overview of the GIAMA requirements and guidelines as well as the design and methodology that was followed during the PGWC Asset Survey. With the second part explaining the data gathering process of the PGWC sustainability benchmarking project.

Chapter 7 concludes the study by looking at the lessons learnt during the project and what contributions the study can make to practice, and it concludes with some recommendations for future projects of similar nature.

Chapter 2: Theoretical framework

2.1 Introduction

> *"...to think anything at all, humans have to ground their thinking on assumptions that are ultimately unfounded."*
>
> (Sachs, 2002, p. 224)

An increasing body of research has shown that a stable functioning life support system is required for a global society to survive on this space ship called earth (Griggs et al, 2013). Sustainable development is seen by many to be the means by which this stable functioning life support system can be achieved, but what does this conceptual theory 'sustainable development' mean?

When different individuals are asked to explain their understanding of what the term sustainable development and the related concept sustainability means, there will most likely be as many different answers as there are individuals. This is no big surprise, as the debate around sustainable development is ongoing, in particular in the political, social and academic arenas. In this literature review on the subject of sustainable development, this study will attempt to clarify what the current world views are on the subject. A series of critical questions are posed in an attempt to try and define in laymen's terms these concepts of sustainability and sustainable development.

The first of these questions is: What is it that we need to sustain? This leads to the next set of questions: Why do we need to sustain it, for whom is it to be sustained and by whom is it to be sustained? This leaves the final and most important question: How can sustainable development and ultimately sustainability be managed and achieved?

The initial theoretical framework portion of this study, will attempt to shed some light on the above mentioned questions. This will be done by taking a critical look at some of the more prevalent theoretical concepts available in the world on the issue of sustainability. By exploring some of these theories and world views, will help to providing greater understanding on the subject of sustainable development and how a holistic systems approached to sustainable development are possibly the best means by which the ultimate goal of sustainability can be achieved.

The second part of the theoretical framework of this study will take a critical look at the theoretical concept of ecological design. It will start off by providing a brief definition of what is commonly understood when one refers to ecological design. Thereafter it will review what is meant by the different concepts associated with ecological design and in particular reflect on the three main approaches of conservation, restoration and stewardship, which are found in ecological design theory. Finally this second part of the initial literature review will reflect on the implications that ecological design principles can have for the building industry and it will attempt to establish what role ecological design can play in providing a sustainable future for all.

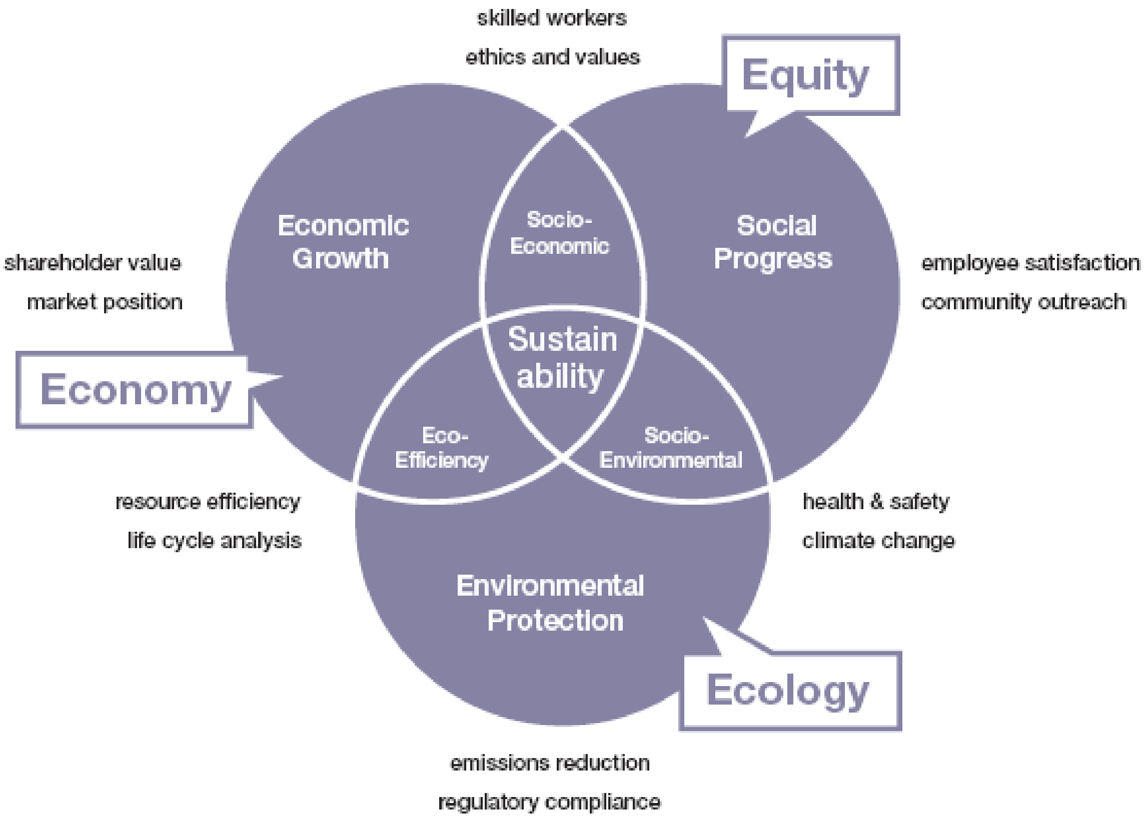


Figure 3: The Sustainability Challenge

(Van Ree, 14-18 May 2007)

2.2 Defining sustainable development

What is meant by the theoretical concepts of Sustainable Development and Sustainability?

In 1987 the Brundtland Commissions in its UN World Commission on Environment and Development (WCED) report '*Our Common Future',* defined sustainable development as:

> *"...development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* (Mebratu, 1998, p. 9).

Since then, any debate on the definition of sustainable development firstly needs to address the issues relating to the concept of '*needs*'. Whose '*needs*' are to be satisfied and which of these '*needs*' should be addressed? The second part of the debate about sustainable development normally focuses on the earth's capacity to be able to satisfy the needs identified in the first part of the debate. This heated debate is due the fact that the understanding of the concept of sustainable development is interpreted differently by the different parties, who are participating in the sustainable development debate. The interpretation of the sustainable development concept is thus subject to the initial, assumed departure points of view, of the different the parties debating the subject.

The individual, participating in the debate on sustainable development's views, would thus be subject to their initial assumptions and viewpoints relating to social, economic and environmental issues. Blake Ratner (Blewitt, 2008, pp. 27, 28) suggests that any debate around these issues of sustainable development can be interpreted as a debate around values. Although there are vast differences between the different role-players in the sustainable development debate's views and interpretations, there is a shared common understanding (Blewitt, 2008, pp. 27, 28) that sustainability should be interpreted as the 'goal' and sustainable development, as the process by which the sustainability 'goal' would be achieved. The natural environment, human society and the global economy is seen as the three dynamic pillars that the sustainability paradigm is built on. This is of course coupled by a shared underlying presumption that an achieved sustainability goal will be dynamic, changeable, and multidimensional interactive equilibrium, between the different pillars that makes up the sustainable development challenge and that the goal of sustainability would be seated in the interconnectivity of the human and natural worlds (Blewitt, 2008, pp. 27, 28). Each of the above mentioned pillars of the sustainable development paradigm bringing with it its own set of dynamic and multidimensional challenges, making the achievement of the sustainability goal elusive and extremely complex.

In the world of sustainable development, there are two opposing and very distinct philosophical approaches at play. Hattingh (2001, p. 9), defines these two approaches as being either a human centred (anthropocentric) or a nature centred (eco-centric) approaches. Three vastly different interpretations exist on how sustainable development should be defined. The institutional interpretation primarily focuses on the complexities of 'needs' that need to be satisfaction. Then there is the human-equality focused ideological view which is based in liberation theology and finally there is the scientific-based academic viewpoint (Mebratu, 1998, pp. 12-17). This means that a participant in the debate on the interpretation of the concept of sustainable development will base their individual arguments on their affiliation towards being either human or nature centred. Their ideological perspective, coupled with their interpretation of 'needs' and their theoretical ideologies or academic view on the subject.

Even though there are many different interpretations of the meaning of the concept of sustainable development, one view point holds true for most participants in the debate on sustainable development and that is a firm believe, that the natural world is in or facing an environmental crisis. Most also believe that changes to the way how humanity interacts with the natural world is critical in the prevention of the possible failure of human civilization on this planet (Mebratu, 1998). With history, clearly showing that most previous major civilizations that existed on this planet in the past, failed due to that civilisation's over exploitation of the natural world (Clayton, 1996, pp. 3-6).

It is thus not so farfetched to assume that the ultimate goal of sustainable development and thus the meaning of sustainability are; to save humanity from self-destruction. If this argument holds true, that it is the human race that sustainability is trying to preserve, then as Hattingh puts it "what about humanity is so important that it should be sustained forever?" (Hattingh, 2001, p. 9). This would be a worthwhile debate to have, except that all those who at this stage can debate this issue is human, which means they are all in all likelihood prejudice to the human condition.

It thus follow that it is us humans whom we are trying to sustain through the process of sustainable development and that ultimate goal of sustainability is the future human survival on this planet. It would thus follow that all other issues in the debate on sustainability goal are thus secondary to the primary goal of human survival and thus ultimately becomes only a nice to have.

If future human survival is the primary goal of sustainable development, then what the real debated around the concept of sustainable development is all about is what the *nice to have's* would be. It follows then that the debate around sustainable development is a debate around the processes and systems that will need to be put in place to achieve the sustainable survival goal of the human race and which *nice to have's* should be included. These processes, systems and *nice to have's* will ultimately determine the quality of life for future human civilizations.

The different word views and the subsequent debate around sustainable development can be seen as a means by which to establish the processes, systems and *nice to have's* which should form part of and facilitate the achievement of the primary goal of sustainable human survival. The different world views on sustainable development can thus be seen as different takes on what it is that humanity would *like to and/or need to have* for humanities future sustainable survival.

2.3 World views on Sustainable Development

The differences in the world views on sustainable development can be defined through the philosophical approaches that the different parties take in their debates on sustainable development. Hattingh (2001, p. 9), suggest two distinct approaches, on the one side there is the human centred approach and on the other side a nature centred approach, couple this with the different interpretations and complexities associated with the perceived 'needs' which require satisfying. This means that an individual's position in a debate on the interpretation of the concept of sustainable development, will be based on that individual's affiliation towards being either human or nature centred and their arguments would be based on their ideological perspective, their interpretation of the 'needs' concept and their theoretical ideologies and/or academic view on the subject.

The world views in terms of sustainable development, is in effect a look at the different aspects of human and environmental interaction and the complex interactions between the needs of the three pillars (social, economic and environmental needs) of sustainable development, to ultimately achieve the sustainability goal of future human survival on this planet.

Global warming is by far the single most important scientifically based theory, which is based on how human industrialized society has to date, impacted on the natural world. This scientifically based theory led to other environmental scientist to start paying closer attention to the impact that the human carbon based, industrial society has had and will have on the natural world. These science based investigations of the impact that human society has on the natural world, provide validity for the environmental pillar inclusion into the sustainable development concept.

Below is a quick overview of some of the different theoretical world views and their contribution to sustainable development theory. It must be noted that these different theories base either agreement, in either an environmental, social or political point of view. The globally considered secondary needs are also highlighted below and should also be taken into consideration in any sustainable development process.

2.3.1 Social and Environmental Movements

The touchstone of the environmental movement and possibly the conscience of most sustainable development practitioners is ***Deep Ecology Theory***. The core of this theory is the presumption that ecological limits does exist and that human existence is subject to humanity being in harmonious co-existence with the natural world. It is thus no surprise that Deep Ecology advocates equality between all forms of life – human or non-human life forms alike (Blewitt, 2008, pp. 29-32). Deep Ecology's approach can sometimes be perceived as being holistic, but only in so far as it tries to sustaining all life on earth, but it falls short of having a truly holistic approach, as it does not acknowledge the value that non-life forms play in the nature. It does provide though a very good point of departure from which to start to develop a sustainable development process.

Eco-feminism brings to the table the similarities which exist, between historical human power structures, in particular the historical treatment of women and the way that humanity is currently treating nature, whereas ***Eco-justice*** argues that race, class and poverty alleviation should be included into the sustainable development debate. It further more challenges the environmentalists to expand their understanding of sustainable development to also include human inequality (Macy, 1998, p. 48).

The inclusion of social movements like ***Social ecology*** into the sustainable development debate, emphasize the inequality that exist in all spheres of human existence and highlights the fact that *"[s]o long as human beings exploit each other in terms of class, race or gender, humanity will exploit and degrade the natural world."* (Blewitt, 2008, p. 34) Social ecology argues that ecological harmony is subject to social harmony.

Eco-psychology argues that human cultural alienation from nature is the main attributing factor why humans are systematically destroying the natural world (Macy, 1998, p. 48). It presumes interconnectedness between humans and the natural world, even though this perceived interconnectedness is still largely untested. It theorizes that humanity cannot exist in isolation from nature and this perceived theoretical interconnectedness should form an essential part of sustainable development theory.

Bio-regionalism other hand helps to focus sustainable development theory on the possible relationships that exist between, ecology, human social organisation and economic production. It also presumes that new technology can ultimately reverse the damage already caused to the natural world. This presumption is of course conditional on a fundamental shift in human needs and values, which is based on a belief that if this shift does happen, a dynamic equilibrium will emerge that would bring about sustainability (Blewitt, 2008, p. 35). It is worth noting that the Bio-regionalism argument highlights the fact that the interconnection concept does not only apply to the connection between humanity and the environment, but that this interconnectedness also exists between all other connections that exist between humans and their surroundings. In the end bio-regionalism contributes to the sustainable development debate the idea that the interaction between the different components should be taken into account as well.

Lastly there is the idea that traditional ecological knowledge (*elder wisdom*) holds the key to finding and or re-establishing humanity's inter-connected balance with nature (Blewitt, 2008, pp. 36-39). This inter-connectedness concept, hold onto the belief that *"[t]he world should not just be understood and valued in human terms.*" (Blewitt, 2008, p. 40). It also proposes that there should exist, a symbiotic relationship founded on equality between human society, the natural environment of nature and science/technology (Blewitt, 2008, p. 40). In the concept of interconnectedness, science plays an important role, but is not seen as being alone in finding the solution to ultimately achieve the sustainability goal. Here both human and non-human factors should also be taken into consideration.

2.3.2 Complexity Theory and Systems Thinking

The problem of sustainable development and its associated complexity, presented a problem to the traditional scientific research approach of reductionist theory. Traditional reductionist theory is incapable of dealing with the multi-faceted nature of the sustainable development problem. The inherent complexity of the study field of ecology necessitated a new form of scientific analysis to be developed, which can facilitate the analysis of the complex systems found in nature. This new approach to studying, provided a new way in which the problems presented by the sustainable development paradigm to be analysed. This new analytical approach, allow for not only the connections to be studied, but it also allows the scientist to study the relationships that exist between objects as well. It is believed that this new way of study will ultimately provide a new way for science to understand the complexities associated with all living things and subsequently develop a new science associated with sustainable living. This is due to the fact that the study of complex adaptive living systems has the ability to identify problems and possibilities that are simultaneously multidimensional, dynamic and evolving (Blewitt, 2008, p. 41). Macy (1998, p. 46) suggests that a greater understanding of the connection that exists between humanity and the natural world would generate a respect by humans for the natural world and thus mitigate the destruction of the natural world by humanity.

GAIA theory, formulated by James Lovelock and Lyn Margulis in the 1960's is a great example of systems thinking. Gaia theory views the earth as a dynamic and self-regulating life support system that has the ability to be accommodating with an automatic balancing system already in place (Blewitt, 2008, p. 45). Due to the fact that Lovelock called his theory GAIA, after the Greek earth goddess, means that he managed to capture humanities imagination while at the same time appeal to their spiritual nature, effectively managing to explain the earth, in terms of a self-regulating process, similar to a living system and breaching the conceptual divide that exist between science and spirituality (Macy, 1998, p. 44). The basic spiritual need of humans is what Gaia theory brings to the sustainable development debate and could become an important tool that can be used in the sustainable development process to instigate the required changes necessary by human civilisation to ultimately achieve the goal of sustainability.

The capitalist approach to change of ***Ecological Moderation*** theory suggests development through the use of technology which simultaneously has environmental benefits. Ecological Moderation thus suggest a way by which costs can be reduced, and business competitiveness can be improved without making any major changes to the political, public or corporate values (Blewitt, 2008, p. 48). The problem with ecological moderation is that it can lead to *'greenwashing'* if applied in a weak sense.

> ***'Greenwashing'***
> When a company, government or other group promotes green-based environmental initiatives or images but actually operates in a way that is damaging to the environment or in an opposite manner to the goal of the announced initiatives. This can also include misleading customers about the environmental benefits of a product through misleading advertising and unsubstantiated claims (Investopedia, n.d.)

Industrial ecologists study material and energy flow between the environment and industry. They suggest that there are three stages associated with material flow namely: the extraction of natural materials; the conversion of these natural materials into raw materials and lastly the conversion of the raw materials into goods to be consumed and disposed of, with each stage producing environmentally harmful waste unless re-used or recycled. The problem with industrial ecology is that it is an overly technical approach to sustainable development and its inability acknowledges how individual, social and organizational cultures can impact materials and energy flows (Blewitt, 2008, p. 48).

Each of the above theories contribute and highlight a valuable point that needs to be taken into consideration when dealing with the complexities associated with developing a sustainable development process, which would ultimately achieve the goal of sustainability.

2.3.3 The New Paradigm

With mounting research showing that a thriving global society, requires a stable and functioning earth systems, and with human population set to reach approximately 9 billion people by 2050, a need for the revision of the definition of sustainable development to be inclusive of both people and planet has become necessary. This newly proposed unified framework suggest, a new sustainable development definition based on a nested concept of a global economy which services society and which lies within the life support system provided by the earth. This new nested idea differs conceptually from the 1987 definition by the Brundtland Commission, which is based on the idea of the three pillars (economic, social and environmental) sustainable development (Griggs, 2013).

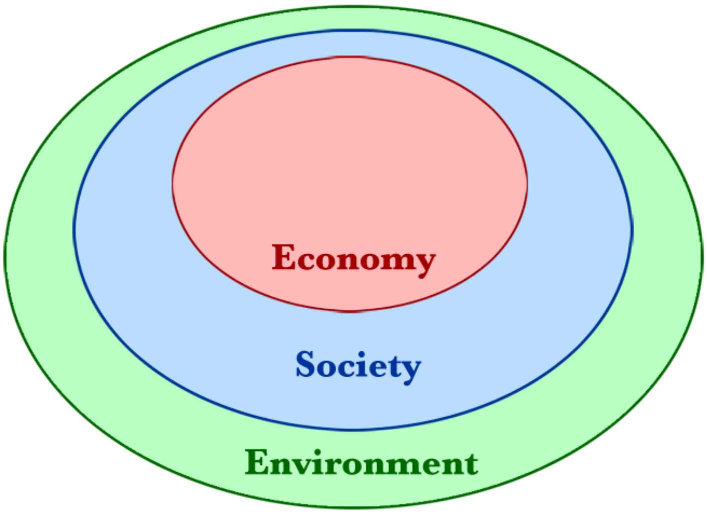


Figure 4: The Nested Sustainable Development Paradigm

(Griggs, 2013, p. 306)

This proposed new definition for sustainable development reads as follow:

"Development that meets the needs of the present while safeguarding Earth's life support system, on which the welfare of current and future generations depends" (Griggs, 2013, p. 306).

This new unified framework idea, combines the new updated people orientated Millennium Development Goals with a list of planetary *'must-haves'* to generate a list of 6 sustainable development goals which are: "1) Thriving lives and livelihoods; 2) Sustainable food security; 3) Sustainable water security; 4) Universal clean energy; 5) Healthy and productive ecosystems; 6) Governance for sustainable societies." (Griggs, 2013, p. 306)

Though this might sound like a great new revision of the currently acknowledged definition of sustainable development, it is yet to be tested by the scientific community and only time will tell if this new definition will be accepted.

Each of the world views highlighted above provides an additional viewpoint and/or objective(s) to the sustainable development debate, taking the sustainable development concept from a simplistic departure point of a means by which to 'save' humanity to a much more complex scenario of how to 'save' humanity, and in so doing create a better life for all, a just world which is based on harmony, equality and balance, for human and non-human worlds alike.

2.4 Defining the Concepts of Sustainable and Ecological Design

Estimations suggest that by 2030 approximately two-thirds of the developing world's population will be urbanised. This represents a challenge of how this growth will be accommodated and whether or not this growth would be beneficial for all. This raise the questions of where will the required resources going to come from and just how 'sustainable' would this growth be in the end? These questions represent the basic questions associated with the sustainable development challenge and only time will tell how successful we will be at solving these problems.

Ecological design does provide a possible means by with some of these questions could be addressed in terms of the build environment. To understand what is meant by ecological design, one has to first look at the world that humans live in. This world consists of two intercepting worlds, on the one side is the natural world and on the other side is the human world. These two worlds interact with each other through dozens of vastly different layers where these two worlds overlap. When there is poor or no integration between these two worlds un-sustainability occurs, thus in order to counteract un-sustainability, one needs to find a way to efficiently and effectively integrate these two different words.

Ecological design concerns itself with providing a framework by which the human world can be redesigned to ultimately facilitate interaction of these two worlds by means of the spaces, landscapes and cities created by the build environment and the through water, energy and waste systems of the build environment (Van der Ryn, 1996).

> *"Ecological design is simply the effective adaptation to and integration with nature's processes. It proceeds from considerations of health and wholeness, and tests its solutions with a careful accounting of their full environmental impact."* (Van der Ryn, 1996, p. 18)

Ecological design, advocates a design approach which is ecologically sound and has a less destructive impact on the natural environmental. This new design approach allows for new design solutions to emerge and to integrate these ecological based designs ideas, technologies, planning methods and policies into every aspect of the human world. Allowing these new ecological design approaches to transcend scale and professional boundaries in a similar way in which nutrients, energy and information flow in the natural world from microorganisms to continents in a natural ecosystem (Gasson, 2002, p. 4). In comparison with Ecological Design, conventional design philosophy seems divided into specialized disciplines which are separated from each other through their individual language, systems and methods. "(T)he inventor Buckminster Fuller once noted, (n)ature did not call a department heads' meeting when I threw a green apple into a pond, with the department heads having to make a decision about how to handle this biological encounter with chemistry's water and the unauthorised use of the physics department's waves." (Van der Ryn, 1996, p. 20).

Nature's design process, 'Evolution' is continuous and completely integrated throughout the entire natural world. Individual organisms in nature are provided with a wide range of abilities like harvesting energy directly from the sun to being able to extract carbon directly from the atmosphere, which enables individual or whole communities of organisms to recycle and regulate nutrients and water while maintaining diversity and structure. The natural world has been created through an evolution process, comprising of a series of nested interconnected activities at different levels. In comparison with the natural world, the human world seems disjointed and without cohesion. No matter how much stand-alone brilliance, intervention or regulation get imposed, this disjointed nature of the human world will go unchanged until such time as design decisions are made that reflect the cohesive pattern found in the natural world (Van der Ryn, 1996).

The design principle *form follows function*, makes up the natural world's delicate composition. Ecological design theory suggests that designers should turn to the rich recourses found in nature for design inspiration. It believes that by emulating natures design strategies the human world could minimise its environmental impact on the natural world. Through the study of the natural world's patterns and cycles, which the natural world has created to sustain life, some very innovative design ideas can be obtained. An example of this is for instance: the use of spider plants to improve air quality in buildings due to spider plants' natural ability to extract pollutants in the air around it. Another good example is how wetlands are able to detoxify compounds, neutralise pathogens and remove vast quantities of nutrients from water which means that wetlands could have an important role to play in the human worlds waste water treatment systems (Van der Ryn, 1996). Essentially the blueprint for human survival can be found in the natural world. The natural world can be seen as representing working capital with a renewable interest rate in the form of clean soil, air and water, but this analogy can only hold true if there is no over spending of this natural capital by humanity.

The management of natural resources on either a regional and or global scale can be seen as a social, economic and ecological problem (Hollings, 2000). Ecological design attempts to address this problem by the of conservation, regeneration and stewardship strategies to prevent and or reverse the over spending of the world's natural capital by humanity.

2.4.1 Conservation

An ecological strategy based on conservation will theoretically slow down the depletion rate of the world's natural capital. It is essentially a preventative strategy which does not exclude damage, but looks at how to minimise the damage that has to be done, thus safeguarding against the situation getting worse. But conservation based sustainable development design strategies often ignore the needs of a more adaptive form of economic development. As far as economic and industrial interests are concerned the uncertainty of nature is often being ignored all together or replaced by management control systems and or engineering solutions (Hollings, 2000). For this reason a strategy based solely on conservation cannot be seen as a means by which a sustainability goal can be achieved, as it by default implies a natural resource deficit, though it can be used as a means by which to limit the deficit in the world's natural resources (Van der Ryn, 1996).

Conservation theory thus highlights that the irrational use of the world's natural resources will result in an environmental crisis. In essence it is not opposed to development, as long as development protects and makes rational use of natural resources, it further more stresses that humanity forms part of nature, but that it will have no future unless humanity conserve natural resource usage.

2.4.2 Regeneration

A regeneration strategy strives to actively restore natural capital through the restoration of damage caused by the human world to communities and ecosystems. Regeneration is a term that effectively describes a process by which to restore, renew and revitalise the natural world's material and energy sources while creating integrated sustainable systems that will address both humanity as well as nature's needs. Regeneration can be seen as a healing and renewal of the known world which embodies a rich harmonious interaction between nature and humanity. It hopes to preserve, protect and restore the plenitude already lost in the natural world (Van der Ryn, 1996).

2.4.3 Stewardship

Stewardship on the other hand is a strategy based on the quality of care of the relationships which exist between the human and natural worlds and can be seen as a process which is based on a committed feedback loop of information between humanity and the natural world. This process requires careful and continual maintenance, through re-investment just as a good gardener tends his garden. The basic principles of stewardship have been developed by means of direct immersion in, observation and reflection of natural eco-systems. These basic principles relate to balance, interdependence, regeneration, diversity and succession of natural ecosystems, human ecosystems and design principles (Smith, 2009). Stewardship is effectively a management system that maintains natural capital through the economical spending and wise reinvestment (Van der Ryn, 1996).

The American Society of Interior Designers sees environmental stewardship as the everyday choices which have tremendous significance for the environment as and that we all share in the responsibility of being environmental stewards. They believe that as an environmental steward, one can choose to use the earth's natural resources (energy, water, raw materials) to effectively reduce environmental impacts. They furthermore see the earth's natural resources to be a part of a whole, life-sustaining system believing that the whole is greater than the sum of its parts (Energy, Materials, Ecosystems, Land, Air and Water). Materials specified on a building project, demonstrate the interdependent relationship that exist between natural resources and as an environmental steward one is responsible for the management and improvement of the environment by means of this list of the distinctive elements pertaining to the process of being an environmental steward:

i. The efficient and effective use of natural resources, thus protecting natural systems while at the same time reducing the world's environmental footprint.
ii. Using a value based practice and decision making process to minimise and or avert environmental harm
iii. The sharing of responsibilities by all involved throughout the full lifecycle of a project, the products and services that is used and supply chain that gets implemented.
iv. Questing for environmental knowledge, through education and science
v. A willingness to challenge the accepted norm and go above and beyond compliance to building codes, rating systems, and the like while striving to raise the performance bar constantly
vi. Being accountable for our choices, our decisions and actions
vii. Anticipating future needs while addressing the needs of the present.

viii. Acknowledging the interconnectivity between environmental quality and quality of life. (ASID, 2012)

2.5 Sustainable and Ecological Design Strategies and Principles

> "Sustainable design describes a design philosophy that values the natural environment as an integral factor in creating new products or modifying old ones." (Ecomii, 2008)

The term sustainable design often refers to the current movements in the architecture and engineering professions which include the local environment of the building and is based on material selection, water and energy conservation as well as the minimising of waste production strategies in buildings.

Today's business environment is made up of clients, employees and shareholders, who are pushing for greater responsibility on issues relating to the triple bottom line of sustainability (social, economic and environmental). Responsible business operations are thus being integrated into every level of a business, with a firm believe that the integration of sustainability factors will enhance the reputations of a business and ultimately improve position and market share. In short it is believed by business that sustainable design will be good for business (ASID, 2012).

Building operation and construction impacts directly on the natural environment. The construction, occupation and end of life demolition of buildings utilise raw material, consumes water and energy recourses and generate vast amounts of solid waste as well as potentially harmful atmospheric emissions. The building industry thus faces some unique challenges to be able to minimise the building industry's impact on the environment, while meeting the demand for both new as well as renovated facilities which are healthy, secure, productive and accessible to all. The retrofitting of existing buildings to meet the current and future needs of humanity can be more cost effective than building new facilities. Including sustainable ecological design principles can increase total building resilience by reducing operational costs and environmental impacts (WBDG, 2012).

Ecological design which generally is defined as "any form of design that minimizes environmentally destructive impacts by integrating itself with living processes" (Van der Ryn, 1996) and sustainable design refer to a hole building life cycle approach, which is at the same time integrated and synergistic. These approaches are, committed to conservation, regeneration and environmental stewardship, resulting in the balancing of economic, social and environmental needs while meeting the functional infrastructure requirements of the facility. The objective of sustainable ecological design is thus to avoid recourse depletion (water, energy and raw materials) and prevent environmental degradation, thus creating a build environment that is productive, safe, comfortable and liveable (WBDG, 2012).

2.5.1 Sustainable Design Principles

While the definition of a sustainable building is still being defined, six fundamental principles do stand out as to what would constitute a sustainable building:

i. Optimising the Potential of the Site

In order to create a sustainable building one has to start with selecting the right site. In this selection process, one should include in one's consideration aspects relating to the re-use and or rehabilitation of any existing structures in existence on the site. A buildings location does impact on the local ecosystems, transportation methods as well as energy usage. This means that the location, orientation and the existing or possible future landscaping of the building should be taken into consideration, irrespective of the size and nature of the building. Physical security, road access, availability of parking and public transport as well as perimeter lighting and the ability to manage storm water runoff is all critical issues associated with the optimisation of the site and thus plays a crucial role in selecting the right site (WBDG, 2012).

ii. Optimising Energy Use

With world fossil fuel supplies dwindling, energy security and independence concerns are increasing. Associated with this is the global concern relating to climate change. It is thus becoming essential that new ways are found, by which to reduce the energy load, increase efficiencies and maximise renewable energy source use in buildings. Any improvement in the energy performance of existing buildings can thus be seen as essential for securing future energy independence. Striving and committing to a net zero energy building is seen as a way to significantly reduce dependence on fossil fuel based energy (WBDG, 2012).

iii. Optimising Water Use

Fresh water is becoming increasingly a scarce resource; sustainable buildings should make efficient use of the available water recourse by conserving, reusing and recycling water for onsite use. This would include the reduction, control and treatment of the sites storm water (WBDG, 2012).

iv. *Using 'Greener' Materials*

The use of 'greener' materials that will help to minimise total life-cycle environmental impacts like global warming, recourse depletion and toxicity of both the natural as well as human environments. These environmentally preferable materials not only benefit human and environmental health, but it also contributes to greater worker safety, reduces liabilities and disposal costs and helps with the achievement of environmental goals (WBDG, 2012).

v. Enhancement of Indoor Environmental Qualities

A building's indoor environmental quality (IEQ) can have a significant impact on the productivity, health and comfort of the people who work in the building. A sustainable building will strive to maximise the available daylight in the building, have adequate ventilation, regulate humidity, provide appropriate acoustic privacy and should avoid the use of materials with high toxic (e.g.

VOC) emissions. Furthermore, individual control of environmental systems, especially temperature and lighting, is advocated by the principles of a good IEQ strategy (WBDG, 2012).

vi. Operational and Maintenance Optimisation Practices

Considering the operational and maintenance aspects of a building during the initial design phase will ultimately contribute to the reduction in both energy and recourse costs. It may also prevent system failure and has the added benefit that it can contribute to an improved working environment resulting in higher productivity. By allowing the operational and maintenance personnel participate in the design and subsequent development phases, the optimal operation and maintenance of the building will be ensured. For example, the specification of materials and systems that requires less maintenance, will result in possible benefits which could include; a reduction in the water and energy consumption of the building, the use of less toxic chemicals and cleaning material in the maintenance of the building, making the building more cost effective while reducing the total life cycle costs of the building as a whole. In addition to this, the inclusion of meters and the introduction of management systems that will enable the tracking and monitoring of the sustainable initiatives can help to quantify for instance, the extent of the reductions in water and energy use and how much waste is being generated. Monitoring sustainability initiatives will also help to enable benchmarking against of the building against other sustainability projects. Which will allow the establishment of just how resilient and adaptable a building is, thus establishing a building's overall sustainability (WBDG, 2012).

2.5.2 Ecological Design Principles

In addition to the above mentioned sustainable design principles, Sim Van Der Ryn and Stuart Cowan (1996) put forward five ecological design principles that, in their opinion, will enable the delivery of the sustainability goal in the building environment:

i. Design solutions are to be site specific.

Ecological design upholds the philosophy that design should be inspired by ecology. For this to be possible, an intimate knowledge of a particular place is essential to the design. It argues for sensitive site specific design solutions that respond to the specific 'nuances of place' and the 'local' people, is small in scale and provide a direct solution that allows of habitation without destroying of the environment thus the design should reflect the bio-regionalism of the site.

ii. Design to be informed by means of Ecological Accounting.

The most ecologically sound design solution is established, by monitoring the environmental impacts of existing as well as new designs. Thus projects should ultimately be based on renewable sources.

iii. Designing with Nature

By respecting the needs of all species, we can meet our own needs by working with, rather than against living processes, thus regenerate rather than deplete the natural resources around us and through this process become more alive. This restorative environmental design principle highlights the importance of place and the instinctive bond that exist between humans and other living things. The living world should be the matrix for all design and biological equity should ultimately determine the design.

iv. Everyone is a Designer.

Honouring the special knowledge that each individual can bring to the design process, listen to every voice so that no individual is seen as either only designer or only participant, thus allowing people to work together, using nature as a toolbox to find the design solutions that will heal not only the place, but themselves as well.

v. Make nature visible.

Environments with no connection to nature, ignores both humanities need of nature as well as the potential to learn from nature. The visibility of the natural processes and cycles found in nature brings the designed environment back to life, it also helps to informs and establish our place within nature. Thus design should follow and not be opposed to the natural laws of life and that the design be sustainable through its integration of living systems and be co-evolutionary with the natural world.

> *"Ecological design brings flows to the foreground. It celebrates the flow of water on the landscape, the rushing wind, the fertility of the earth, the pluralities of species, and the rhythms of sun, moon, and tides. It renders the invisible visible, allowing us to speak of it and carry it in our lives."* (Van der Ryn, 1996, p. 24).

Ecological design embraces the philosophical strategies of stewardship, regeneration and conservation, and brings together those technical aspects and personal dimensions that are associated with obtaining a sustainability goal. Thus, by following ecological design principles, reductions in energy and material flows can be achieved, which mean that the human world can once more be integrated with the natural world (Van der Ryn, 1996).

2.5.3 Building industry application of Ecological Design Principles

Birkeland (2002, p. 3), in Design for sustainability: A sourcebook of integrated eco-logical solutions mentions that, *"(p)oor urban design and architecture kills more people each year than terrorism."* Un-sustainability is a design problem, which means that it is possible to reverse un-sustainability through design. The transfer of harmful resources between the natural and human worlds is mostly masked by current urban life. Consequently the current urban life system have the ability to destroy both the human and the natural world's means of survival, as it limits basic life choices and creates conflict over available resources (Birkeland, 2002, p. 3).

The Brundtland commission proposed that development is the solution by which infrastructure can be provided, for both the natural and human worlds to flourish. Birkeland (2002, p. 4), on the other hand argues that the built environment could be the means by which social and environmental transformation could be achieved. But for this to become reality, a paradigm shift is required as the management, design and planning tools is geared to addressing symptoms associated with environmental protection, rather than fixing the inherent problems that lies in the design of the system. The building industry is based on the principle of 'best practice'. It is this principle that limits one's ability to question the effectiveness of a design solution and allows for inefficiencies and mistakes of the past be repeated. A new decision making system is thus required in the building industry, which will encourage diversity, reversibility and adaptability of design solutions, because the design of a building can either impact positively or negatively on material and resource flows (Birkeland, 2002, p. 5).

Examples of ecologically designed neighbourhoods and buildings, demonstrate that significant resource reductions is possible through appropriate and responsible design solutions. These examples show that a smaller ecological footprint can be achieved through designs that have a high conservation standard, which include but are not limited to the utilisation of high standards of insulation; district and or solar heating; water conservation and the use of sustainable building materials. Emphases are also placed in these designs on the use of passive design principles and recycling and material re-use is encouraged. The role that automobiles plays in these developments are also minimised by locating the developments in close proximity to public transportation and designing into the development the necessary infrastructure that will encourage bicycling and walking. This means that it is possible to limit the number of available parking spaces as other means of transport is available (Beatly, 1997).

If you are designing either a new development or are planning a major renovation, the Ecological design provide a great point of departure by which one can reduce a developments' ecological footprint, but these new 'sustainable developments' only make up a fraction of the huge existing building stock already in existence in the world. Can the existing building stock be made more sustainable?

2.6 Conclusion

Integrating ecological and sustainable design principles into the build environment and allowing "...nature to do the work, (will) allow ecosystems to flourish even as they purify and reclaim wastes, ameliorate the climate, provide food, or control flooding." (Van der Ryn, 1996)

This initial theoretical baseline literature review looked at some contemporary literature on sustainability, sustainable development, sustainable design and ecological design. Providing a theoretical background on which the rest of this research study on Developing a Sustainability Benchmarking System can be build.

The initial literature review revealed that sustainability is seen as the goal that the Sustainable Development process hopes to deliver. It also revealed that the primary aim of sustainable development is to achieve the goal of survival of future generations of the human race and that it is the responsibility of the current human generation to realise this goal. Quality of life for future generations was also identified as a secondary but equally important goal of the sustainable development process. Which leaves the open-ended question: Why does humanity need to be sustained? I would presume that this would be a very one-sided debate as the natural world is not capable to participate.

This leaves the posed question of how the goal of sustainability can be accomplished. The world views on sustainable development and sustainability, revealed a number of different points that should ideally be incorporated into the sustainable development process to ultimately achieve the sustainability goal. The goal of sustainability was identified as being far more complex in nature than the simple goal of human survival might imply. In principle the goal of sustainability suggests that humanity should strive through the sustainable development process to create a future for humanity that is not just better for future human generations but also better for the future of the natural environments in which humanity exist. A sustainable development process in other words is seen as a dynamic, complex and multidimensional process which not only addresses issues relating to human existence but also takes into consideration those aspects that impact the natural environment as well.

It is a holistic view of the dynamic, complex and multidimensional aspects associated with the sustainability problem, and ideally a systems theory approach to sustainable development should be used to identify and study the relationships that exist between the different parts of the sustainable development process. Allowing humanity to make informed decisions that will lead to achieving the ultimate goal of sustainability.

A person's life is spent predominantly in or around buildings structures. These building structures are created to satisfy the very basic human need of shelter (cold, heat, wind, rain...etc.), but it is because of this protection function of buildings that they also contribute to the isolation of humanity from nature. Buildings also impose a huge environment cost on the natural environment. All this because of the human need for shelter, which raises the question; Is it possible to fulfil this basic human need for shelter without isolating humanity or damaging the environment at the same time?

In principle, yes, it is possible to protect the world's natural recourses and prevent human isolation by means of environmentally responsible design coupled with manufacturing processes which are based on lifecycle assessments and objectives. These objectives can be achieved through conservative material use and re-cycling, making sure that harmful toxins used in products and subsequent pollution are minimised and that water and energy use is efficient and effective. Lastly that the building or building product's end of life should be taken into consideration, in particular to re-use, re-cycle, re-purpose and finally dispose of the building or building product in a sustainable and environmentally friendly way (ASID, 2012).

As the American Society of Interior Designers (2012) puts it:

> "*The prosperity of humankind and the quality of the environment are interlinked and fundamental to our success through collaboration, shared responsibility and integrated design. As environmental stewards we need each other for inspiration, for support, for information, for best practices, for accountability, for collaborations - ultimately creating a community that takes us into the future.*"

Sustainable and Ecological design are design philosophies which provide the conceptual framework by which humanity may be able to re-connect and re-integrate with the natural world and ultimately achieve a sustainable future for all.

Ecological design in particular highlights the true impact built environments had and still have on the world's natural environment. It argues that a conscious shift in design philosophy is required, and suggests a re-examining and fixing of the design problem, instead of fixing the symptoms caused by the design problem.

This initial literature review furthermore highlights the fact that even though great improvements have been made to date, in designing 'new' sustainable and ecological developments, greater emphasis should be placed on what is to become of the existing building stock in the world. These buildings have an important role to play in how building structures impact both the human as well as the natural world.

Chapter 3: International Building Rating Tools

3.1 Introduction

This chapter will provide an overview of some of the available building rating tools to establish if they address all the aspects of the sustainability challenge. There exists numerous building rating tools in the world, some which are used internationally, while others are country-specific or region-specific. These building rating tools have primarily been developed to rate buildings in terms of their environmental sustainability, and to specifically measure, rate and certify buildings in terms of their environmental impact on the world. But these building rating tools, currently in existence, fall short in being able to rate and address the sustainability challenge which has been defined in the initial chapters of the study.

This chapter will take a quick look at the different rating tools that currently exist, to establish what the main criteria being used are, for assessing buildings in the world today. What differences exist between the major rating tools and where these rating tools fall short when assessed in terms of the social, economic and environmental criteria that makes up the sustainability challenge.

In addition to the three main building rating tools used internationally, a quick overview of a few country-specific building rating tools will also be reviewed to show the general trends that exist when it comes to rating building. Thereafter the specific rating tools developed for existing buildings will be discussed, followed by a conclusion that will provide overview of all the building rating tools discussed.

3.2 The dominant building rating tools

There are three dominant building rating tools currently used in the world and it is these building rating tools that this study will predominantly focus on, to highlight the differences and similarities that exist between them. These three ratings tools are the LEED, BREEAM and Green Star rating systems. This focus on these three more dominant rating systems is done to narrow the field of comparison for this study, as there are almost as many building rating tools as there are countries in the world today. These more dominant building rating tools discussed in this study are:

3.2.1 LEED

The *Leadership in Energy and Environmental Design (LEED)* is a building rating approach, which was developed by the United States of America's (USA) Green Building Council (USGBC). It was first launched in 1998 and has subsequently become an internationally recognised green building certification system. It provides third party verification of the design and / or as build rating of either a building or a community, and is predominantly used in the USA, Canada, Brazil and India. The LEED approach uses strategies aimed at improving performance across metrics categories which are deemed to be important. In essence the *LEED* approach, rate the design of a building according to five main categories, each category carrying a different weighting, signifying that particular categories importance by means of the amount of credits assigned to that particular category (IPD, 2010, p. 17).

The five main categories and associated credit are as follow:

i. **Energy and Atmosphere** (35 credits)
Here the design of a particular building is rated according to the reductions obtained in terms of energy use and CO^2 emissions of the building.

ii. **Sustainable Sites** (26 credits)
Here the design of particular building according to the sensitivity of the impact of the building.

iii. **Indoor Environmental Quality** (15 credits)
Here the design of a particular building according to the improvement in indoor environmental quality.

iv. **Materials and Resources** (14 credits)
Here the design of particular building according to the stewardship of recourses.

v. **Water Efficiency** (10 credits)
Here the design of particular building according to the buildings efficient use of water.

Rating of a building using the LEED rating system is done by way of an initial self-assessment, according to the different categories listed above. After which, the scores of each category is validated by the Green Building Certification Institute (GBCI) who then provides certification. Credits are awarded based on 100-point scale, with the possibility of an additional 10 bonus points which can be obtained for innovative the design is (6 credits) and regional priority (4 credits) which means the maximum LEED Score is 110 points. This allows the following certifications to be awarded:

i. **Certified** 40-50 credits
ii. **Silver** 50-60 credits
iii. **Gold** 60-80 credits
iv. **Platinum** 80-110 credits

NOTE: *No certification can be obtained by buildings that score of less than 40 credits* (IPD, 2010, p. 17).

3.2.2 BREEAM:

The *Building Research Establishment Environmental Assessment Method* (**BREEAM**) is a rating system that was developed by the Building Research Establishment (BRE) of the United Kingdom (UK) and was first launched in 1990. It is a widely used environmental assessment method for buildings, setting the best practice standard for sustainable building design in the UK, mainland Europe as well as the Middle East. The **BREEAM** rating system makes uses nine categories to assess a broad range of environmental impacts which include environmental management issues, water and energy usage as well as waste production. These nine categories their associated credits and weighting is:

i.	**Energy**	(24 credits)	(19% weighting)
ii.	**Health and well- being**	(13 credits)	(15% weighting)
iii.	**Materials**	(13 credits)	(12.5% weighting)
iv.	**Pollution**	(12 credits)	(10% weighting)
v.	**Management**	(10 credits)	(12% weighting)
vi.	**Land use and ecology**	(10 credits)	(10% weighting)
vii.	**Transport**	(10 credits)	(8% weighting)
viii.	**Waste**	(7 credits)	(15% weighting)
ix.	**Water**	(6 credits)	(6% weighting)

(IPD, 2010, p. 16)

Rating of a building by way of the BREEAM system is done by an initial self-assessment which is based on the performance of the building in each category listed above where after the scores of each category is validated by a licensed BREEAM assessors.. The predetermined weighting of each category, enables the credits to be added together and to produce an overall score out of 100%. This allows certification to be awarded by the Building Research Establishment according to the following available certification criteria:

i.	**Unclassified**	0-30%
ii.	**Pass**	30-45%
iii.	**Good**	45-55%
iv.	**Very Good**	55-70%
v.	**Excellent**	70-85%
vi.	**Outstanding**	85-100%

NOTE: *BREEAM allows for all buildings to be rated regardless of their final score* (IPD, 2010, p. 16).

3.2.3 GREEN STAR:

The *Green Star* scheme was pioneered and developed by the Green Building Council of Australia (GBCA) and first launched in 2003. It is a comprehensive, environmental rating system for the evaluation of the environmental design and construction of buildings and is predominantly used as a building rating system in Australia, New Zealand and South Africa. It sees its primary aim as driving the transition of the property industry towards sustainability. The Green Star rating system takes a more middle of the road approach to rating buildings and as such, makes use of eight categories to assess the environmental impact of a building, which is a direct consequence of the projects site selection, design, construction and maintenance. In addition to the primary eight categories (which include environmental management, energy and water use as well as waste production), Green Star also include innovation as an additional category in which bonus credits can be obtained.

These eight primary categories are:

i.	**Energy**	(30 credits)	(25% weighting)
ii.	**Indoor environmental quality**	(28 credits)	(15% weighting)
iii.	**Materials**	(22 credits)	(13% weighting)
iv.	**Emissions**	(17 credits)	(8% weighting)
v.	**Water**	(15 credits)	(14% weighting
vi.	**Transport**	(14 credits)	(9% weighting)
vii.	**Management**	(14 credits)	(9% weighting)
viii.	**Land use and ecology**	(9 credits)	(7% weighting)
ix.	**Innovation**	(5 credits)	

(GBCSA, 2012, p. 23)

Rating a building by way of the Green Star rating system is done by means of an initial self-assessment, in terms of to the different categories listed above, where after the scores are validated by a case manager of a specific country's Green Building Council. Once the credits in each category have been assessed, a percentage score is calculated and the Green Star environmental weighting factor is applied for that specific category. In order to obtain certification, certain conditional requirements has to be satisfied, after which certification of the building as either a design or an as-build certification according to the following stars rating will be awarded (GBCSA, 2008):

i.	**4 Star**, signifying 'best practice'	45-60%
ii.	**5 Star**, signifying 'excellence'	60-75%
iii.	**6 Star**, signifying 'world leadership'	75-100%

It must be noted that even though the categories and awarding of different star ratings in different countries are the same, the amount of credits and the weighting of each category differ from country to country to allow for different the different importance placed on the different categories.

3.2.4 Comparison between LEED, BREEAM and GREEN STAR

In order to be able to make comparisons between the different ratings systems outlined above, the GREEN STAR Categories was used as a basis by which this comparison was done. This is because the GREEN STAR categories seem to provide a much simpler categorisation. Even so one must keep in mind that there are a number of fundamental differences relating to these different rating systems.

For instance, BREEAM uses nine categories to assess environmental performance and applies weighting factors to each category with no importance being attached to Innovation. LEED on the other hand only uses five categories with additional credits available for innovation in design and regional priority, but the LEED categories are not weighted. GREEN STAR seems to take the 'middle road' by using eight categories, with weighting of the individual categories being applied (IPD, 2010, p. 18). GREEN STAR is also country/region specific which the other two are not. This achieved bay way of the credits that can be achieved in a specific category well as the weighting of that category is country specific. GREEN STAR also makes provision for awarding Innovation by way of extra credits that can be obtained (GBCSA, 2012) (IPD, 2010, p. 18).

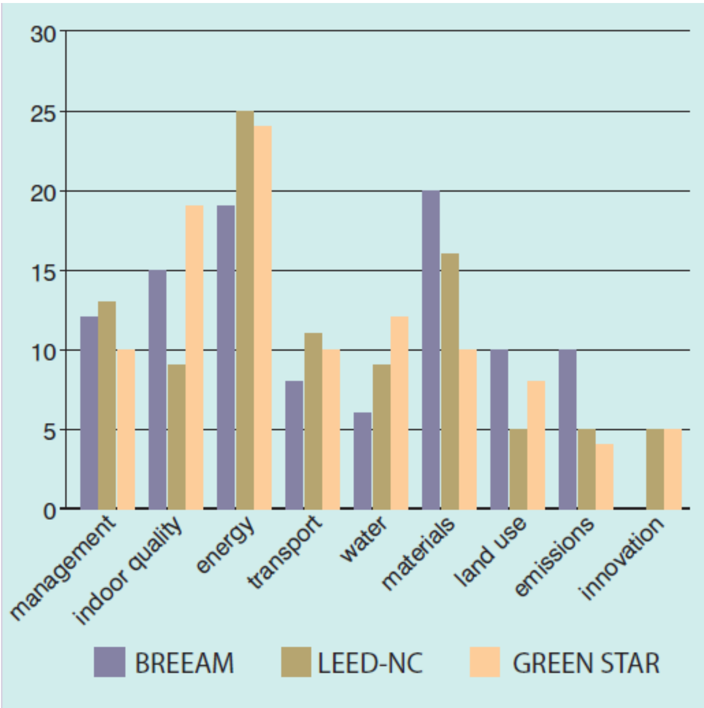


Figure 5: Weighting differences between BREEAM, LEED & GREEN STAR

(IPD, 2010, p. 18)

When one compares the category weightings, BREEAM can be seen to places greater importance on materials, emissions and land use. LEED on the other hand, places greater emphasis on management and energy, whereas GREEN STAR, places greater importance on indoor quality and water (IPD, 2010, p. 18).

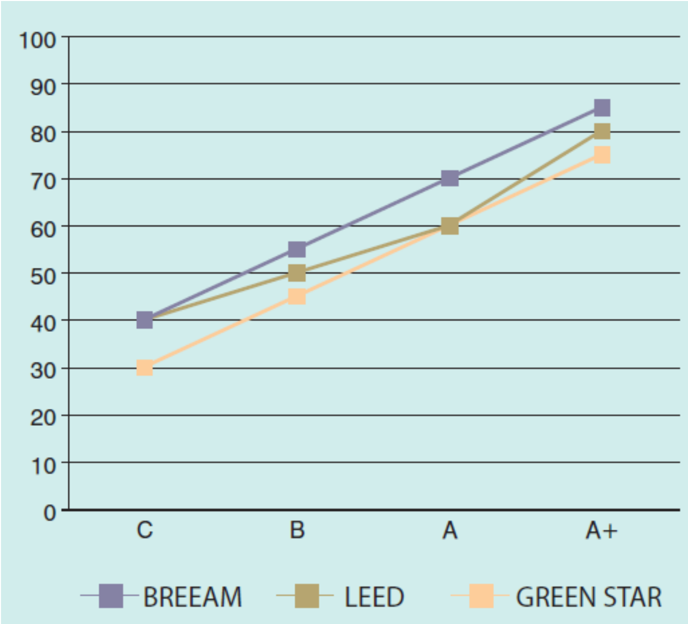


Figure 6: Rating differences between BREEAM, LEED & GREEN STAR

(IPD, 2010, p. 18)

When one compares the certified ratings of the different rating systems, BEEAM has the most onerous questionnaire for accreditation, while GREEN STAR has the shortest. Here LEED's ratings hold the middle ground.

3.3 Country specific building rating tools

Besides the dominant building rating tools discussed above, there are a number of other building rating tools that are worth mentioning. These rating tools are mainly used on a national basis in their individual countries. There building rating tools are listed below according to the countries they are primarily used in:

Australia

NABERS (National Australian Build Environmental Rating System) is a performance based rating system that has specifically been developed to enable rating existing buildings, in particular office buildings, hotels or residential buildings. The buildings are rated on the basis of the buildings, measured operational impact on the environment. NABERS is a national initiative which is managed by the NSW Government and is designed to work in conjunction with GREEN

STAR, allowing you to compare the actual operational performance data established by NABERS with the environmental potential from the GREEN STAR rating. NABERS focus lies on energy and water use, indoor environmental quality and greenhouse gas emissions (IPD, 2010, p. 68).

GREEN STAR – Australia, as discussed above, was developed by the Green Building council of Australia (GBCA) and launched in 2003 (IPD, 2010, p. 68).

Brazil

AQUA is the Brazilian certification system which has been adapted from the French HQE system, but in Brazil the **LEED** rating system is also widely used (IPD, 2010, p. 68).

Canada

Green Globes is a building environmental design and management tool which is based on the BREEAM rating system. It is an online assessment protocol, guidance and rating system for green building design, operation and management (IPD, 2010, p. 68).

China

The **'ESGB'** ('Evaluation Standard for Green Building') launched in 2006 is similar to the **LEED** rating system. **'ESGB'** collects building energy consumption data by the Ministry of Construction (MoC) and this data are then used to asses a buildings performance, after which a Green Building Star rating can be awarded. The **GOBAS** (Green Olympic Building Assessment System) is another green building rating system used in China and was developed from Japan's **CASBEE** (Assessment System for Building Environment Efficiency). **LEED** is also being used in China, where high performance building projects are supported by both business as well as government (IPD, 2010, p. 68).

France

The **HQE** (High Quality Environmental) approach was developed by the Association for High Quality Environments (ASSOHQE). HQE certification rates consideration of environmental issues in the construction of buildings. It is based on the principles of sustainable development as was set out at the 1992 Earth Summit. This standard focuses on the creation of a pleasant indoor environment and the management of impacts that the building has on the outdoor environment (IPD, 2010, p. 68).

NF-HQE ® certification is a scheme developed specifically for non-residential buildings. This global approach has been designed to improve the environmental quality of the build environment. It made up of two distinct parts. The first part deals with the environmental quality of the building and is made up of 14 categories. The second part has been developed specifically to enable the ongoing environmental management of the building project. This combination of process and results in an integrated system is what makes this scheme so unique. (IPD, 2010, p. 68)

Germany

The **DGNB** (German Sustainable Building Council) certification was developed as a joint venture between the DGNB and the Federal Ministry of Transport, Building and Urban Affairs as a tool, to be used in the planning and evaluation of buildings. This tool is a clearly arranged and easily understandable, rating system to form a comprehensive perspective on quality. The DGNB certification covers all relevant topics of sustainable construction and the buildings and focuses on ecology, economy, social-cultural and functional topics as well as techniques, processes and location. The certification is ultimately awarded in terms of either a bronze, silver of gold rating (IPD, 2010, p. 68).

India

GRIHA (Green Rating for Integrated Habitat Assessment) was jointly developed by The Energy and Resource Institute (TERI) and the Indian Governments, Ministry of New and Renewable Energy. It is a green building design evaluation system which is suitable for a variety of buildings in an array of different climatic zones found in India. GRIHA rates buildings on four main categories which are; i) site selection and site planning, ii) building planning and construction phase, iii) building operation and iv) maintenance and innovation (IPD, 2010, p. 68).

Italy

ITACA was developed by the Sustainable Building council Italia (SBC Italia) with the support from the Instate for Innovation and Transparency. The ITACA certification is in terms of full life cycle of the building. This assessment tool contextualises environmental impacts according to type of project, building characteristics and its location and allows for the estimation of the level of environmental sustainability and focuses on five main areas: The quality of the site, the consumption of resources, environmental burdens, indoor environmental quality, and finally the quality of service provided (IPD, 2010, p. 69).

Japan

CASBEE (Comprehensive Assessment for the Building Environmental Efficiency), developed by the Japan Sustainable Building Consortium (JSBC) under leadership of the Ministry of Land, Infrastructure, Transport and Tourism as a voluntary evaluation tool for assessing the environmental design and performance of buildings. CASBEE essentially evaluates buildings in terms of two assessment categories: The first of which is Quality and Performance, which looks at the indoor environment, the quality of service as well as the outdoor environment of the building. The second category assesses the building in terms of its environmental loadings in particular energy, materials and the off-site environment (IPD, 2010, p. 69).

Hong Kong

BEAM (Building Environmental Assessment Method) was established by the BEAM Society with the issue of two assessment methodologies, one for new buildings and the other for existing office buildings. BEAM is largely based on BREEAM, and provides building users with one performance label for the overall qualities of the building. In principle a BEAM rated buildings will be safer, healthier, more comfortable, more functional and more efficient than a similar building which does not conform to the same prescribed level of performance. BEAM prioritises indoor quality and amenities, but also stresses the important role that local, regional and global environmental impacts have on a building (IPD, 2010, p. 69).

Malaysia

GBI (Green Building Index) promote sustainability in the build environment in Malaysia. It raises awareness among architects, contractors, developers, engineers, designers, planners as well as the public about environmental issues and our responsibility for future generations. The **GBI** methodology assesses buildings in terms of six categories; energy efficiency, indoor environmental quality, sustainable site planning and management, materials and recourses, water efficiency and finally innovation (IPD, 2010, p. 69).

Portugal

LiderA (Leadership for the Environment in Sustainable Building) is a voluntary assessment system for sustainable building and the build environment. In terms of LiderA, buildings are assessed on six categories and rated on a scale from A to C.

These six categories are:

i. Site integration,
ii. Resource consumption and efficiency in terms of water, energy and materials,
iii. Load impacts in terms of waste-water, emissions, solid waste, noise and thermal effects,
iv. Indoor environment,
v. Durability and accessibility,
vi. And environmental management and innovation,

(IPD, 2010, p. 69)

Singapore

GREEN MARK was established by the Building and Construction Authority (BCA) in Singapore to drive Singapore's construction industry towards more environmentally friendly buildings. Promoting sustainability in the build environment and raising environmental awareness among developers, designers and builders alike, at both concept design stage as well as during the actual construction phase of the building. Green Mark buildings are seen to reduce water and energy consumption, limits environmental impacts, improves indoor environmental quality and provided clear direction for continual environmental improvement (IPD, 2010, p. 69).

What is evident, from the above breakdown of the available building assessment tools currently available in the world, is that even though they have substantially different departure points, and methodologies, they all have the same goal in mind and that is to produce a safer, healthier, more comfortable, more functional and more efficient built environment.

3.4 Rating existing buildings

The above review on the currently available building assessment tools highlight, that the vast majority of these building rating tools can be used to establish, rate and certify the environmental sustainability of any new or majorly renovated building in terms of either a design and or an as-build basis. The rating and subsequent monitoring of the performance of an existing buildings, is lagging behind, but rating tools like, **NABERS** (National Australian Build Environmental Rating System) in Australia (which works in conjunction with GREEN STAR Australia), **BREEAM In-Use** and **LEED-EB** is fast busy closing this gap.

Investors and occupiers are expecting buildings to be more environmentally friendly (World Green Building Council, 2013). This means that more and more buildings are being certified according to one of these above mentioned international rating standards. A demand is consequently being created for current data, relating to the environmental performance of existing building to be easily and readily available enabling this data to be updated and reported on, on a much more frequent basis. A need to be able to link this data to the financial performance of the building has subsequently also developed, and has become a key component to the successful management of a building or a property portfolio (IPD, 2010).

This need for building specific environmental performance data is the main driver that is driving the development of building rating tools that would be able to measure the overall performance of buildings or property portfolio. Associated with this need for reliable and readily accessible performance data on existing buildings, is the need to have an international building rating standard, which will enable different buildings categories in different parts of the world to be accessed on the same assessment criteria. Originations is finding environmental compliance and reporting requirements overwhelming, especially in light of the numerous number of different way by which a buildings environmental performance can be assessed and reported on. An international building rating standard would go a long way to making this task easier to originations and building owners.

IPD (2010, p. 10) provides just such an international building rating standard, providing a high quality performance analysis, benchmarking and research service, which is founded on their industry standard and measurement framework known as Global Estate Measurement Standards. IPD’s aim is to provide a simple, universal set of core information, from which many reporting requirements can be met by organisations and building owners alike. This set of core information aims simplify as well as provide support, enabling environmental performance management tasks, corporate as well as regulation compliance reporting and accreditation to be simplified (IPD, 2010, p. 10).

3.5 Overview of building rating tools

Numerous building rating tools exist in the world, enabling architects, contractors, developers, engineers, designers, planners and the general public at large to certify new buildings or building undergoing major renovation on the basis of their design or as-build quality in relation to the impact the building will have on environmental sustainability for current and future generations.

These building rating tools generally asses' a buildings according to the following categories:

i. The building's integration with its site as well as its immediate surroundings.
ii. The building's resource efficiency and consumption, generally defined as the buildings water, energy and material consumption.
iii. The building's waste production and pollution, in particular in terms of solid waste, wastewater, emissions like for instance CO_2, noise generation as well as the buildings thermal effect.
iv. The building's indoor environment, which is generally, assessed according to the buildings air quality, the availability of natural light, the exposure to toxins and the thermal comfort buildings of the building.
v. The building's durability in terms of maintenance.
vi. The building's accessibility in terms of transport.
vii. And finally how easily the building's environment can be managed.

Assessing these generalised categories, in terms of the sustainable development challenge as defined in the initial chapters of this study, one finds that these assessment categories deals almost exclusively with a building's impact on the environment, whether it be human or the natural environment.

It thus stands to reason that the current international building rating tool, generally cannot be seen as a true reflection of building's overall sustainability, as for instance both the social and to a lesser degree the economic pillar of the sustainability challenges, as per the Brundtland commission's basic definition of the sustainability challenge, has largely been ignored by these building rating tools, with the only real economic benefit being the more efficient use of natural goods. The social impact of the building is neither assessed, nor is it certified. What is clear is that these building rating tools have been developed to rate and certify only the environmental performance of buildings.

What has emerged, as a result of having to produce reports on a building's environmental performance and sustainability, is that relevant and reliable building performance data is needed, which will allow building owners and organisations to report on a building's management and overall environmental performance.

Chapter 4: Benchmarking

4.1 Introduction

> *"Efficient management is dependent on the availability of good information and the ability to interpret it meaningfully and use it efficiently. In the case of property management, good data would inform senior management, and help ensure that property is given due consideration at a strategic level"*
>
> ***Lord Carter of Coles -*** *Operational Efficiency Programme 2009* (OGC, 2010, p. 2)

The Better Building Partnership (2010, p. 3) in the 'Sustainability Benchmarking Toolkit for Commercial Buildings: Principles for best practice', defines benchmarking as: "A point of reference for measurement; a defined level of performance used as a reference for comparisons. Benchmarks can be based on averages or percentiles of real performance. On the other hand, they can be based on policy-driven objectives such as 'net zero carbon'. "

Benchmarking is a lengthy and complex process with numerous benefits, which can include for instance a greater understanding of how an existing building operates. It allows comparisons to be made between buildings and it enables the identification of areas where improvements can be made. It also provides the information on which new legislation can be based (BBP, 2010, p. 4).

A building's economic and environmental sustainability performance can be accessed by way of a number of different assessment methodologies already in existence in the world. **LEED**, **BREEAM** and **Green Star** are examples of such assessment methodologies, which assess new buildings or buildings undergoing major renovation work. **NABERS, LES-TER** and **BREEAM in Use** on the other hand are methodologies which assess existing buildings in terms of their environmental performance. In addition to these, there also exist a number of organisations which offer sustainability benchmarking services (BBP, 2010, p. 4) **IPD**, the **Better Building Partnership** and the **One Planet Action Plan** is examples of such sustainability benchmarking services. These sustainability benchmarking initiatives have led to a far greater understanding of how to measure, report and benchmark a building's sustainability.

4.2 Defining benchmarking

The term '*benchmark'* comes from the surveying profession and refers to a process where a notch or mark is made to indicate a given height, from which all other heights can be measured. It has subsequently come to mean any standard against which something is compared (OGC, 2010, p. 2).

Estate management requires vigilant attention to detail, no matter what the economic climate is. This is so that space and recourses are not wasted and that the associated costs are fully understood. The ability to maintain this consistently over the long term requires a robust process which allows for continuous measurement. Benchmarking can provide this robust process, enabling comparisons to be drawn on basis of cost, space and recourses utilisation as well as the performance of a particular building or estate over time. An additional benefit of benchmarking is that it can also be used to provide peer and industry comparisons. Variables which can affect management, can be measured, counted and compared on a like for like basis, providing understanding of where opportunities may exist, which can ultimately lead to improvements in efficiency and effectiveness (OGC, 2010, p. 2).

Benchmarking can thus be seen as a point of reference for measurement, where a defined level of performance is used as a reference from which comparisons to be made. Benchmarks can either be based on averages or percentages of real performance over time. Alternatively, benchmarks can be based on policy-driven objectives such as *'net zero carbon'* (BBP, 2010, p. 3).

Efficient and effective management of resources requires that an organisation is able to measure and monitor the performance of resources, to ultimately improve the management of those resources (City Of Cape Town, June 2012). Buildings are valuable assets, which support the core operations of any organisation, thus ensuring that buildings are managed efficiently, effectively and environmentally sustainably seems to be an essential. Collecting data is relatively simple, but transforming that data into meaningful matrices suitable for performance comparisons is another matter. The right data matrices are required to make effective and informed decisions which can deliver solid benefits, legalise efficiency savings, improve performance and ultimately provide a means by which relevant reporting can be done (OGC, 2010, p. 3).

Growing trends of mandatory mechanisms exist, which require estate managers to collect environmental sustainably data. Though the required data for each scheme varies, for instance the data required for Energy Performance Certification (EPCs), Display Energy Certificates (DECs) and Carbon Reduction Commitment (CRC) all differ significantly (BBP, 2010, p. 4). In addition to these, a number of international standards on sustainability measurement and reporting are being development, such as IPD's Cost, Space and Environmental Codes (IPD, 2010) the Global Reporting Initiatives (GRI) Construction and Real Estate Sector Supplement (CRESS) (GRI, 2010-11) and the UNEP Global Guide for Building Performance as part of the Sustainable Building and Climate Initiative (SBCI).

The UNEP-SBCI's mission for instance is, to promote the worldwide adoption of sustainable building and construction practices. Its work plan is guided by the following goals:

i. The provision of a global platform for collective action and dialogue of all building sector stakeholders for the addressing of sustainability issues of global significance, in particular climate change.

ii. The development of tools and strategies to achieve as wide as possible acceptance and adoption of sustainable building practices and policies throughout the world.

iii. The establishment of globally acknowledged baselines based on a full building life-cycle approach, with a primary focus on energy efficiency and greenhouse gas (GHG) emissions.

Ultimately the UNEP-SBCI's mission is to participate in pilot projects, which will support and inform policy developments, while at the same time recognizing the role that buildings can play in the mitigation of climate change (UNEP, 2012).

GRI (Global Reporting Initiative) Sustainability Reporting Guidelines on the other hand offer reporting principles, standard disclosures and an implementation manual for the preparation of sustainability reports by organizations, regardless of their size, sector or location. It also offer an international reference for all those interested in the disclosure of governance approaches and of the environmental, social and economic performance and impacts of organizations. These GRI guidelines do form a useful base for use in the preparation of any type of document that requires sustainability reporting on (GRI, 2013).

An ever-increasing number of companies and organizations want to make their operations more sustainable. Expectations also exist that requires long-term profitability to go hand-in-hand with social justice and environment protection. Sustainability reporting can help organizations to set goals, measure performance and manage change, in order to make organizations more sustainable for all. Essentially, sustainability reporting will convey a buildings impact (be it positive or negative) on issues relating to the environment, society and the economy. It makes abstract issues more tangible and concrete and can assist in the understanding as well as the management of the effects that a building can have on sustainability. Utilising internationally agreed disclosure methods will enable information contained within sustainability reports to be made accessible and comparable, thus providing stakeholders with enhanced information on which to base their decisions. GRI suggests that it is critical for both society and the markets that sustainability reporting evolves, not only in terms of its content, but also from an exceptional activity which has been the undertaking of a minority group of companies leading the initiative to a global standard of practice (GRI, 2013, p. 3).

GRI Sustainability Reporting Guidelines was thus developed by means of a global multi-stakeholder process, which involved representatives from the business, labour, civil society sectors, the financial markets, and auditors and experts in various specialised fields. Close dialogue with regulators and governmental agencies in several countries was also initiated. All this was to enable the guidelines to be developed in alignment with internationally recognized reporting principles and related documents, which are referenced throughout the GRI Sustainability Reporting Guidelines (GRI, 2013).

GRI also makes a point of emphasising the need to focus on the reporting process. It believes a focus on the material aspects of reporting will make sustainability reports more relevant, more credible and ultimately more user-friendly (GRI, 2013, p. 3). The effect of this would be better information relating to sustainability, providing estate managers and society on a hole with the means to make better choices. Management may monitor a far wider array of sustainability-related topics, as part of their daily management activities, but this focus on materiality means that sustainability reports will be centred on matters that are critical and relevant for the building or estate's goals, thus the impact of the building on society and the environment can be managed much more effectively. It is believed that GRI's Sustainability Reporting Guidelines (G4) provides a globally relevant framework that support a standardized approach to reporting, encouraging a prescribed degree of transparency and consistency to make information useful and credible (GRI, 2013).

GRI Sustainability Reporting Guidelines makes use of references of widely accepted norms and codes in the form of issue-specific reporting documents. It has been designed as a consolidated framework to facilitate building performance reporting against different international codes and norms on issues relation to the sustainability challenge. It furthermore provides guidance on how to present disclosures on issues relation to sustainability in different reporting formats, whether they are annual reports, integrated reports, standalone sustainability reports, or simply reports that address particular international norms. Integrating strategic sustainability-related information with other material financial information and can be seen as a positive development in the world of sustainability reporting (GRI, 2013). Sustainability will increasingly be central to the changes that companies, markets and society will have to navigate in the future. Thus for this reason, information on sustainability aspects, that is relevant and material to the sustainability challenge should be at the core of any integrated report system.

4.3 The benchmarking process

Sustainability will increasingly be central to the changes that companies, markets and society will have to navigate in the future. Thus for this reason, sustainability information that is relevant or material should be at the core of any integrated report. The benchmarking process is the means by which this sustainability information can be managed. The benchmarking process involves looking beyond a building or estates boundaries to examine how other similar buildings or estates have achieved their performance levels. In the process providing clarity in terms of to the process required to ultimately achieve performance excellence. (OGC, 2010)

Benchmarking as a process relies heavily on reliable data, which is critical for delivering meaningful analysis. Comparing performance and/or quality relative to other performance and/or quality factors can reveal the strengths and weaknesses of a building. By breaking down and understanding the associated cost structures, can identify inefficiencies. This knowledge and understanding creates the foundations on which to base cost reduction and/or improvement decisions, making decisive targeted cost and performance improvement actions possible. If the lessons learned from the benchmarking process are applied appropriately, then these lessons can form the basis by which to improve critical performance functions within a building or they can be used to inform the development of a strategy for improvement across the whole property portfolio. But it must be noted that benchmarking seldom remains static and should never be seen as a once off exercise. For benchmarking to be effective, it should become an integral part of a continuous and on-going improvement process with the ultimate goal of keeping abreast of ever-improving best practice (OGC, 2010, p. 3).

By using the benchmarking process, the following benefits are possible in any building or a property portfolio has been benchmarked:

i. It will enable a like for like comparison between buildings to be made.
ii. It can facilitate in the better understanding of how a building or a property portfolio is performing.
iii. It can highlight where the greatest savings can be made.
iv. It will enable the setting and monitoring of realistic targets.
v. It can assist in legislative and regulatory compliance.
vi. It will allow organisations to assess what an individual buildings or the organisations entire property portfolio's impact is on the environment.

(OGC, 2010, p. 3)

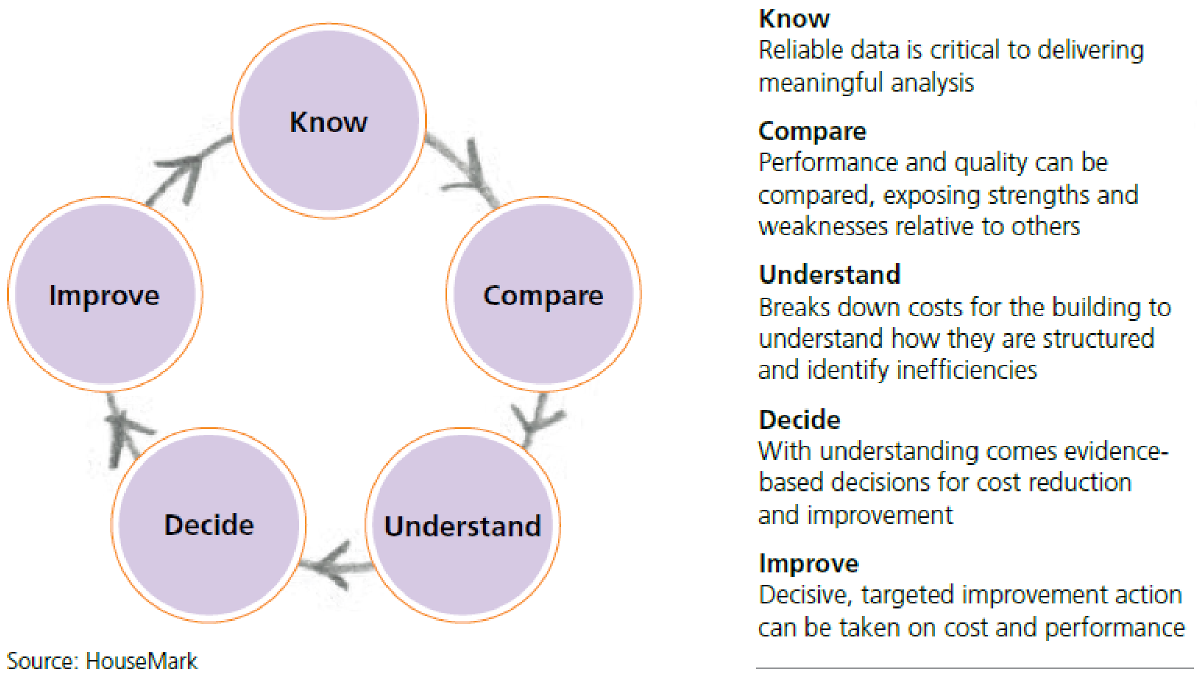


Figure 7: The Benchmarking Process

(OGC, 2010, p. 3)

4.3.1 Benchmarking Property

Benchmarking the property sector can be seen as an important tool which can help to assess and hopefully reduce the impact that the current built environment has on both the human and the natural environments. Improved measurements by way of the benchmarking process can help to improve building design and performance. Benchmarking can also help in prioritising the more appropriate choices, actions and behaviours. It is thus necessary to develop benchmarking processes which are robust and sufficiently flexible to allow for the inclusion of a range of characteristics that influence the sustainability performance of a property, so that the sustainability objectives for buildings can be achieved (BBP, 2010, p. 2).

The benchmarking of a building or property portfolio should be done by establishing the performance of the building which then, ideally should be measured against, independent validated private sector benchmarks as well as against the targets and standards set by government, provided that these targets and standards have been set. These measurements which would include the efficiency, effectiveness and environmental sustainability measurements of a particular building should ideally be measured on a yearly basis (OGC, 2010, p. 3). Reporting should then be done on the individual building, as well as the whole property portfolio's performance. With comparisons being made by means of consistent and independent validated matrixes, against benchmarks that have been derived from comparable buildings in the private as well as the public sectors and which include current best practice standards, which have been set for a specific building type. Information from the benchmarking process can then be used to inform the buildings ability to deliver services and the impact the building has on the environment. This information can then be used to inform strategic decisions relating to the buildings (OGC, 2010, p. 3).

Benchmarking can be a time consuming and sometimes difficult exercise. Starting simply by adopting a '*graduated approach*' is essential. Complexity can then be build up as understanding of the buildings and property portfolio grows (OGC, 2010, p. 7). It is worth noting that any approach by which to improve the sophistication of benchmarks, will require commitment and time. At the same time the process should be flexible enough to allow for the inclusion of additional metrics due to possible changes in the industry, while finding and maintaining the right balance between the original focus of the benchmarking process, which in terms of this study relates to the improving of the performance of the building(s) while constantly exploring increasingly more sophisticated ways of measuring the performance of buildings (BBP, 2010, p. 2).

The initial starting point of any benchmarking data collection process will include a number of stages that will range from surveys, specifically formulated to capture data from the building managers and occupants, to high-end, reliable benchmark analysis, which is used to assess and drive cost, space and environmental efficiencies as well as building effectiveness. Data is collected by way of four main steps which are:

i. Data collection, for the creation of Key Performance Indicators (KPIs)
ii. The independent validation and checking of the data, to ensure the reliability of the KPI outputs.
iii. The development of independent, robust industry standard benchmarks.
iv. And finally the assessment of individual building performances which can leads to constructive decisions being made for the future development or operation of a building (OGC, 2010, p. 3).

4.3.2 Key Performance Indicator (KPI)

Any property benchmarking process should incorporate a framework which can assist with the cost categorisation of a property and it is imperative that this benchmarking process should have a robust set of definitions for each data element *(known as a KPI)* for which data will be collected and processed. This dataset would provide the essential consistency to allow for effective internal and external benchmarking to take place, thus enabling reliable and like for like comparisons to be drawn between and across buildings (OGC, 2010, p. 6). These KPIs should be tracked over time and should broadly speaking consist of the following broad types of environmental performance indicators, which should operate on a hierarchical basis and should ideally be scored and tracked on a yearly basis.

Strategic Indicators, which are required to provide direction and can be used for broad based reporting purposes. These strategic indicators should be developed specifically for broad level reporting purposes like environmental budget indicators. Like for instance; total carbon produced, total energy used or saved, total amount of waste produced or total water consumption over an predetermined period of time (normally on a yearly basis). This allows annual change indicators to indicate the percentage change that has occurred over a set period of time (IPD, 2010, pp. 44-45).

Tactical Indicators are required to measure the impact of specific dimensions on higher order outcomes. These tactical indicators are KPIs that are management focused, and in principle control the strategic indicators. They are the drivers for operational performance improvements and permit comparisons to be drawn against internal and external benchmarks, while at the same time allowing comparisons against national as well as international benchmarks to be made (IPD, 2010, pp. 44-46).

Operational indicators help to provide greater understanding of the performance of processes and activities as these operational indicators track change and control building or portfolio operations, over time and are specific to the type of building or operation in question (IPD, 2010, pp. 44-47).

Qualitative Indicators can in essence be strategic, tactical or operational and provide a description of the chosen approach and current acknowledged *best practice* that is to be applied. These quantitative indicators can for instance, take the form of an *Environmental Health Check* (IPD, 2010, pp. 44-47).

It is worth noting that care should be taken to ensure that the most important factors are indeed measured when one identify and chooses the KPIs. One should also ensure that one limit the number of KPIs chosen as too many KPIs can cause confusion and might make it difficult to communicate. In principle, the most important KPIs should summarise '*totals*' for instance total environmental impact, total energy use or total amount of waste produced or recycled. A buildings performance can be established by means of a well defined set of KPIs, which should be supported by a mandatory dataset. This dataset should ideally be divided into three areas for data analysis commonly known as the ***3E's***; Efficiency, Effectiveness Environmental and Sustainability (OGC, 2010, p. 6).

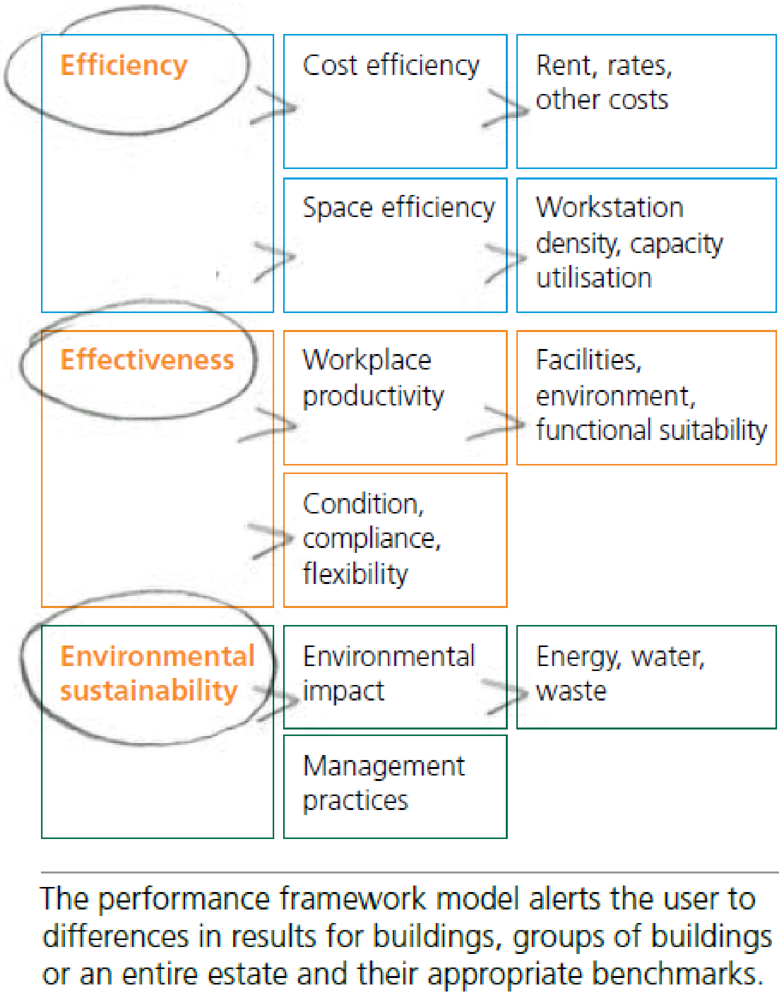


Figure 8: The Performance network model

(OGC, 2010, p. 6)

Efficiency relates to the measurement of aspects relating to the running cost and occupation of a building. *Occupancy efficiency* measures the amount of space per person in a particular building and is reported on as either space per workstation or workstations per person or both. *Cost efficiencies* relate to the costs associated with the operation of the building and would normally include rent, rates and other associated costs and is expressed as the cost per person or cost square meter of a particular building (OGC, 2010, p. 6).

Environmental sustainability relates to the environmental aspects associated with the building. It measure and report on the total energy or water consumption of the building as well as the total amount of waste produced by the building in the form of for instance the amount of CO_2 that is produced or the amount of recycled or non-recycled waste generated per person associated with a particular building. In addition to these consumption and production data, management practices which can also have an indirect impact on the environment gets measured and reported here, in the form of a management practice score (OGC, 2010, p. 6).

Lastly ***Effectiveness,*** relates to the facilities that the building is providing. The overall effectiveness of the building is established by an assessment scores which scores the building in terms of the facilities that is being provided by the building. For instance, what type of workplace environment is being provided by the building, how suitable are these spaces, provided by the building in relation to the function of the building as a whole. Effectiveness also defines and rates the buildings compliance to regulations and overall flexibility and finally effectiveness looks at the how the buildings performs in relation to current health and safety practices and regulation (OGC, 2010, p. 6).

4.3.3 Data requirements

For any robust benchmarking process it is imperative that the data collected be accurate, consistent and verifiable. Data in isolation will have limited value and can be without meaning as meaning is given to the data by transforming the data into information by the creation of the relationships between elements. By combining data into KPIs add considerable value and meaning to the data, but ultimately this data will only become truly significant when is underpinned by the knowledge of relative performance against other buildings. For instance it can highlight if the buildings performance is *'good or bad'* and how the building compares with other similar buildings (OGC, 2010, p. 7). Benchmarking can effectively provide understanding by means of identification of opportunities and or areas that can be utilised for action.

With benchmarking often being difficult as well as resource intensive, it is advisable that a simple and graduated approach be adopted. Complexity can be added as the understanding of the buildings grows over time. It is also advisable that the data collection process be facilitated by a robust data capture and processing system which is at the same time also flexible to enable the inclusion of additional data matrices in the future. It is essential that this data capturing and processing system provide a level playing field on which comparisons can be based. Thus the core data set should be focused on a readily available basket of data elements for all buildings. This should provide a good balance between improving performance and seeking new ways by which to measure building performance (OGC, 2010, p. 7).

Identifying the patterns, understanding the relationships, and comparing one building with other similar buildings provides the means by which the core data captured on spread sheets and incorporated into databases can move from pure data to data providing information in the form of performance indicators, which ultimately provide us with knowledge and wisdom (OGC, 2010, p. 7). It is thus through this added value to the data, that the benchmarking process can provide a means to solve the sustainability challenge.

4.3.4 Performance framework and assessment

Relative building performance is illustrated through a standardized performance model by way of a balanced view of all the relative performances relating to a building or estate. By capturing various levels of KPIs, the model can provide an independent, fact based and comparative assessment of a buildings effectiveness, environmental sustainability and efficiency. It is worth noting that in order for the model to provide critical context, all KPI results should be clearly set out alongside private sector performance benchmarks, government standards and appropriate target levels. The model present performances of each KPIs score relative to a benchmark index score of 100. This underlying benchmark is of course derived from data held in the database on a similarly equivalent private sector building or estate, used as a property benchmark and/ or *good practice* or industry standard and forms the basis from which any assessment will be made. Thus a performance framework model will be able to alert the user to the differences in the results for the specific building and/or estate and their appropriate benchmarks. It can also highlight how cost and special relationships can influence and or impact the overall efficiency of a building. (OGC, 2010, p. 9)

Any robust property benchmarking process should use a hierarchical model that can be used to explain the performance of a building or estate against benchmarks in a clear and systematic manner. The use of consistent KPIs and the standardization with regard to reporting can provide a clear and objective means of communication of the building or the estate's performance in terms of the buildings efficiency, effectiveness and environmental sustainability.

For example in figure 9 below, high level results are indicated on the **A** level, with **B** and **C** levels indicating which components are responsible for driving the results found in level **A**. The relative efficiency of a building should thus be able to prompt the justification and challenge. A score of say 98 for efficiency, informs the user that the overall £/FTE of £ 7 006 is aligned to a private sector performance of an equivalent building in a similar location. The action will be to review the **B** level KPI contributions of the building, which will provide an understanding of whether or not a good performance in one area is not perhaps masking the poor performance in another area. This analysis of lover level results, provide a justifiable means by which better management decisions can be made for the whole building or portfolio (OGC, 2010, pp. 9-10).

> ***Full-time equivalent** (**FTE**) is a unit that indicates the workload of an employed person (or student) in a way that makes workloads comparable across various contexts. FTE is often used to measure a worker's involvement in a project, or to track cost reductions in an organization. An FTE of 1.0 means that the person is equivalent to a full-time worker, while an FTE of 0.5 signals that the worker is only half-time."* (IPD, 2009, p. 25)

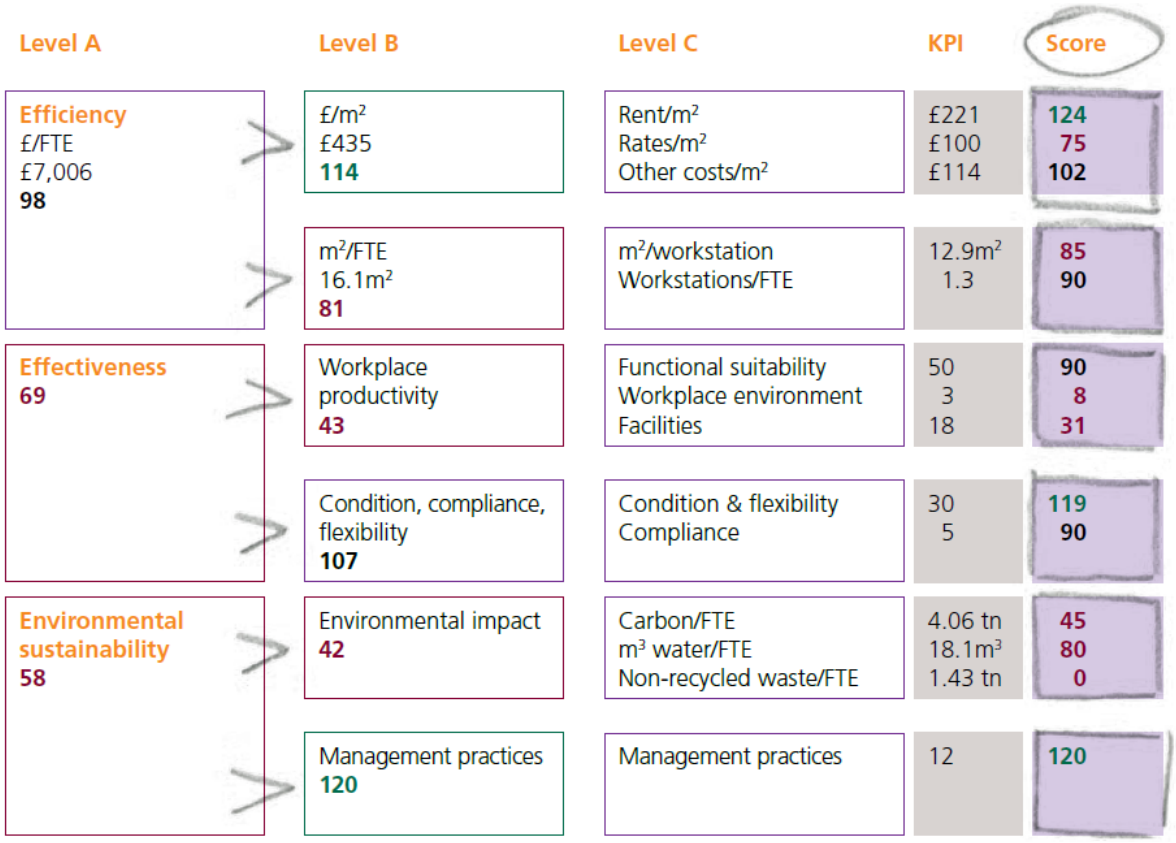


Figure 9: The Performance Framework

(OGC, 2010, p. 11)

***NOTE:** "Performance scores for each metric, a score of between 0 (low) and 200(high) is given to reflect how results compare to a benchmark index score of 100. The underlying benchmark is derived from data held on equivalent private sector buildings and or good practice or industry standards"* (OGC, 2010, p. 11)

Similarly, an **A** level score of 69 for effectiveness expose the possible risk in the building, here the lower **C** level scores for both workplace environment and facilities may help in the development of future improvement strategies for the building.

The 58 environmental sustainability score exposes the real issues relating to this building or estate. As a norm, all measures of environmental impact have relatively low scores. The action that is called for here is to establish if the environmental data is robust or not. It is imperative that this environmental data is indeed robust. In addition to this, one need to establish if there is any real performance issues highlighted here and what is driving the performance of the building?

The 114 score value for the £/m^2 indicated on **B** level for Efficiency indicate that the £/m^2 (£435) is lower than the equivalent private sector benchmark. Thus it would seem that there is good value reflected here for the building or estate. The aim here would be to strategically manage the £/m^2 by means of location, building selection and cost management. A report on the **C** level KPIs should help to identify the best opportunities while taking into consideration future business and development requirements and goals (OGC, 2010, pp. 9-11).

In short the overall performance of the building or estate in the example above shows that the **A** level scores is broadly aligned with the benchmark, but that environmental sustainability and effectiveness is not performing as well. The performance drivers indicated by the **B** Level scores are responsible for driving the performances reported at the **A** level. In the example above, the £/m^2 is lower than the benchmark, but them^2/FTE (16.1m^2) still indicate significant improvements that can be made. The KPIs at C level provide the understanding of the basic reported performance of the building or estate at the higher **A** and **B** levels to the users.

4.3.5 Reporting

Reporting is an essential and integral part of the overall benchmarking process, as reports can present the key issues at different levels. Reports will highlight where a building stand in terms of performance, it can identify where opportunities exist and is able to clearly summarize the results. These rapports should be produced as standardized documents which should include tables and graphics as well as all results at a building level. This information should be made available in a spread-sheet type format, to allow active and flexible future use of the information contained in the report (OGC, 2010, p. 12).

The standardization of reports is essential to enable ease of analysis and better understanding of the data contained in a report. Transparency of the results will help to identify opportunities, challenge performance and raise understanding. To enable this standardization of the reports, it is recommended that all reports associated with the building benchmarking process should contain the following information:

- *Benchmarking results* which are based on KPIs that has been based on public/private sector contextual information.
- *Trend analysis* which highlights the year on year performance change associated with the building.

- *Ranked performances* of the building, indicating opportunities and weaknesses at all levels of the building or estate.
- *Interpretive text* which provide explanations of the matrixes used.
- *Consistency* with regard to the *scoring approach*, allowing for ease of understanding as well as interpretation.
- And a *building level performance model* that can provide a clear and understandable report for each building as well as the estate.

(OGC, 2010, pp. 12-14)

4.4 Meeting the performance challenge

Unless an organization is prepared to commit appropriate recourses to the benchmarking process, benchmarking will not be a success. It is crucial that all role players, which include not only staff, but all the senior stakeholders as well, who will need to allocate recourses from their teams as well as make potential changes to the way they operate over time. It is thus imperative that the benefits that will be derived from the benchmarking process is clear and that there is a strong commitment and leadership form the senior sponsor of the benchmarking process.

Effective asset management as well as the benchmarking of the performance of a building, depends heavily on reliable as well as verifiable data. However the inherent value of this data is subject to the data being current and complete. Poor-quality data can be misleading and therefore worse than no data at all. The wide range and potentially large volume of data that is required to be in place, an appropriate management structure for this data is essential. This will ensure that the data is properly defined, managed and maintained.

It is thus essential that a centralised property/estate/facilities team is put in place to handle all asset management and property services and that an up-to date asset register for all the buildings are kept. A centrally located database/system, which holds all key property information associated with the estate is key to the ultimate success of the benchmarking process. It is furthermore absolutely paramount that all performance assessments need to be comprehensive. The ultimate aim should be that the data captured and the reports on the matrixes should reflect the entire estate portfolio (OGC, 2010, pp. 12-14).

4.5 Conclusion

The benchmarking process is a process that seldom remains static and should thus never be seen as a once off exercise. For benchmarking to be effective, it should become an integral part of a continuous and on-going process which improves over time keeping abreast changes in best practice principles (OGC, 2010, p. 3). Care should also be taken to ensure that the most important factors are indeed measured and one should also ensure that the number of KPIs is limit, as too many KPIs may cause confusion and result in difficulties when reporting. It is advisable that the most important KPI's be expressed as *totals,* for instance total environmental impact, total energy use or total amount of waste produced or recycled.

It is imperative that the data collected for any robust benchmarking process is accurate, consistent and verifiable. This is because data in isolation will have limited value and can be without meaning. The meaning in a benchmarking process is given to the data by transforming the data into information by creating relationships between elements. Combining data into KPIs add considerable value and meaning to the data, but ultimately this data will only become truly significant when it is underpinned by the knowledge of relative performance against other buildings. Ultimately benchmarking can provide understanding by means of the identification of opportunities and or areas that can be utilised for action and as such help in bringing about true sustainability to the building industry.

Chapter 5: Sustainability Benchmarking

5.1 Introduction

The Better Building Partnership (BBP) (2010, p. 6) in their Sustainability Benchmarking Toolkit suggests that "...sustainability benchmarking is a process that assesses and compares the sustainability performance of a building against other properties or pre-defined targets and benchmarks." Sustainability benchmarking is a process that covers a wide range of property as well as operational performance characteristics, which include for instance the building's fabric, its water and energy usage, waste production as well as transport related characteristics. Sustainability benchmarking allows comparisons to be drawn over time at multiple a levels, be it at a unit, building or a portfolio level.

The building performance in terms of sustainability can be viewed from either a distinct design or an in-use perspective. Under the design perspective, the sustainability performance of a building is assessed in terms of the physical fabric and components that makes up the building. For example, the different building elements performance specification in terms of heating and cooling systems, insulation and lighting performance, is certified in terms of what they have been designed to achieve. This perspective would suggest to the owner or estate manager whether or not to improve, for instance the heating, cooling or lighting systems or upgrade the sustainability performance of the physical fabric of the building by means of either refurbishment or by way of a significant maintenance programme (BBP, 2010), which is the approach that most current building ration tools use to establish the design or as-build rating of a building.

The In-use perspective on the other hand measures the performance of the building on an operational sustainability level, while the building is used by the occupiers of the building. The operational performance of a building is directly affected by the way the building is used by its occupiers and how the owner or estate manager runs the shared services of the building. What is very important here is the interface between the 'owner and occupier' and it is this interface which determines how efficiently the building is operated (BBP, 2010, p. 8). This is the approach favoured by the benchmarking process.

Currently a number of organizations are capable to analyze a building's characteristics and operational data and consequently provide a sustainability benchmarking services. These organizations would include IPD, Upstream Sustainability Services at Jones Lang LaSalle, and Bureau Veritas to name but a few (BBP, 2010, p. 8). These organizations have to date contributed greatly towards the understanding of sustainability measurement, reporting and benchmarking processes. *Figure 10* below provides a summary of some of the sustainability measurement, benchmarking and reporting tools currently available.

Measurement	BBP	IPD Environment Code	LESTER	DECs	Upstream Sustainability Benchmarking	BREEAM In Use	GRI
Frequency	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**
Building details							
Area	Net Lettable Area (m^2)	Net Lettable Area (m^2)	Net Lettable Area (m^2)	Total usable floor area (m^2)	Net Lettable Area (m^2) Gross Internal Area (m^2)	Gross Internal Area (m^2) Net lettable Area (m^2)	
Air conditioned	Yes/No Extent of HVAC provision	Yes/No	Yes/No	Yes/No	Yes/No Extent of HVAC provision	Yes/No	
Occupancy	Number of employees as FTEs, Number of workstations, hours of occupancy	Full time equivalent employees	Hours of occupancy	Number of occupied days and hours of occupancy	Number of employees as FTEs, hours of occupancy, total number of visitors/ customers	Number of employees as FTEs, hours of occupancy, total number of visitors / customers	
Asset rating (EPC)	Yes if available	×	×	Yes if available	Yes if available	Yes if available	
Number of floors	✓	✓	✓	×	✓	yes	
Number of rooms	×	✓	×	×	×	×	
Refurbishment information	Date of last refurbishment	Date of last refurbishment	Date of last refurbishment	×	Date of last refurbishment	Date of building services renewal	
Energy							
Mains electricity	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	GJ/annum
Oil	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	GJ/annum
Gas	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	GJ/annum
LGP	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	GJ/annum
Solid fossil fuels	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	GJ/annum
Onsite renew-able energy generation	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	GJ/annum
District Heating	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	GJ/annum
District Cooling	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	GJ/annum
Carbon calculations	DEFRA grid mix standard & fuel emission factors	DEFRA grid mix standard & fuel emission factors	DEFRA grid mix standard & fuel emission factors	DEFRA grid mix standard & fuel emission factors	DEFRA grid mix standard & fuel emission factors, IEA emissions factors, GHG Protocol	DEFRA grid mix standard & fuel emission factors	Greenhouse Gas Protocol
Carbon emissions	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes
Optional							
Communal electricity	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	
Separable energy uses where separately metered	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	kWh/annum	
Green energy supply from the grid	kWh/annum	kWh/annum	kWh/annum	×	kWh/annum	×	
Water							
Mains water consumption	×	m^3/annum	×	×	m^3/annum	m^3/annum	m^3/annum
Harvested water	×	m^3/annum	×	×	m^3/annum	m^3/annum	m^3/annum
Recycled Water	×	m^3/annum	×	×	m^3/annum	m^3/annum	m^3/annum
Waste							
Total non recycled waste	×	Tonnes/annum	×	×	Tonnes/annum	Tonnes/annum	Tonnes/annum
Recycled waste	×	Tonnes/annum	×	×	Tonnes/annum	Tonnes/annum	Tonnes/annum

Figure 10: Summary of existing sustainability measurement and reporting tools

1) This summary is based on a short analysis of existing tools and does not represent the breadth, depth nor quality of the tools reviewed. What is more, the list of tools may not be comprehensive.
2) BREEAM and Upstream Sustainability Services do not currently give credit for using green tariffs as no energy supplier currently meets their obligatory target for renewable energy generation.
3) GRI does not specify measurement units to use when reporting but sets out a list of principles and indicators that organizations can use to measure and report their environmental performance against. (BBP, 2010, p. 24)

5.2 Benefits of Sustainability Benchmarking in Buildings

The sustainability benchmarking of a building holds a number of benefits to the occupiers of a building. It allows for the environmental impact in terms of, energy and water consumption, waste stream generation and CO_2 emissions of a building, to be assessed and reported on. It also creates a greater understanding, of the operation of the building, by identifying the high and low impacts. Providing greater understanding of why, certain buildings consume more resources than others. For instance, a building with intensive energy usage activities, like server rooms, would through the benchmarking process have their focus shifted from pure energy consumption comparisons, to comparisons in terms of whether or not the building is performing at an optimal level.

Benchmarking thus provides the means by which to identify where appropriate action would be required while at the same time indicating where savings can be made. By understanding the sustainability of a building, allows one to identify at what level a buildings is actually performing. Allowing one to identify which areas requires improvements and where action is required, allowing one to also identify opportunities for savings. Benchmarking consequently allows building and or estate managers to set realistic targets, it also provides the means by which to monitor whether or not these set targets has been met. Sustainability benchmarking will ultimately be able to indicate where specific performance improvement programmers has been successful, thus assisting in the planning of the most appropriate allocation of recourses (BBP, 2010, pp. 6-7).

Sustainability benchmarking enables comparisons to be made between buildings, estates and peer groups. In addition sustainability benchmarking also provides assistance with regard to legislative and regulatory compliance issues, as it creates a robust framework that helps in the preparation for compliance with emerging legislation, like GIAMA or the Carbon Reduction Commitment Energy Efficiency Scheme. It also informs appropriate changes to be made, like the changes to the EU Energy Performance of Building Directive for instance (BBP, 2010, pp. 6-7).

Finally, sustainability benchmarking helps to improve the value of the building as investors are taking sustainability issues into account in their making decision process. Not to mention the ever increasing volume of mandatory standards and legislation, relating to the environmental performance of buildings which the benchmarking process will be able to satisfy as well as the rising aspiration for greener buildings by the occupiers. All this suggest that '*green*' factors will play an increasing role in the way that buildings will be valued in the future. Sustainability benchmarking will be able to assist with both the valuation as well as the investment and decision making processes in the future, as early evidence suggests that properties which are more sustainable are less likely to depreciate at the same certify as other un-sustainable buildings depreciating (BBP, 2010, pp. 6-7) (GBCSA, 2012).

5.3 Challenges of sustainability benchmarking in buildings

The sustainability benchmarking process will ultimately vary according to its specific purpose as well as the availability of relevant data. Not with standing this, the key steps and associated challenges related to the sustainability benchmarking process will most likely include; data collection challenges, the measuring and assessment of the performance of the building or estate, comparing and benchmarking performances and finally acting upon the results (BBP, 2010, p. 9). These issues are individually discussed below:

5.3.1 The data collection challenge

In order to develop an appropriate and robust benchmarking process, the collection of accurate, consistently measured and verifiable data is an essential requirement as this will enable performance as well as progress measurements. Monitoring and management will be enabled and most importantly it will help to focus behavioural changes to achieve the best results in terms of building sustainability performance. But a lack of reliable and verifiable data may lead to situations where it is impossible to use the most effective metrics to improve and or incentivise change. However it is possible to initiate the benchmarking process by using readily available data, even if this data is limited, and then systematically over time increase the sophistication and robustness of the sustainability benchmarking process as well as the accuracy of the data (BBP, 2010) (IPD, 2012).

It is nevertheless very important to clearly define the scope and purpose of the benchmarking process at the beginning. This scope should include those areas that are intended to incentivise behaviour. With this in mind one should very carefully consider which KPIs will be used to report on. As this will identify the type of matrices and associated data that one will need to collect. However the identification of the KPIs will ultimately be influenced by the nature of the available data to be used by the matrices for measurement (IPD, 2012). For example; gross or net lettable floor area for floor space measurements; full time employee's equivalent (FTEs) or workstations for the measurement of the number of employees; or generally metered or sub-metered data for water and energy consumption data. Data can often be inaccessible or not readily available, for instance the energy consumption of individual occupiers in a multi-let building would most likely require the installation of sub-meters not to mention the significant time and monetary implications that this would have (IPD, 2012) (BBP, 2010).

The benchmarking process should also clearly state the scope of the data that is to be collected. For example whether or not whole building data would be collected and if both, the owner provided services as well as occupier's consumption related data are to be collected. The means the source from which data is obtained may vary and can greatly affect the robustness of the final sustainability benchmarking results. This is partly due to the fact that there is currently no industry best practice standard in the field for sustainable benchmarking data collection. The result being that some would rely for instance on utility bills for the collection of energy and water consumption data while others measure the actual energy consumption through half hourly automatic meters and smart meters (IPD, 2012) (BBP, 2010).

In terms of the regularity for data collection, it is possible to sustainable benchmark a building on data available on an annual basis, but a more regular data collection process allows for a far more active property management approach by means of more frequent monitoring, targeting and reporting techniques (BBP, 2010, pp. 8-10) (IPD, 2012).

5.3.2 Performance measurement

A number of critical issues need to be addressed when measuring the performance of a building. This is because the operational performance of a building can be represented in both absolute and normalised terms. These operational performance indicators have their own set of individual problems and benefits associated to the measurement and assessment of the performance in these buildings. It is important to note that these operational performance indicators are necessary to provide a complete picture of a particular building's performance as well as to ultimately assist in the management of the property.

It is also imperative to identify and select the most appropriate driving metric to normalise the sustainability KPI in order to influence the right behaviour and ultimately deliver improved building performances. It is worth noting, that the lack of agreed metric definitions as well as the associated problems regarding the availability of accurate, reliable and replicable data, is currently preventing the effective use of most these matrices (BBP, 2010, p. 10).

Absolute Performance *is "a way of measuring an organization's progress and how effective and efficient it is at running its business. The absolute performance standard is a benchmark for quality control that is only attainable in theory. However, it is a good way to measure how well a business and its workers are doing"* (Investopedia, n.d.). Absolute performance can be seen as an important means by which to enable the understanding of the overall impact of a building by drawing comparisons from a consistent portfolio over a set period of time.

Generally most real estate organisations does collect the necessary data that is required to measure and report on absolute environmental data like CO_2 emissions and or energy consumption over a period of a year. But due to the characteristics of the property sector, concerns does exist with regard to the effectiveness of absolute measures of performance, in particular in how this would be able to influence the right behaviour to ultimately deliver sustainable operational improvements in a building. Due to the dynamic nature of the real estate market and the rapid changes that can potentially occur, in particular in relation to portfolio size and asset ownership, care should be taken when absolute performance measurements are taken into consideration (BBP, 2010, p. 10).

Normalised performance on the other hand, takes into consideration the dynamic nature of the property market, allowing performance comparisons of the building to be drawn over time. Normalised performance is essentially the benchmark, according to which performance comparisons can be made. Normalised measures have the added advantage of allowing near-peer group comparisons to be made at both a building as well as an estate level. Being able to set a sector related benchmark as well as being able to identify and possibly certify industry leaders is seen as important. By providing a much more detailed assessment of how the building is performing allows building and/or estate managers to set much more appropriate targets. Normalisation is essentially achieved by relating the impact of a performance metric (e.g. kWh of electricity or litres of water) to another driving variable like for instance the occupation or the floor area of the building. This allows the electrical consumption of a building to be presented as kWh /m^2, or kWh / FTE, or kWh/workstation (BBP, 2010, p. 11).

The challenge lies, in which normalised metric to use for the development of the benchmarking tools which will be able to assess the sustainability a building, as the results can ultimately have an influence on which behaviour to adopt to ultimately improve the buildings performance. The most common approach to date, has been to assess the buildings performance relative either its occupational density or floor area, with each approach having its own set of advantages and/or disadvantages, keeping in mind that the benchmarking process needs to be adjusted for that specific area's weather conditions and in some cases the specific usage of building (BBP, 2010, p. 11).

Measuring a buildings performance relative to its floor area is probably the most commonly used and simplest form of normalised indicator in sustainability benchmarking. The use of this normalised indicator stems historically from being recorded and used in a number of other property management purposes, for instance in rent and insurance calculations. This means that the required data is generally, readily available, is fairly accurate, is verifiable and can be easily be reproduced.

In recent years, the trend to increase the overall occupational density of a building may seemingly be able to improve the overall environmental footprint of the building. But this type of strategy does result in a higher emission production per m^2 of floor area of the building, which is due to the higher occupancy of the building. Possible improvements can thus be overlooked if a pure per-floor-area indicator is used. Measuring the performance of a building relative to a buildings occupational density, is a way according to which the performance improvements in a building can be assessed as well as be reported on (BBP, 2010, p. 11).

Occupational density measurements require that one measure the number of occupants utilising the buildings facilities over a set period of time. One needs to be aware of a number of difficulties associated with this approach. The first of which relate to how the occupancy of a building is defined and subsequently measured, the next difficulty relates to the type of activities are engaged in by the occupiers, and finally what the unintentional associated risks there are in terms of a the higher occupational density in the building. The primary risk associated to the higher occupational density of the building, is that there is no definition industry standard for occupational density available. The notion of 'persons' differ relative to the type of property that is being assessed. It is thus essential that industry definitions relating to occupational density needs to be clarified before this form of normalisation can be developed further (BBP, 2010, p. 11). Varying definitions in the retail and office sectors illustrate this point. In offices, a person is defined by either a notional 'worker', such as the full time employee (FTE) or by means of a workstation description. In retail, properties are managed according to notional 'visits' which is measured according to footfall. Energy consumption in the retail sector, for instance is also much less driven by the visitor numbers than it is the case in the office sector. Questions relating to how comparable footfall measurements are for different types of retail properties also remain. Ideally these definitions should be able to indicate how often measurements are taken, which will enable changes in occupancy levels to be taken into consideration. This issue, relating to the type and the frequency of the data is further complicated by the far more practical difficulty of collecting data.

The next concern relates to the type of occupier and or business activity associated with the building, as this can influence which would be the more appropriate metrics to use. A consultancy type business for example, may have a large workforce, but the very nature of the business means that the majority of the 'workers' does not utilise the building on a permanent basis, resulting in a high person to workstation ration. Thus reporting will produce significantly different results if either FTE's or workstations are used to report the buildings performance against.

Unintended consequences pose another concern when using occupational density. This is because higher density does not necessarily means an improved sustainable performance of the building. Generally there are certain improvements relating to cost and energy use that can be made by means of a more efficient utilisation of the available floor area. But these improvements are in all likelihood subject to 'ceilings' that will limit the gains that can be achieved, there does exist a certain threshold where the design and operation of a building will be compromised. More over energy demand is not only driven by the number of people using the building. The lighting and ventilation needs of a building are for instance influenced by the floor area, the volume of the space as well as the number of the people utilising it. Lastly as was reported in the BRICS research summery (Carbon Trust, 2009) that more sustainable working environments can improve overall employee productivity and that there does exist a point at which higher density will impact on the productivity of the occupier, resulting in the building becoming less attractive to potential occupiers (BBP, 2010, p. 12).

5.3.3 Benchmarking performance and making comparisons

The key purpose of any benchmarking process is to measure, analyse and report in terms of the space, cost and environmental performance of a building. Spatial as well as contextual data is required to enable the conversion of this data into special rations that will help to gain clarity with regard to the special usage of a building. This data also allows one to set performance targets and track performance progress over time. It provides support for effective decision making in terms of space usage and allocation. It communicate confidently and accurately, any spatial improvements that has been achieved and it enables comparisons to be made against other buildings and or building portfolios. A robust data set for a building or building portfolio, allows benchmarking to be used to compare spatial performance against other similar buildings, allows one to identify buildings that are performing poorly. It facilitates in the setting of realistic performance targets and allows for informed decisions to be made (IPD, 2009, p. 31).

To enable these comparisons between buildings to be made, on a like for like basis, buildings need to be categorised into different groups, consideration being given to the deferent special uses that exist.

Building categorisation is essential to enable comparisons between different buildings of similar characteristics to be made. In the UK for instance categorisation has typically been based on the type of HVAC system, the technical specification and the level of service of a particular building. (OSCAR for the management of retail properties and ECON 19's guide for offices are the main UK references in this regard). But currently a debate is unfolding, in particular in the office building sector, whether incentives for more sustainable behaviour should require a move beyond this type of characterisation and whether or not it should include the usage of the building as well as the intensity of usage of the building (BBP, 2010, p. 12).

For instance, in the office building sector, buildings could be categorised in terms of occupation density, rather than by the type of the HVAC system. The resultant effect would be that a benchmarking assessment can be based on the CO_2 emissions per floor area indicator which means a number of population density bands can be investigated for a specific building type. However it is essential that there is an agreement on the standardisation of the occupation density indicator, this will make the occupation density indicator a robust and acceptable approach by which to assess the sustainability of a building. However until further work relating to this indicator has been carried out; the occupation density indicator approach can only be used to complement the existing categorisation, which is based on a buildings HVAC systems. On the other hand, within the retail sector, an approach based on occupation density is not suitable; this is because energy consumption in the retail sector is less driven by the number of people using the building than by the floor area and the volume of the building in question. Thus the current norm of categorising retail buildings according to their HVAC system is more appropriate (BBP, 2010, p. 13).

Based on the above findings, the building classification for the PGWC's office buildings should ideally consist of the following categories: non-air-conditioned, standard air-conditioned and prestige air-conditioned office buildings. It is also advisable to incorporate occupation density into the assessments of the performance of the PGWC's office buildings as occupation density can have a positive impact by way of influencing and improving the sustainability performance of a building.

It is also worth noting that special use areas, such as catering areas, car parks, server rooms and the like, is an important and integral part of any building and that these areas does impact on a buildings overall sustainability. An approach is thus proposed, which utilise 'special areas' categories to differentiate between different buildings and enable comparisons between buildings with similar areas. Whilst this approach would involve significant effort to obtain the data set for the development and refinement of such a proposed approach, it is believed that there may be a significant benefit with regard to improving the performance and ultimately the sustainability of the building.

5.4 Proposed best practice principles

To benchmark the sustainability of buildings or building portfolio is a challenging exercise and it has become evident that it is not usually possible to immediately implement a detailed and fully comprehensive system from the outset, as there is generally much to learn. Thus the industry norm currently is to employ a 'Graduated Approach' to sustainability benchmarking (BBP, 2010, p. 15) (IPD, 2012).

5.4.1 '*Graduated Approach' to* sustainability benchmarking

The Usable Building Trust developed the *Graduated Approach* (see figure 10 below) to sustainability benchmarking (BBP, 2010, p. 15). This approach to sustainability benchmarking advocates that the benchmarking process should start off simply and build up complexity over time. It allows for the development and of the benchmarking process over time, thus allowing sophistication of the process to be introduced as a greater understanding is gained of how building operate and what the key factors is that influence the occupier behaviour.

Essentially it advocates that the benchmarking process can be refined, as the data collection process becomes more accurate, reliable and routine over time. For instance, data may be collected at a greater level of granularity. This means that once the monitoring of buildings energy consumption becomes standard practice, greater granularity can be introduced by for instance monitoring energy consumption on a half hour basis or by the introduction of monitoring energy consumption at an individual tenant or floor basis. The following are some additional aspects that one might want to consider introducing into the sustainability benchmarking process over time:

i. The physical description of the building, for instance; how many floors are there; does it have a linear or rectangular building shape and for forth.
ii. Additional sustainability indicator can be introduced like waste production, water consumption, access to public transport and so forth.

iii. The level of detail can also be increased for instance energy consumption can be divided into the different forms of energy used in the building, in addition to this the energy consumption of the building can also be monitored on either a floor or a tenant basis or both.
iv. The efficiency and accuracy of the measurements can be increased, for instance by the introduction of smart metering.
v. By the introduction of different or additional normalisation matrices for instance: floor area; occupancy hours; and occupation density.
vi. Defining the buildings use more accurately.
vii. Making provisions for changes in the property portfolio and the intensification of the building operations to be accounted for.
viii. The identification of special uses area like server rooms; car parks and canteens.

(IPD, 2012) (BBP, 2010, p. 15)

A ***Graduated Approach*** to sustainable benchmarking will also provide a number of advantages as it:

i. enables existing data collection mechanisms and the relevant data to be utilised from the outset, while facilitating over time the improvement of the scope and quality of the data.
ii. enables and promotes the introduction of an increased sophistication, while at the same time providing improved understanding, of the detailed particulars of the buildings performance relative to sustainability.
iii. provides a framework for the progressive adoption of absolute and normalises indicators as well as near-peer categories, to encourage improved performance and more meaningful comparisons with peer performance.
iv. facilitates in the collection of more sensitive and sophisticated data such as occupation density and 'special use' areas in order to provide more accurate information about the buildings performance.
v. with increased sophistication in terms of the sustainability benchmarking process, will provide curtail information which both owners as well as occupiers can use to best focus their energies to effect performance and behavioural change.

(IPD, 2012) (BBP, 2010, p. 15)

5.4.2 Key data collection principles

Data collected over a sufficient time frame, to be able the discern trends and which can be used to compare one building with another, is the key to the success for any benchmarking process. This data collected, must also be accurate, consistent, verifiable and replicable and will ultimately form the backbone of the benchmarking process. It is very important to ensure that the data is collected over a consistent time period, which will ensure that the benchmarking process, can take into account for instance seasonal variations, which may skew the performance of the building if not taken into account. It is also very important that both the owners and as well as the occupiers engage and co-operate in the data collection process to ensure the ultimate success of the data collection process. The requirements for the data collection process should be realistic, achievable and practical (BBP, 2010, p. 17) (IPD, 2012).

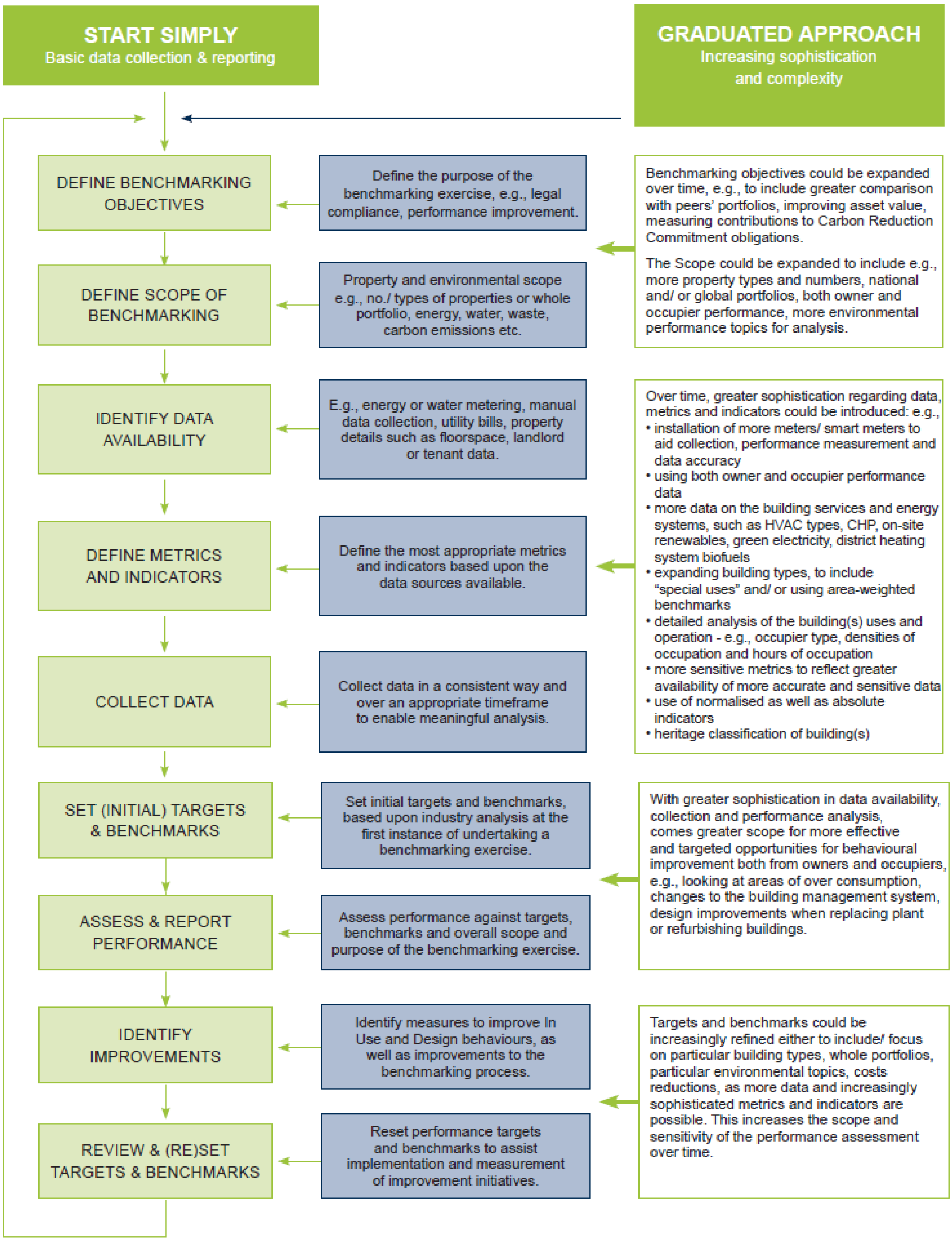


Figure 11: A 'Graduated Approach' to sustainability benchmarking

(BBP, 2010, p. 16)

5.4.3 Accounting for change

The benchmarking process should be robust enough so that it can account for any changes that might occur with regard to the property portfolio size and composition. This will ensure that positive progress in the sustainability performance at a building level is properly reflected in the reporting process and does not get masked by the changes that might occur in the property portfolio. For instance, an increase in the number of the occupiers of a building or the acquisition of another building may lead to an increase in a building portfolio's overall sustainability performance, which may mask improvements in terms of sustainability performance that has already been achieved at a building level. Some organisations for example would rationalise their occupation levels form several buildings into one or two, in order to improve their overall carbon footprint. But this only result in a higher emission ratio per unit of floor area, due to there being more people occupying fewer buildings. Emissions relative to floor area or absolute metrics will not reflect this overall strategic improvement. Thus it is important to carefully select indicators that can ensure that changes in building as well as building portfolio levels are properly accented for in the sustainability benchmarking process (BBP, 2010, p. 17) (IPD, 2012).

5.4.4 Incentivising the right behaviour

"Care needs to be exercised in the development and the employment of metrics, indicators, targets and benchmarks to ensure that they drive the desired behaviour to achieve improvements in the sustainability performance of buildings, while minimising unintended consequences." (BBP, 2010, p. 17). It is thus important from the outset to be absolutely clear about the intended purpose for the benchmarking process. This purpose could be for instance to influence behaviour in terms of the use or the design of the building, or perhaps a combination of the two. Ultimately the benchmarking process as well as the results obtained by means of the benchmarking process should be used to identify those properties or areas that are underperforming. The benchmarking process can also be used to inform property managers which strategy needs to be pursue to improve that building area area's performance (IPD, 2012).

5.4.5 Owner - occupier partnership

The success of the sustainability benchmarking process is subject to the quality of the data that will be collected and this data should ideally cover the whole building, including both the owner as well as occupier's consumption data. It is thus very important that the owners and occupiers engage and co-operate with the data collection process as well as the subsequent implementation of the proposed efficiency measures. *Green Leases* and *Memoranda of*

Understandings are formal means by which the implementation of performance efficiency measures can be achieved.

Reporting on only the owner services will not provide a holistic picture of how the building is performing and any potential improvements to the buildings performance will be limited to the common areas and the services that are provided by the owner. By measuring the occupier areas as well, will provide a much more holistic picture. Providing clarity on where efficiency improvements and savings can be made. It will also provide an opportunity for the owners and occupiers to work together, share knowledge on how the building is functioning and develop sustainability plans for the building as a whole (BBP, 2010, p. 18) (IPD, 2012).

5.4.6 Knowledge sharing

Successfully implement a sustainability benchmarking process, can be a very complex undertaking and will require time and patience, as there are many challenges to overcome and detailed decisions that will have to be made. Sharing knowledge and experiences between those in the property sector is encouraged, who engage and embrace benchmarking as well as performance measuring. It is believed that the property sector as a whole can make a significant contribution to both the goal of reducing the building industries impact on the environment as well as preserving and enhancing the value of their individual property assets (BBP, 2010, p. 18) (IPD, 2012).

5.5 Agreeing on sustainability metrics and industry standards

The exploration of the available literature, did reveal that a universally recognised industry standard for sustainability benchmarking in the built environment, would help to ensure all benchmarking tools and services will follow methodologies based on an agreed set of indicators and metrics. This would improve the overall efficiency of sustainability benchmarking process by avoiding duplication of data collection and ensure that the data is compatible, comparable and portable between various tools and services (IPD, 2012) (BBP, 2010, p. 20).

The key sustainability metrics identified below, require universally recognised definitions, which will allow the sustainability benchmarking process to become far more efficient. Suggestions are also made of potential alternatives, which may form the basis for discussion with regard to the development of universally recognised industry standards for the benchmarking process.

5.5.1 Space measurement

The first metric that requires a universally recognised industry standard to be developed, relates to how space should be measured. In South Africa, SAPOA (South African Property Owners Association) is generally recognised as the authoritative voice of the commercial and industrial property industry (IPD, 2012). It provides the industry standard for measuring floor areas which is generally recommended for space measurements of new as well as existing office, retail and industrial buildings. SAPOA provides a useful source of information, not only to its members, but also to government and business at various levels, by way of its involvement in the collection and dissemination of property data and statistics. This is done in association with IPD in South African (SAPOA, 2013).

The main problems that does exists in terms to the SAPOA way of measuring space, is that it is rental income focused and that it has been developed primarily for the residential, industrial and commercial property sectors. It is not geared to provide the relevant data that can be used to truly assess and evaluate workplace efficiency within buildings, as it does not measure internal structure and un-usable areas under 0,5m^2 separately. It also does not provide any clear guidance on how to measure non-commercial buildings like healthcare and education type buildings. (SAPOA, 2005) (GAPP GIBB TALANI, 2013) IPD on the other hand, in their Space Code (2008), suggests a conceptual framework for measuring floor areas in office buildings which allows one to measure an office building according to a far more refined area measurement matrix. *Figure 12* below graphically indicates this matrix that could possibly be adapted for use on different building types.

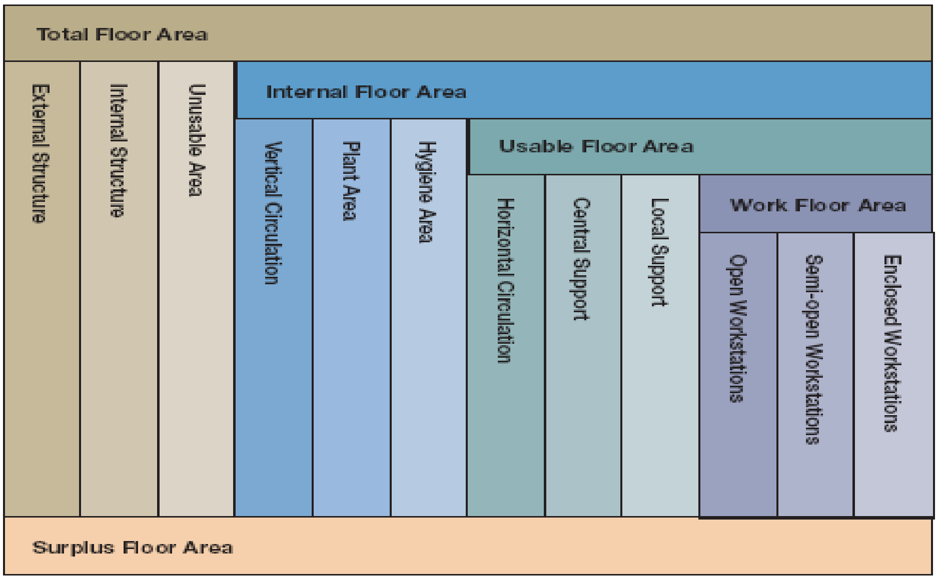


Figure 12: Conceptual framework for measuring floor areas in office buildings

(IPD, 2008, p. 25)

The SAPOA method measures an office building primarily in terms of the income revenue obtainable from the rentable area, as can be seen by the comparison between IPD and SAPOA's method for measuring floor areas in office buildings below. Essentially SAPOA measures:

- ***Construction Area,*** which in principle is the same as IPD Space Code's ***Total Floor Area.*** (IPD, 2008) (SAPOA, 2005)
- ***Building Area,*** this is defined by SAPOA as the construction area of the building, minus all major vertical penetrations, basement and parking. The intention of this measurement is purely for development planning purposes, as the building area relates to the buildings zoning. FAR (Floor Area Ratio) or the other commonly used terms to define FAR - *Bulk* and FSR (Floor Space Ratio) - is a terms related to building area measurements, which provide an indication of the maximum building area permissible by the Local Authority on a specific property as defined by the zoning scheme. It should also be noted that there does exist significant variations between the interpretations of FAR by different Local Authorities in South Africa (SAPOA, 2005). IPD Space Code's (2008) on the other hand, does not make any reference to the use of building area.
- ***Usable Floor Area*** of an office building is defined by SAPOA (2005), as that area of the office building which is exclusive for the occupation of the tenant, in other words the total area of the building enclosed by the dominant face minus the common areas and major vertical penetrations. The net height of any usable area should be greater than 1,5m and any duct areas with a floor area of more than 0,5m^2 should be included with major penetrations.

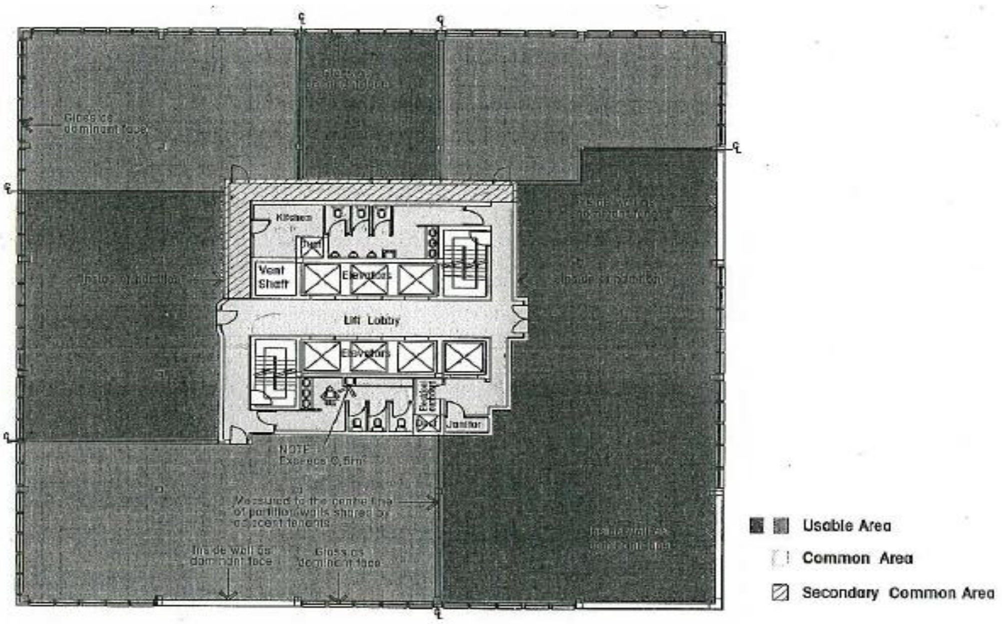


Figure 13: SAPOA – Usable, Common and Secondary Common Areas

(SAPOA, 2005)

SAPOA also provide two separate definitions to distinguish between primary and secondary common areas. *Primary common areas* are defined as all rentable area that is not usable area plus any remotely located common area, like for instance the entrance foyer, a plant room some form of service room, plus any portion of the rentable area not on a given floor. *Secondary common areas* are defined as those areas beyond primary common areas, which give access to multiple tenancies, like for instance access passages and fire escapes. It is also worth noting that these areas may vary over time, and that all common areas are measured to the outside finished surface of the wall defining the common area.

Supplementary areas are defined as any additional revenue producing area, which falls outside the definition of rentable area, these areas would most likely include for instance stores, balconies, terraces, patios, access/service passages, signage/advertising areas & dedicated parking areas (SAPOA, 2005).

IPD's Space Code (2008, p. 30) on the other hand defines ***Usable Floor Area*** as a subsection of the *Internal Floor Area* of the building, which in turn is defined as the floor area measured up to the internal surface of the facade and all structural elements. *Internal floor area* is thus all areas, excluding external structure, internal structure and any unusable areas. *Internal floor area* calculation also makes provision for sub category calculations with regard to vertical circulation, plant and hygiene areas, work floor areas and usable floor areas.

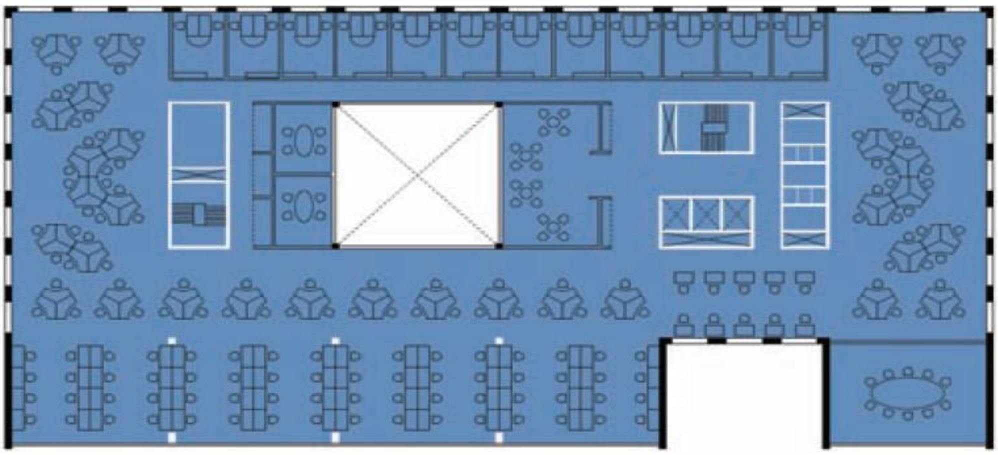


Figure 14: IPD – Internal Floor Area

(IPD, 2008, p. 30)

Usable Floor Area according to IPD (2008, p. 30) is the floor area that corresponds to the organisations processes; this equates to the total floor area, minus the vertical circulation, plant and hygiene areas. Any usable floor area should also have a height of more than 1,5m. This definition does not, in principle, differ much from SAPOA's (2005) definition for usable floor area. Where IPD does differ substantially from the SAPOA definitions is in their definition of *Un-usable areas*, which they define as areas with a net length or width of more than 0,25m and with a floor area of more than 0,5m^2. IPD further differentiate form SAPOA in their classification of the common areas of the building, which they separately categorise and measure in terms of horizontal, central and local support areas.

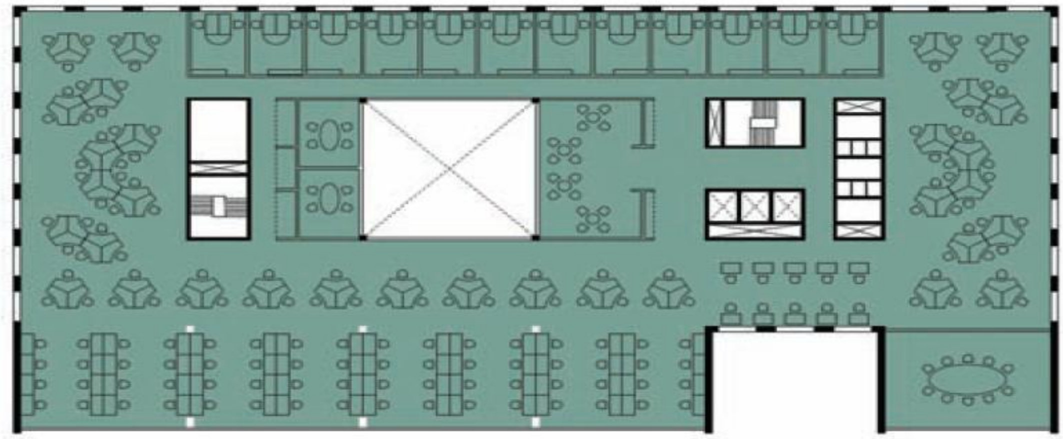


Figure 15: IPD – Usable Floor Area

(IPD, 2008, p. 30)

Horizontal circulation is defined by IPD's Space Code (2008) as any usable floor area taken up by horizontal circulation, which will include primary circulation and escape routes. ***Central Support*** area according to IPD is defined as usable floor areas that are taken up by all support spaces, which are shared by occupiers. These would include social areas, meeting spaces, catering areas, and resource areas. ***Local Support*** areas on the other hand are defined as usable floor areas taken up by support spaces which are shared by the occupiers from one department or floor level.

IPD (2008, p. 34) also provide for a ***Work Floor Area*** subcategory which they defined as the total floor area corresponding to the support of all individual work processes. Sub categories are once again provided here, so that distinctions can be made between ***Open***, **Semi-open** and **Enclosed Workstations**, with clear definitions of what is meant with each category.

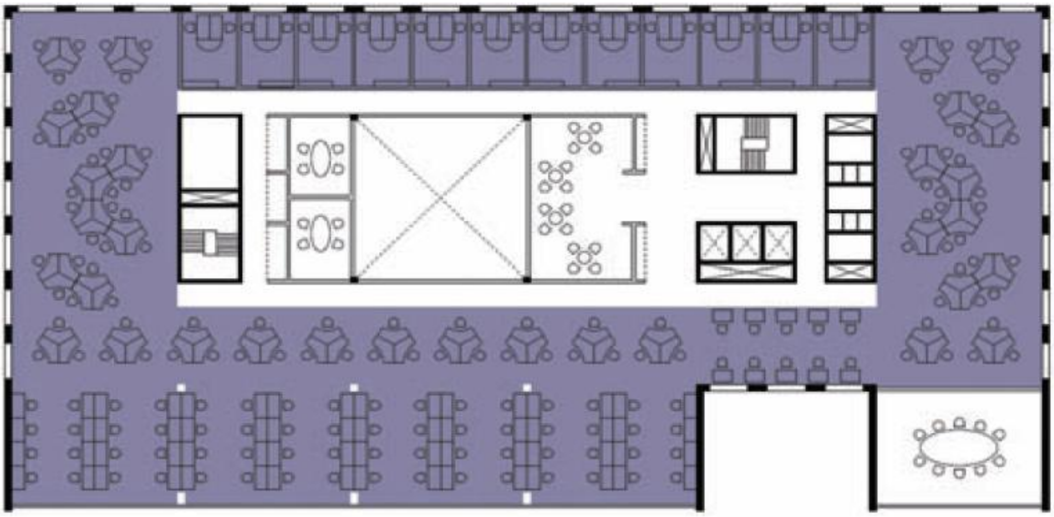


Figure 16: IPD – Work Floor Area

(IPD, 2008, p. 34)

- ***Rentable Area*** is defined by SAPOA (2005) as the total floor area enclosed by the dominant face of the building minus major vertical penetrations. The rentable area includes any internal structure and columns, should have a minimum floor to ceiling height of 1,5 m, comprise of both usable area as well as common area but it excludes any supplementary area which may produce additional revenue.

According to SAPOA (2005) the purpose of rentable area, is to determine the revenue-producing area, which in terns is defined as the rentable area plus the supplementary area plus parking. The rentable area is also used to calculate the R/U Ratio of the building which is defined as the rentable area divided by the Usable Area.

IPD (2008, p. 34) on the other hand defines the rentable area as the total floor area minus the external structure, minus the vertical circulation, minus the plant area, but includes internal structure, hygiene areas and usable floor areas.

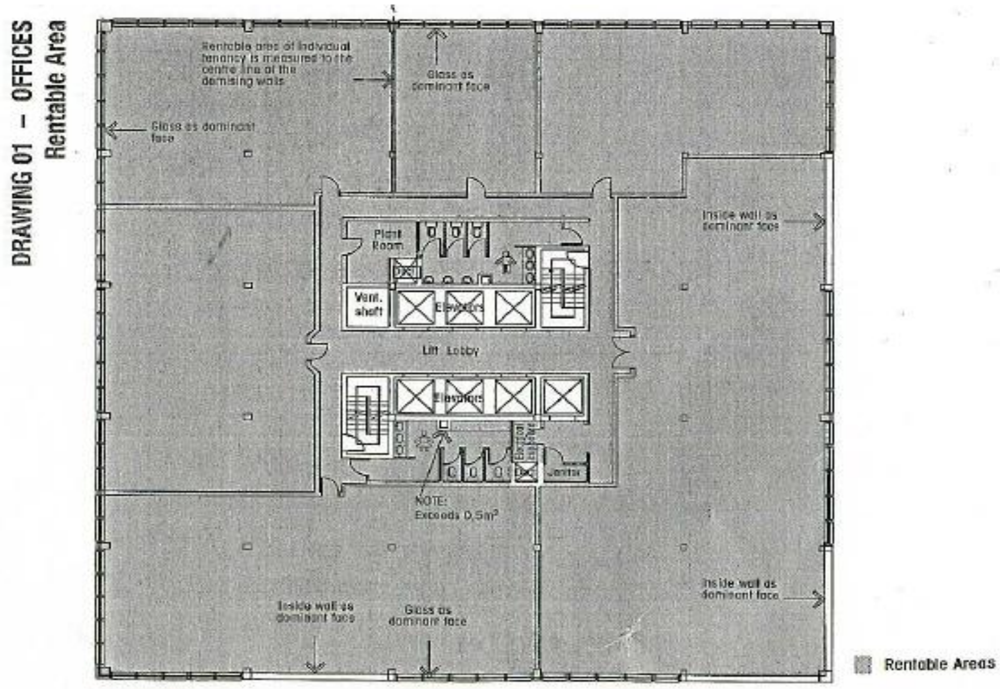


Figure 17: SAPOA – Rentable Area

(SAPOA, 2005)

What is evident from the above analysis between IPD and SAPOA's methodologies for determining areas is that the use of ***per floor area***, as an indicator is common practice within the property sector. But there is no clearly defined and recognisable standard of how to measure this indicator.

SAPOA's method of measuring office buildings is a well-defined an accepted method for measuring floor area within the building sector in South Africa. It thus makes sense to use this method of measurement to for the sustainability benchmarking process for the PGWC. But it must be noted that the SAPOA method of measuring, was been developed to enable the calculation of revenue returns for the commercial, industrial and retail buildings, rather than for benchmarking the sustainability of a building. This is especially of concern, in light of the future role out of the sustainability benchmarking process for health care and education buildings in the future. It would thus be advisable to incorporate some of the IPD sub categories structure into the future development of the SAPOA method of measurement over time, which will allow for a much wider range of sustainability reporting to be possible, especially in terms of the space efficiency of a building, which under the current SAPOA method of measuring would be problematic.

5.5.2 Occupation density measurement

The idea of benchmarking a building's sustainability by using occupational density is gaining increasing interest, but currently there are no agreed industry standard that for the measurement of this indicator. Below a number of different approaches which can be pressured as a possible industry standard for measuring occupancy in a building.

i. Full Time Equivalent (FTE)

IPD in its Cost and Environmental Codes (2009, p. 25) propose that a possible industry standard for measuring occupational density could take the form of a *Full Time Equivalent* (FTE). This approach suggests that the number of personnel is calculated in terms of their full-time equivalents. It allows for non-payroll staff like; contract, consultant and outsourced staff, are converted to FTE on the following basis:

1.00 FTE	= Personnel working on a regular basis for more than 32 hours a week
0.80 FTE	= Personnel working on a regular basis for 24-32 hours a week
0.60 FTE	= Personnel working on a regular basis for 16-24 hours a week
0.40 FTE	= Personnel working on a regular basis for 08-16 hours a week
0.20 FTE	= Personnel working on a regular basis for less than 08 hours a week

Here the premise is to qualify as a member of staff; the staff member must use the building as their main base of operation and it is expected that the staff member must work there for part of their typical working week (BBP, 2010) (HM Government, 2012).

ii. Workplaces or Workstations

Another way in which occupation density can be established is by means of the workplaces or workstations**.** The IPD Space Code (2008) definitions of work stations are widely used in the UK at present (BBP, 2010, p. 21) (HM Government, 2012) (IPD, 2009).

According to IPD's Space Code (2008):

- **Open Workstations** are defined as work areas which are suitable for high communication and or little concentration activities typified by open plan offices and touchdown spaces.
- **Semi-open Workstations** are defined as work areas which are suitable for medium concentration and or communication areas such as cubicles, work lounges and teams spaces.
- **Enclosed Workstations** are defined as work areas which are suitable for high concentration and low communication areas such as study booths, team rooms, shared offices and private offices.

The Australian Green Building Rating (ABGR) on the other hand propose the following definition; that a workplace is defined in terms of computers, either desktop or laptop which are in regular use, but which exclude computers in low-use training, meeting and boardrooms. With this approach, one is required to execute an on-site count within a predefined timescale of each functional space within the building. There are also predetermined guidelines which set out on how to treat special cases (BBP, 2010, p. 21).

iii. Workplace Density

The British Council of Offices (BCO) defines *occupational density* as a measure of the number of people within a given special area and is generally expressed in terms of m^2 per person. (BBP, 2010, p. 21) *Space efficiency*, according to IPD (2008) is calculated according to the ratio of net floor area per *FTE employee*. An industry standard for *Workplace Density* could in principle be based on the IPD and BCO definitions on workplace density. The Better Building Partnership (2010, p. 21) proposes that workplace density should be seen as: "...a measure of the number of discrete work points within a given total area of space, (defined as) the Net Internal Area (NIA) divided by the number of workplaces."

BBP, IPD and BCO have so far each proposed definition for low, medium and high occupation density categories for buildings. For interest sake, lists are provided of what each organisation puts forward as their definition for high, medium and low occupation densities:

BBP defines occupation density, based on the work that was carried out by Upstream Sustainability Services for BBP, in terms of m^2 Net Lettable Area (NLA) per FTE (worker):

- **High** occupation density is seen: **< 12 m^2 NLA/worker**
- **Medium** occupation density is seen: **12 to 16m^2 NLA/worker**
- **Low** occupation density is seen: **> 14 m^2 NLA/worker**

(BBP, 2010, pp. 21-22)

IPD defines occupation density in terms of m^2 (NIA) per FTE or workstation:

- **High** occupation density is seen: **< 10 m^2 NIA/ workstation or FTE**
- **Medium** occupation density is seen: **10 to 12m^2 NIA/workstation or 10< to 12<m^2 FTE**
- **Low** occupation density is seen: **> 12 m^2 NIA/ workstation or FTE**

(BBP, 2010, pp. 21-22)

BCO's Guide to Specification defines occupation density in terms of m^2 (NIA) per workplace:

- **High** occupation density is seen: **< 7 m^2 NIA/ workplace**
- **Medium** occupation density is seen: **8 to 13m^2 NIA/workplace**
- **Low** occupation density is seen: **> 14 m^2 NIA/ workplace**

(BBP, 2010, pp. 21-22)

5.5.3 Defining Special Uses

Special use areas (like server rooms, catering areas, car parks, call centre ect.) within a building should be clearly defined. The Better Building Partnership in their Sustainability Benchmarking Toolkit (2010, p. 22) suggests that either the Display Energy Certificates (DECs) or LES-TER's definitions could be used to provide a clear definition for different special use areas.

LES-TER is an industry initiative led by the British Property Federation, with technical assistance from the Usable Buildings Trust and financial support from the Carbon Trust. It is a set of tools and a process designed to enable landlords and tenants to measure, understand and reduce their emissions from their ownership and occupancy of commercial buildings.

- **The landlord's energy statement (LES)** is a tool that helps landlords understand their buildings' energy efficiency, compares the performance of common services (heating, lighting and ventilation supplied by the landlord) against similar buildings with similar uses, identifies any areas for improvement and illustrates where year on year improvements have been made.
- **The tenant's energy review (TER)** is a tool which allows tenants to assemble information on the energy and emissions attributable to the energy they purchase directly from suppliers. It also records 'stress' factors (such as high densities of occupation, long hours and intensive energy uses, like dealing rooms and data centres). It assists tenants in making energy reductions in the electricity uses they control through the production of an automated energy savings report, helping to identify potential savings opportunities.

Display Energy Certificate(DEC) is based on the measured energy use, where the actual energy consumed in the building is compared to a benchmark for similar buildings, and shown on the certificate A1 - G scale in terms of primary energy. There is also a CO2 indicator which shows the CO2 emissions associated with the building's energy consumption. Benchmark or typical buildings have a E1 rating. The DEC layout is specified in S.I. 243 of 2012.

From the 9th January 2013 publicly and privately owned buildings over 500m2, frequently visited by the public, are required to exhibit a DEC, in a prominent place, clearly visible to the public. The DEC is intended to encourage public authorities to adopt environmentally responsible and efficient use of energy in buildings. – More information is available at: http://www.seai.ie/Your_Building/BER/Large_Public_Buildings/DEC_FAQ/#whatis

5.5.4 Adjustment for Hours of Operations

In terms of the operating hours of a building, the following terms will needs to be more clearly defined. For instance:

- Is a working hour a 60min time period or not?
- What constitute the core working hours?
- Is a work day to be considered as 9am to 5pm or should it be seen as a 24 hours period?
- Is weekends to be seen as one 48 hour time period or is Saturdays and Sundays to be dealt with separately (BBP, 2010, p. 22)?

5.5.5 Adjustment for Weather

There are issues around whether or not adjustments should be made in terms of extreme temperatures. For example, should adjustments be made to allow for both heating and cooling of the building? Then there is also the question around the type of fuel should be used to negate these adverse weather conditions, should it be coal, gas, oil or electricity (BBP, 2010, p. 22)?

5.5.6 Adjustment for Vacancies or Voids

Generally the average vacancy certify of a property is considered to be that proportion of the property, which has been vacant, over a one year period. This vacancy can be calculated in terms of floor area, but is also sometimes reflected in terms of potential rent. Ideally this vacancy figure should reflect how much of the building has been vacant, as this vacant portion of the building would normally not require services that would consume energy whilst vacant. For example, say 50% of the lettable floor area of a building has been vacant for say a 6 months of the benchmarking period, then the average vacancy certify would be 25%. This data can then be used to assess changes in consumption patterns between the benchmarking assessment periods, for instance if this data is consistent amongst all participants, then this data may be used to adjust the performance indicator (BBP, 2010, p. 22).

5.6 Conclusion

The sustainability benchmarking of building is a challenging exercise which relies heavily on a process that assesses and compares the sustainability performance of a building against other properties or pre-defined targets and benchmarks. It essentially draws comparisons between the performances of buildings over time at multiple a levels. It is also not usually possible to just implement a standard benchmarking process. A tailor made sustainability benchmarking process, developed over time is advised, even though there are a variety of existing tools available which can be used as part of a sustainability benchmarking process.

The primary benefit of sustainability benchmarking is that it allows one to assess and report what the environmental impact of a building is. It also provides greater understanding, of the operational aspect of a building. It also provides the means by which to identify where appropriate action is required to improve the environmental performance of a building. Sustainability benchmarking allows building and estate managers, to set realistic targets and provides the means by which to monitor whether or not these targets have been met or not. It also enables comparisons to be made between buildings, estates and peer groups and it provides assistance with compliance to legislative and regulatory issues. It ultimately creates a robust framework that can help in the preparation of emerging legislation. Sustainability benchmarking ultimately helps improve the value of the building, as investors are increasingly taking sustainability issues into account in their decision making processes.

Developing an appropriate and robust sustainability benchmarking process does present a number of challenges. The first of these challenges relates to the collection of accurate, consistent and verifiable data, which can enable performance and progress measurements to be made, but it is worth noting that it is possible to initiate the benchmarking process by using readily available data, even if this data is limited, and then systematically over time increase the sophistication and robustness of the benchmarking process as well as the accuracy of the data.

It is also imperative to identify and select the most appropriate matrices, to normalise the sustainability indicators which will influence the right behaviour and ultimately deliver improved building performances. But the lack of agreed matrix definitions as well as associated problems relating to the availability of accurate, reliable and replicable data does prevent the use the most effective matrices.

The type of occupier and or business activity associated with the building is another concern that does exists, as this can influence what would be the more appropriate matrices to use. Occupational density matrices can for instance present unintended consequences as higher density does not necessarily means an improved performance of the building. There is also the associated risk that there is no standard industry definition for the matrices, which makes comparisons between buildings difficult. This is complicated further by the far more practical difficulty of how data is to be collected.

The purpose of any sustainability benchmarking process is ultimately to measure, analyze and report in terms of buildings space, cost and environmental performance of a building. For this to happen, spatial and contextual data is required that will enable the conversion of the collected data into spatial rations, which in turn will help gain clarity in terms of the spatial usage of a building. This will allow one, to set and track performance targets over time. It will also provide support, for effective decision making in terms of the space usage. It will also allow confident and accurate communication in terms of any spatial improvements that has been achieved.

A best practice norm currently exists to employ a *Graduated Approach* to sustainability benchmarking (BBP, 2010, p. 15) (IPD, 2012). This norm also suggests this data should be collected over an adequate time frame that will allow trends to be identified. The data so collected should be accurate, consistent, verifiable and replicable will ultimately form the backbone of the benchmarking process, which will ultimately ensure that any positive progress in the sustainability performance at a building level is properly reflected, so that the right behaviour can be incentivised.

It is also important to be absolutely clear from the outset what the intended purpose for the benchmarking process will be. With the success of the sustainability benchmarking process being subject to the quality of the data collected, it is essential that this data should including both the owner as well as occupier's consumption data. This requires that the owners and the occupier engage and co-operate with the data collection process as well as the subsequent implementation of the efficiency measures agreed on. An owner-occupier partnership is thus essential for the success of any sustainability benchmarking process, which can make a significant contribution to both the goal of reducing the building industries impact on the environment as well as preserving and enhancing the value of individual buildings.

The successful implementation of a sustainability benchmarking process is a complex undertaking and will require time and patience. There are many challenges to overcome and detailed decisions will have to be made. As such the sharing of knowledge and experiences between those engaged in the development of sustainability benchmarking processes are encouraged.

Chapter 6: PGWC's sustainability benchmarking pilot project - Case Study

6.1 Background

In January 2010 a Multi-disciplinary consultancy team consisting of **GAPP** *Architects & Urban Designers*, **GIBB** *Engineering and Science* and **TALANI** *Quantity Surveyors* was appointed by the **PGWC** (Provincial Government Western Cape) to develop a surveying system and implement a pilot project consisting of hospitals, schools, cultural buildings and offices in 5 inner city precincts. This pilot project consisted of the design and development of the surveying system, which included an initial audit survey. This audit survey consisted of the above mentioned buildings being surveyed in terms of their condition, capacity, legal compliance to legislation as well as conformance to the PGWC's norms and standards. In addition it also provided contextual data for use in urban regeneration and rural development projects. It also provided baseline data, on which maintenance and management cost budgets could be based. The survey was also required to certify these buildings certified in terms of their overall environmental sustainability.

The initial project brief called for the shortcomings in the present PGWC asset management process to be addressed, in particular in terms of the principles set out in GIAMA *(Government*

Immovable Asset Management Act). The project brief also required that recommendations are made, for the improvement of the PGWC asset management assessment and managing processes and to test these improvements for the PGWC's immovable assets. The methodology developed by the consultant team, will then be applied to the rest of the PGWC's property portfolio. With the ultimate aim of the project being that the developed methodology would become the standard, by which the PGWC can manage their immovable assets in the future.

The initial design and development of the assessment system was done during the 2010-11 financial year. This was followed by an initial audit that was executed from January 2011 to March 2012 consisting of 919 000 m^2 of building area. The full implementation of the balance of the PGWC's property portfolio, which consisted of approx. 7million m^2, followed directly after the initial audit with the completion date scheduled for the end of the 2013 financial year.

The advantages derived from this PGWC property portfolio audit, is that it can provide robust baseline data set, that can be used in urban regeneration or modernisation project for the improvement of the 'image' of the province, either done by means of Public-Private Partnerships or User Agreements. In addition to this, it also facilitated with conformance of the PWGC assets to the protocols and user requirements contained in GIAMA (GAPP GIBB TALANI, 2013).

From the outset, certain concerns were raised by the consultant team, relating to the handling of the data obtained by means of the audit process. It was believed, by the consultant team, that a conventional paper based survey, would be inadequate and that the manipulation of data in this conventional paper format, will limit its usefulness. These concerns are relevant due to the overall size and scope of the PGWC's asset survey. It was also pointed out by the consultant team that the information 'snapshot' produced, by a conventional paper based system, will quickly become outdated and thus lose its usefulness. Thus a conventional survey paper based survey will not be able to address all the requirements of the brief, nor would the time and budget constraints be able to be overcome if a paper base system was pursued. The consultant team proposed that the ultimate goal of the audit survey should be that the surveying system developed should be able to be taken over by the PGWC, allowing the PGWC self-manage the process in the future from inside PGWC Public Works department (GAPP GIBB TALANI, 2013).

The proposed approach that was ultimately adopted by the multidisciplinary consultant team GAPP, GIBB & TALANI for the asset survey, was based on the Institute of Public Works Engineering Australia's (IPWEA) Building Condition and Performance Assessment Guidelines. These Australian guidelines were able to addresses most of the needs and objectives that was identified by the stakeholders. The IPEWA process is based on a full building lifecycle costing principle and has the ability to provide projected future project costs. It is also a process that is compatible with most of the principles and protocols required by GIAMA with the added cost advantage that it favours a generalist, rather than a specialist surveying approach (GAPP GIBB TALANI, 2013).

6.1.1 PGWC Asset Survey - Design and Methodology

GIAMA (The Government Immovable Asset Management Act, Act no 19 of 2007) effectively provides a basic framework in terms of which, all national and provincial government departments are supposed to manage their immovable assets. The Act, in addition to providing a management framework, also:

i. Clarify the asset management principles which are to be used.
ii. Ensures that an effective asset management system is in place.
iii. Aligns the use of the assets with specific service delivery objectives which is set out by the National Government.
iv. Optimises the cost of service delivery by making sure that there are accountability measures in place and that:
    - there are better functional usage of assets,
    - the assets are properly maintained,
    - the environment, historic and cultural heritage are protected,

    while improving health and safety standards.
v. Clarifies the roles of users and custodians.
vi. Imposes an accountability duty on those officers who are accountable.
vii. Determines the minimum content and legal status of asset management plans.
viii. Provides for the administration of the Act, and it enables the minister to make regulations.

One of the requirements of the initial brief to the consultancy team was to propose and develop an appropriate system to effectively and efficiently create a baseline condition and compliance survey of the PGWC immovable assets. This was to meet, all of the GIAMA requirements and this proposed surveying system was to be in such a format and of such a nature that it would enable the various User Departments to compile their own individual U-AMP reports. The secondary requirement of this initial brief was to test this proposed surveying system by means of an initial pilot project.

After some research by the consultancy team on the different available immovable asset surveying systems available in the world, it was decided that the process for the PGWC Asset Survey will be based on the IPWEA (Institute of Public Works Engineering Australian) method, and that the associated SPM Asset Management software, will be used to capture and process the data. The primary reason for the use of the SPM software is its ability to capture, manage, process and automatically produce detailed reports, thus allowing continued access to all of the data captured by the PGWC Asset Survey (GAPP, 2013) (IPWEA-NAMS.AU, 2006).

Due to some minor differences between the method used by IPWEA and the requirements of GIAMA, a hybrid method was developed by the consultancy team which integrated the IPWEA method with the GIAMA requirements. An example of one of one of these minor differences is that he rating system required by GIAMA is the reverse of the rating system used by the IPWEA and its associated SPM web based data capturing and reporting system. In GIAMA, a ***5*** rating is indicative of a high level of service delivery, with a low level of risk, whereas according to the IPWEA/SPM rating system, a ***5*** rating indicates a high level of risk, and a low level of service delivery. The subsequent re-programming of the SPM system to reflect the GIAMA requirement had to be put in place.

6.1.1.1 User Asset Management Plan (U-AMP)

GIAMA very specifically describes the minimum requirements of the content of a U-AMP. The Act stipulates that a U-AMP report by each User Department should contain as a minimum, the following:

i. An introduction which summarises the long term immovable asset strategic intent.
ii. The service delivery objectives.
iii. The immovable asset requirements set out according to the User's annual strategic plan.
iv. An acquisition plan, which will also contain a summary of all current and proposed new acquisitions which is informed by the impact of service delivery objectives.
v. A refurbishment plan which contain a summary of current and proposed refurbishments based on the need to:
    - Extend the life-cycle of an asset and improve its condition, as informed by the 'Custodian' of the asset (C-AMP).
    - Improve the functional performance and utilisation of an asset as informed by the 'User' of the asset (U-AMP).
vi. A required repairs report to enable the re-instatement of the immovable assets to their original state. *(Note: this excludes the day to day maintenance or compliance/conformance issues which form part of the C-AMP (Custodian Asset Management Plan) compiled by the custodian in point (i) above.)*
vii. All surplus immovable assets are to be surrendered to the custodian.
viii. Budget requirements to fund the above needs.

A final report has to be compiled by the various User Departments and will be made up of the information supplied by various bodies and processes, which would include, but is not limited to the PGWC Assert Survey. The appointed consultancy team would be able to provide, through the use of the adjusted IPWEA methodology and the SPM software, most of the asset-specific information to conform to the GIAMA requirements, but it will not be required to provide asset requirement forecasts, based on strategic service delivery intent and objectives as described in points (i) and (ii) above.

6.1.1.2 User Asset Management Plan (U-AMP) - Preparation Process

The preparation of a U-AMP requires that ten processes be followed. The U-AMP manual provides 13 templates to help with the organisation of information and the required reporting in terms of the ten processes, all of which are to be included in the final U-Amp report as various annexure. These ten processes deal with two levels of information. The first is a higher level statement of strategic service delivery objectives, expressed in terms of the User budget and programme objectives, and should be compiled by the various User Departments. The second level of information deals with asset-specific information, feeding in from the templates and matrices described in *paragraph 6.2.1* above, which in turn is informed by means of a survey and other sources of information.

The PGWC asset survey by way of the adapted IPWEA methodology will be able to provide the some of the required information (as is noted under each process) to both the User and the Custodian, which in turn will enable them to compile the U-AMP. The 10 processes are as follow:

PROCESS 1: Budget, Programme and Strategic Information

Process 1 simply calls for the matching of the asset requirements with the services delivery objectives. This is a key component of the overall asset planning process as it will be the basis for rationalising the demand against the available resources, while maintaining the required level of service. This process must form part of a User's strategic service delivery planning. In the U-AMP a narrative summary is required which must express the per budget programme objectives, as well as a per budget programme objectives over a medium term expenditure framework (GIAMA, 2007).

Note: *Due to the fact that the above information is strategic of nature, input from the immovable asset survey would not be required.*

PROCESS 2: Asset Specific Information

Process 2 calls for the occupation and/or allocation of assets to users to be verification. It is the responsibility of the Custodian to provide each of the User Department with current schedules of assets allocated to specific Users. In addition to this the Custodian should also provide the Users with current planned maintenance, renovation and refurbishment activities schedules as per the lifecycle plan which the Users should use to populate Template 2a (GIAMA, 2007).

Note: *The impact on the immovable asset survey as far as the first part of **Process 2** is concerned, relates only to verifying the accuracy of the Asset Register. The second part of **Process 2** requires the Custodian to provide planned maintenance information which will be generated from the condition survey which is an integral of part of the PGWC's immovable asset survey. This will define the Custodian's planned maintenance, renovation and refurbishment activities as part of the C-AMP.*

PROCESS 3: Determine Functional Performance of Assets

Process 3 uses the 6 norms and standards identified in the U-AMP guidelines. It is these 6 norms and standards that PGWC used as the basis to define the consultancy team's brief and will ultimately be used to calculate the functional performance of an asset. Conceptually, by cross referencing the various ratings allocated to a particular asset a functional performance rating will be arrived at which serves as a basis for decision making with regard to the continued use, renovation, refurbishment or the disposal of a particular asset.

The functional performance relates to the level to which the assets meet the needs of the Users and is calculated through the following sub-processes:

i. **Setting a Required Minimum Performance Standard:**
Here a statement of the required minimum standard that an asset is expected to be in, in order for this asset to deliver a level of service, is set. It can be considers as a generic level of service statement applicable to a specific asset where ***P1*** is the worst condition and no service delivery is possible and ***P5*** is the best condition with the highest service delivery. This form of rating will be used at a later stage in the process to derive other rating methods through a matrix system. For example, a functional Primary school will be certified as ***P3***.

Note: *No input is required form the PGWC's immovable asset survey, as the rating is read off a table to establish a level of service benchmark and will therefore not require the formulation of any questions in terms of IPEWA method and SPM software.*

ii. **Accessibility Rating**
In GIAMA accessibility is generalised as 'the asset is not accessible to the general public and should not be used for the current service delivery objectives' for a rating of ***A1*** and as 'fully accessible with well-designed public areas and parking and accessible to the disabled' for a rating of ***A5***. It must be noted that disabled access is considered part of this rating. These accessibility requirements in terms of the function of the asset should thus be taken into account (GIAMA, 2007).

Note: *This section requires quite a number of observations and the formulation of questions in terms of the IPWEA method and SPM software.*

iii. **Suitability Index**
The suitability index is determined by a cross reference on a matrix table of the required standard and the accessibility rating where a suitability rating of ***A*** is defined as: 'the asset is fully suitable for its function' and a suitability of ***C*** is defined as**:** '*the asset does not meet the required suitability criteria*'

Note: *No input is required form the PGWC's immovable asset survey, as the rating is read off a table as described above.*

iv. User Condition Rating

A general condition rating per asset is allocated to give an indication of the physical condition of the asset. A full condition assessment is not required. ***C1*** is 'the asset has failed and is unfit for occupancy and the health & safety risk is high' while ***C5*** is 'the asset has no apparent defects, no risk' (GIAMA, 2007).

Note: *The condition information from the full PGWC asset condition survey must be reconfigured into a general rating per asset, according to the GIAMA ratings. Please note that in the GIAMA requirements as far as the U-AMP is concerned, compliance is grouped with condition under this heading, as the specific compliance issues are dealt with by the Custodian.* (GAPP, 2010)

v. Operating performance Index

The operating performance Index is determined by a cross reference between the Required Performance Standard and the Condition rating. An ***O3*** rating is considered as 'the functional performance does not meet the standard expected for the functional operating requirements' and a ***O5*** rating is considered as the standard exceeds the level expected for function and operational requirements (GIAMA, 2007).

Note: *No input is required form the PGWC's immovable asset survey, as the rating is read off a table as described above.*

vi. Functional Performance Index

The functional Performance index is determined by a cross reference between the suitability index and operating performance index on a matrix table. Any ***C*** rating (1 to 5) means that 'the asset does not meet some aspect of the minimum suitability criteria and any ***A*** rating means that 'the asset is operating optimally and is fully suitable for its required function' (GIAMA, 2007).

Note: *No input is required form the PGWC's immovable asset survey, as the rating is read off a table as described above.*

PROCESS 4: Determine the utilisation of assets

In **Process 4** the utilisation of the assets is assessed, against the applicable norms in consultation with the Custodian and compiles an utilisation plan. This requires a space norm calculation, to be measured against the actual measured space allocation, to provide a percentage of optimum utilisation (GIAMA, 2007).

Note: *The impact on the PGWC asset survey as far as this process is concerned mainly relates to verifying the norms for the specific asset type against the actual use of space* (GAPP, 2010).

PROCESS 5: Conduct a GAP analysis

In ***Process 5*** the user department must conduct a GAP analysis (*the comparison of actual performance with potential performance)* to determine the gap between the optimal performance of the immovable assets and existing requirements to maintain the required level of service. The improvement of an existing asset should be based on the functional performance index. Here an ***A*** rating means an asset can be re-configured, a ***B*** rating means an asset should be re-furbished and a ***C*** rating suggest disposal off or surrendering of the asset back to the Custodian, because it does not meet the minimum criteria in terms of service delivery any more (GIAMA, 2007).

Note: *No input is required form the PGWC's immovable asset survey, as the rating is read off a table described above.*

PROCESS 6: Determining new immovable asset requirements

In ***Process 6*** the new asset requirements are determined, when the User Department's asset requirements cannot be met by the assets allocated it, according to the analysis described in the section dealing with the required output data in terms of the IPWEA methodology or where the functional performance index is ***C,*** with ***C1*** being the lowest priority and ***C3*** the highest priority (GIAMA, 2007).

Note: *No input is required form the PGWC's immovable asset survey, as the rating is read off a table as described above.*

PROCESS 7: Determine the need for refurbishments or reconfiguration of an existing asset

In ***Process 7*** the priority for the required refurbishment or reconfiguration of the accommodation according to the functional performance rating is determined. Assets with a ***B*** rating must be prioritised, with ***B3*** being the highest priority and ***B1*** being the lowest priority (GIAMA, 2007).

Note: *No input is required form the PGWC's immovable asset survey, as the rating is read off a table as described above.*

PROCESS 8: Determine surplus assets to be relinquished

In ***Process 8*** the assets conforming to the following criteria are to be earmarked for surrender.

- Assets with a performance standard of ***P1***.
- Assets with a functional performance index rating of ***C.***
- Where the Custodian, in his long term strategic plan, has determined that an asset must be disposed of. (GIAMA, 2007)

Note: *No input is required form the PGWC's immovable asset survey, as the rating is read off a table as described above.*

PROCESS 9: Determine repairs that need to be conducted

In ***Process 9*** the User Department must requests the Custodian to estimate the cost of repairs required due to breakage/failure or damage in order to re-instate the asset to a condition where it is suitable for maintaining the required level of service. General maintenance, or changes to the asset in order to comply or conform as well as amendments to meet service delivery standards do not form part of this budget (GIAMA, 2007).

Note: *The condition information from the full condition survey must be reconfigures into a general rating per asset, according to the GIAMA ratings* (GAPP, 2010).

PROCESS 10: Prepare an immovable asset budget

In ***Process 10*** a summary of all budgetary requirements over at least two Medium Term Expenditure Framework (MTEF) cycles is required according to Treasury requirements.

Because of the lifecycle of buildings it is important to incorporate lifecycle costs into a longer planning cycle spanning several MTEF cycles. Budget information is obtained from **Process 6** - *Determining new immovable asset requirements* and **Process 7** - *Determining the need for refurbishments or reconfiguration of existing immovable assets* and it includes both the capital as well as refurbishment or reconfiguration budgets (GIAMA, 2007).

6.1.1.3 Information the PGWC immovable asset survey will be providing

PGWC immovable asset survey, by way of the adapted IPWEA methodology, will be able to provide, in terms of the above mention *Processes* the following information to both the Custodian and the User, this will enable them to compile the U-AMP (User Asset Management Plan). In terms of:

PROCESS 1: The PGWC asset survey will be able match and verify the asset requirements with the service delivery objectives, nut no additional information would be required (GAPP, 2010).

PROCESS 2: The PGWC asset survey will verify whether or not the asset is occupied and/ or allocated to Users. In terms of *Process 2*, questions developed and incorporated into the PGWC asset survey, are mainly aimed at verifying correctness of the Asset Register Information. The following information will be and captured and /or verified under the following headings:

i. Under **Property Identification** the property name and the custodian's property ID number will be verified. In addition to this, the physical address of the property will also be captures. Here information will be captured to reflect the formal description of the property in terms of the erf. number, street address, suburb or precinct, the city or town, the province, and finally the GPS (global positioning system) coordinates.
ii. Under **Ownership,** information relating to the title holder**,** title deed number and whether or not the asset is owned or leased will be captures under this heading.

iii. Under **Property Information,** the extent of land associated with the property, the construction and /or improvement area, the number of floor levels and the heritage status, property is captured.

iv. Under **Occupancy Information,** the asset type for instance offices, school, and hospitals are provided. In addition to this, a common asset description of the usage of the building is provided, here the user department is also capture as well as whether the accommodation provided is of a temporary or permanent nature.

In addition to the information that is required to be verified above, additional information that should be provided by the Custodian as part of the C-AMP is required on the current and planned maintenance in order to be able to complete **Template 2 a** as defined by GIAMA. Below is a list of the main headings and thy type of related information that will also have to be capture and or verified:

ix. In terms of the **Acquisition Information,** the acquisition date**,** the capital cost and the current replacement value should be captured.

x. In terms of **Maintenance Activities**, the annualized asset cost**,** the full building lifecycle (expressed in years)**,** the renovation cycle ((expressed in years)**,** the maintenance strategy, and the remaining life of the building should also be captured here.

In terms of the above recording of the maintenance activities, The PGWC asset survey will generate the Custodian's maintenance plans by way of the SPM component and condition survey methodology which does not form part of this study (GAPP, 2010).

PROCESS 3: Here the PGWC asset survey will be able to determine the functional performance of assets by way of the survey questions that has been developed in terms of:

i. The **Required Performance Standard** of the building, which is evaluated in terms of a predefined set of norms and standards.

ii. The **Accessibility Rating** of the building, is established by the PGWC's asset survey by way of survey questions relating to the accessibility of the asset in terms of:
   - The function of the facility, in terms of a high accessibility rating.
   - The location of the building in terms of public transport**.**
   - The location of the building in terms of road access.
   - The availability of parking for the general public.
   - The ease of access of the general public to the building.
   - As well a disabled access.

iii. For the **User Condition Rating** of the asset, the PGWC's asset survey rates the condition of the individual components that makes up the asset. This individual component rating also takes into account the required

Performance Standard in terms of the *Operational Requirements*, under *Process 1*. Two specific outcomes are therefore required here from the condition assessment; the first outcome is the rating of the asset according to the terms of the acquisition information and the second outcome will be in terms of the maintenance activities (GAPP, 2010).

PROCESS 4: It requires the PGWC asset survey to determine the utilisation of the assets. The survey questions that were developed for this section deal with the utilisation of the assets against a predetermined set of norms and standards relating to occupation and space requirement and utilisation of the asset. (GAPP, 2010)

PROCESS 5: In order to conduct the required GAP analysis of *Process 5*, suitable questions relating to the sustainability as well as the level of service of the building was developed the PGWC asset survey team (GAPP, 2010).

***PROCESS 9*:** Requires the PGWC asset survey to determine the repairs that needed on the building. In order to comply with this process, a list of repairs emanating from breakages or failures is generated by the PGWC asset survey for the inclusion by the Custodian into the C-AMP. The information required relates to; the description of the repair and its current status, as well as the estimated expenditure, the expenditure year and the type of budged applicable to the repair (GAPP, 2010).

PROCESS 10: Requires no additional questions in order to prepare an immovable asset budget other than the information that will be provided through the processes outlined above (GAPP, 2010).

As outlined above, most of the asset-specific data, required for the generation of the GIAMA reports, can be supplied, by way of the adapted IPWEA methodology and SPM software implemented by the PGWC asset survey, either as a direct output, or as information underpinning other decision making processes. It is also worth noting that the format, in which this required data is made available, can be adjusted to suit the various reports and template formats required by GIAMA, once the reporting formats has been defined and configured.

Though the PGWC asset survey team will be able to assist with the collection and processing of the data, the consultant team will not be responsible for the compilation of the User Department's U-AMP report. The User Departments as well as the Custodian will thus have to be intimately involved in providing information and producing the required reports.

6.1.2 IPWEA approach to building assessment

The IPWEA approach is a two part hierarchical approach for assessing building. The first part of the assessment, rates to the condition of the building. This condition assessment aims to provide sufficient information in terms of project maintenance and renewal costs in order to allow informed and strategic asset management and planning decisions to be made. For condition assessment purposes, assets are divided into categories, and then into component groups, component types and finally into components. It is worth noting that the word 'component' as opposed to *element* was discussed by the consultant team, but it is decided to recommend the use of the term *component* as a standard definition as is defined in the Building Condition and Performance Assessment Guidelines (BC&PAG) document (IPWEA - NAMS. AU, 2009). For the purposes the survey, a typical asset will be divided into the following hierarchical sub categories:

i. **Ground** - in this first category all information relating to a specific property is captured.
ii. **Site –** this category contains information relating to the specific site and site works, this will include smaller buildings related to for instance parking, infrastructure, and security.
iii. **Block** – category will contain information relating to various larger buildings that exist on the site.
iv. **Floor** – category will contain information relating to the various floors of the individual building in terms of the definition of a 'block'.
v. **Unit** – Would be spaces or rooms with similar characteristics. Typical units within a building will be circulation areas, parking garages, public reception areas, offices, boardrooms... and so forth.
vi. **Components** – would typically be the building elements creating for instance the external or the internal fabric (like windows and doors) of the building, the mechanical and electrical services equipment, the vertical transportation (like lifts and escalators), fire service equipment and so forth.

(IPWEA - NAMS. AU, 2009)

The second part of the assessment assesses the quality of the buildings in terms of how it is used by its occupants in relation to its compliance in terms of current building regulations, space utilisation and general functionality. This part of the assessment will address the GIAMA requirements in terms of performance standards, accessibility ratings, suitability indexes and overall operational performance of the building. In terms of the PGWC's asset the survey, assets will typically be assessed in terms of their quality according to the following sub categories:

i. **Criticality** – assessment of buildings and their components in the context of their use and location is intended to assist management in make strategic decisions in terms of allocation of funds, in terms of both *Capex* (capital expenditure) and *Opex* (operating expenditure).

The level of service assessment of buildings in the BC&PAG document is defined as 'the standard of service that is to be achieved and the benchmark against which performance can be measured'. This standard is set through the strategic objectives of the service provider and to a large extent determines the risk and criticality assessment of assets, as it balances the available funds against the required level of provision of service expected by the relevant users of the building (IPWEA - NAMS. AU, 2009).

The component criticality, it is assessed at a scale of 1 to 5 according to the following criteria:

- **Health and Safety** of occupants and public/customers.
- **Consequence of Failure** in terms of delivery of services, financial loss associated with downtime as well as the image of the organisation.
- **Appearance** of components in relation to position and function such as signage, paint and floor finishes.

(GAPP GIBB TALANI, 2013) (IPWEA-NAMS.AU, 2006)

It is worth noting that the following assessment guidelines were instituted by the consultant team under consultation from SPM in Australia to simplify and standardize the assessment and reporting processes. These guidelines are; that only the visible building elements would be assessed; that the residual structural value will constitute the parts of building that has not been assessed and lastly that each component within the component library will have a cost and expected life expectancy component attributed to it, on which future building life cycle planning, management and budgeting can be based (GAPP GIBB TALANI, 2013) (IPWEA - NAMS. AU, 2009).

In addition IPWEA's management strategy guidelines include the following processes which enable future building life cycle planning, management and budgeting:

i. A condition surveys of all components that form part of the building as a whole.
ii. A quality assessment to determine fit-for-purpose of the building.
iii. The establishment of criticality criteria in terms of the components that makes up the building as well as the building as a whole.
iv. The assessment of the full life-cycle of the building in terms of both the components as well as the building. This assessment will focus separately on the remaining useful life of individual component elements.
v. This management system also provides pro-active as well as urgent re-active maintenance planning to take place at the same time.
vi. This management process can also identify the renewal and replacement costs of components based on that components criticality and life cycle.

But IPWEA's management strategy guidelines do not recommend the use of straight line asset management depreciation models. It also does not agree with an assumed standardised 50 year life-cycle approach to building life-cycles nor are that whole building valuation methods used. It furthermore discourages maintenance only financial forecasting as well as the separation of renewal and new-build budgets. (GAPP GIBB TALANI, 2013) (IPWEA - NAMS. AU, 2009)

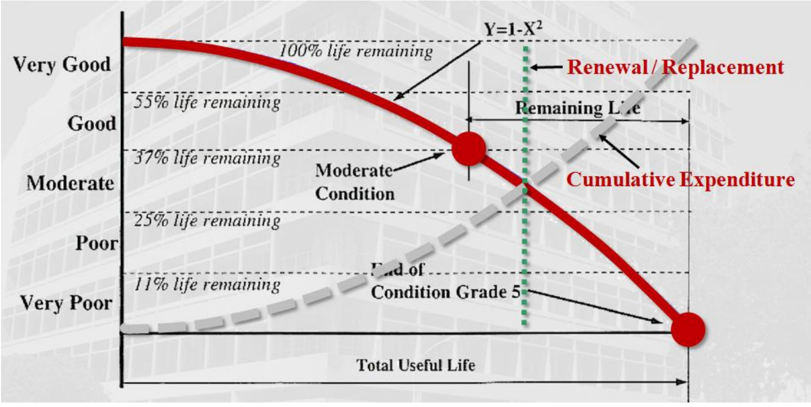


Figure 18: Life Cycle Assessment

(GAPP GIBB TALANI, 2013)

Why assess a building in terms of its life cycle? *Figure 18* above, provides a graphic representation of a typical building life cycle. The red line indicates the deterioration of building over time while the light grey dashed line, indicates the expenditure that is required to provide the same operational level of service of building, plotted over a period of time. The green dotted line indicates the optimal point in time, where the expenditure will outweighs the condition of the building it is at this point in time that a major renovation project should ideally take place. The IPWEA's management process enables the identification of this point in time with far greater accuracy. This allows for consistency in the level of service that is to be provided. The IPWEA process thus provides the optimal point in time for work to be executed, to enable the provision of a predetermined level of service, norm or standard. *Figure 19* below; provides a graphic illustration of how this process, to maintain a predetermined level of service, works.

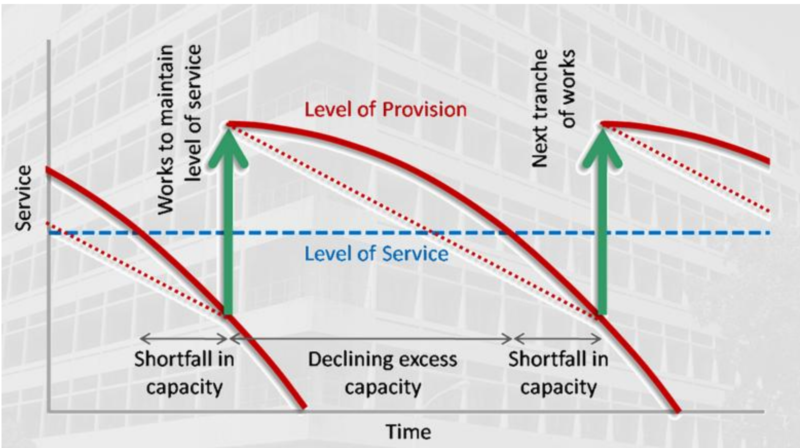


Figure 19: Level of Service/Provision

(GAPP GIBB TALANI, 2013)

The IPWEA management system thus facilitates asset planning as it is can focussed on generating financial data which can be used for CAPEX as well as OPEX budgets in terms of long term financial planning outcomes. It further more allows current replacement cost to be determined by breaking a building down into sectors and specialised components, which in turn allows depreciated replacement cost to be determined at a component level. It further more allows for the separation of residual structural value generally 45-55% of the total value, from condition-based component value. This enables long term budget and works forecasting done on say a 10, 20 and even a 100 year basis (GAPP GIBB TALANI, 2013).

6.1.3 SPM Assets software methodology

To facilitate with the implementation of the IPWEA management system the consultancy team GAPP GIBB TALANI, proposed and implemented a software based data capturing methodology called ***SPM Assets*** for the PGWC immovable asset survey. This web based software product, provided a core library of building components in its database, which by means of pre-programmed algorithms, can make predictions for the use in future management and planning of the PGWC's property portfolio. This methodology required that a site based a survey is carried out on the condition of the building components. A desk based survey on certain Property Quality Standards (PQS) questions, developed by the consultant team, is also carried out to establish compliance with GIAMA (Government Immovable Asset Management Act). The site surveys and PQS data collection is made easy by way of the mobile application component of the ***SPM Assets*** software product, which allows for mobile site data capturing by way of any a hand held device like an I-PAD. The survey data is then immediately uploaded by the hand held device onto a web based database. It is this database that provides the data which the ***SPM Assets*** uses to drive the Project Planer, Maintenance Planner and Report Planner tools of the ***SPM Assets*** software product. Thus providing a fully integrated management tool that the asset manager can use to plan, budget and manage all current and future improvement and or maintenance projects. I addition to its management function, this tool can also provide dynamic reporting in the form of a dashboard.

The ***SPM Assets*** software is essentially a hierarchy based methodology, which links individual records together. For example, an individual immovable asset would be linked to the site associated with the asset, the building or buildings on the site, the individual floor within a particular building, the room on a particular floor and finally the individual components that make up that specific room. This hierarchy based methodology up to floor level, is illustrated in *figure20* below.

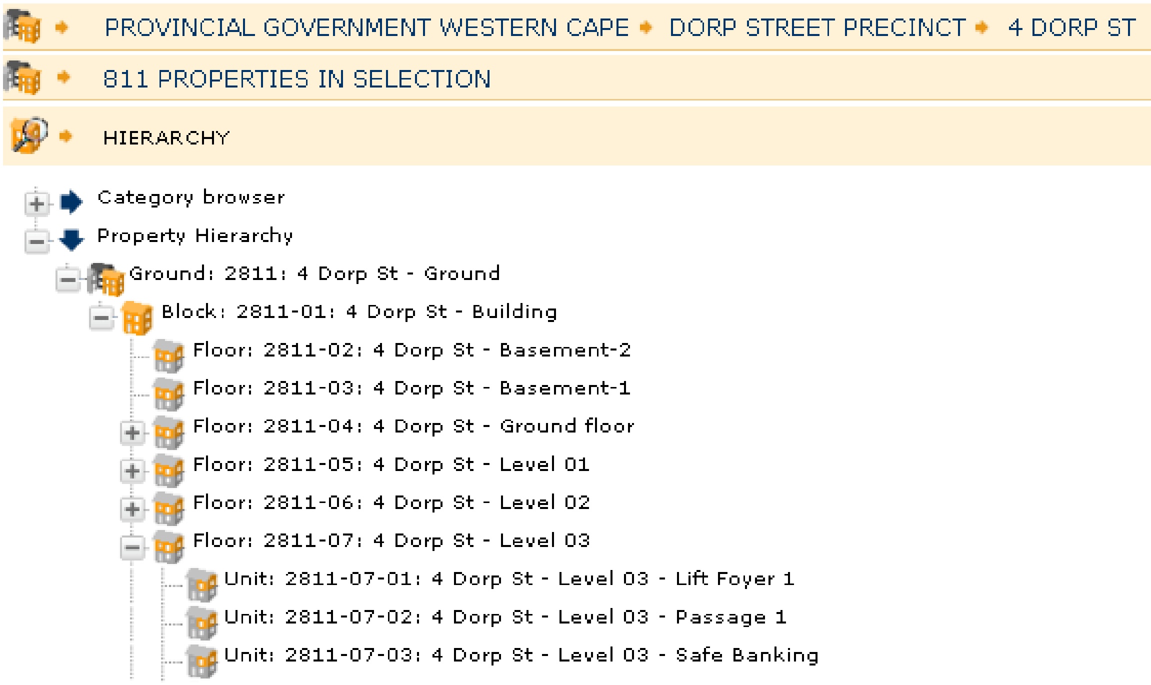
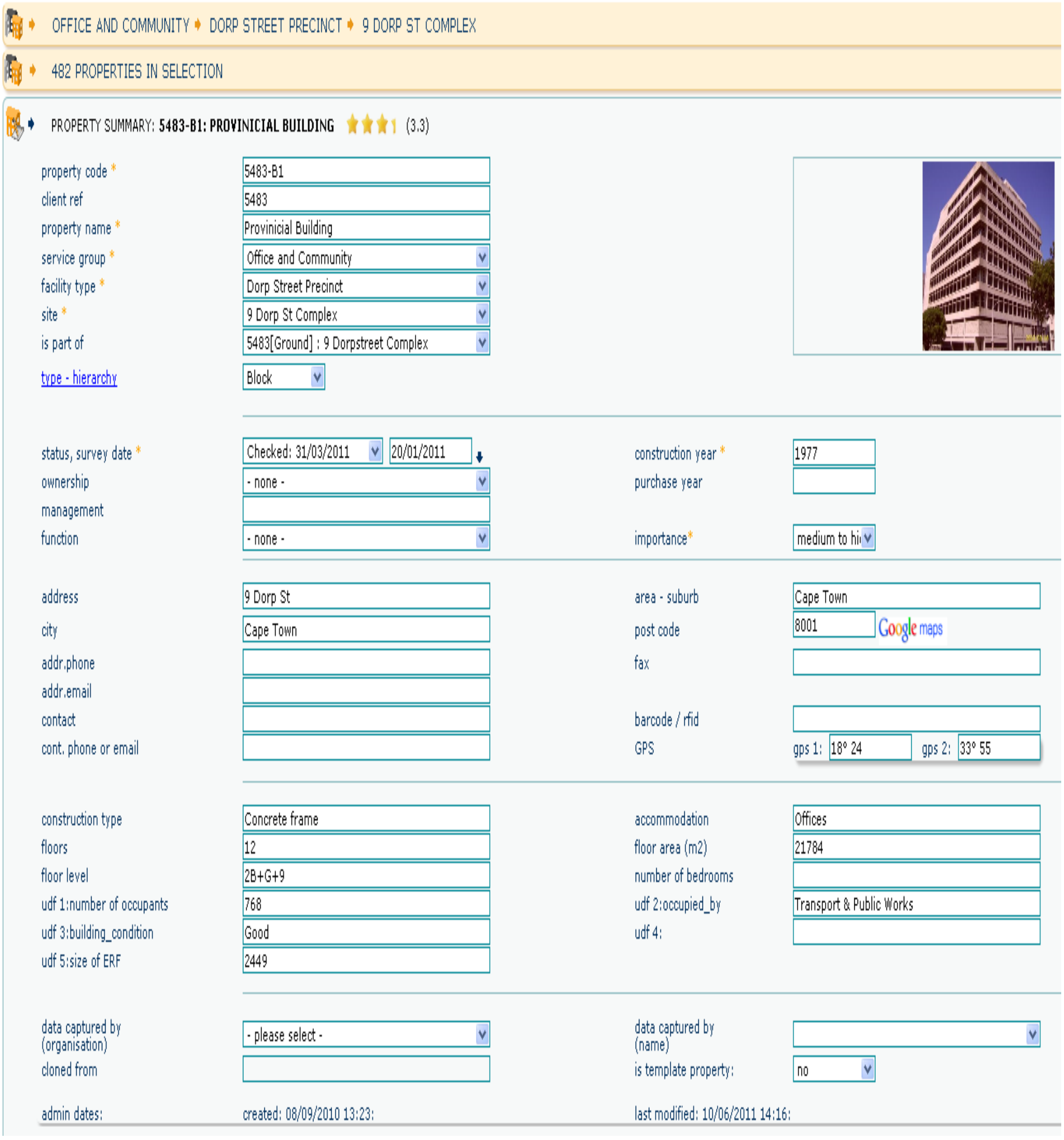


Figure 20: ***SPM Assets*** **software's hierarchy based methodology**

(GAPP GIBB TALANI, 2013)

The ***SPM Assets*** software's ability to capture information, from property level information as is illustrated in *figure 21* below, to the detail information that gets captured and certified at a component level, according to the illustrated sample *figure 21* below, provides for a very robust and useful dataset.



OFFICE AND COMMUNITY ♦ DORP STREET PRECINCT ♦ 9 DORP ST COMPLEX

482 PROPERTIES IN SELECTION

PROPERTY SUMMARY: **5483-B1: PROVINICIAL BUILDING** (3.3)

property code *	5483-B1		
client ref	5483		
property name *	Provinicial Building		
service group *	Office and Community		
facility type *	Dorp Street Precinct		
site *	9 Dorp St Complex		
is part of	5483[Ground] : 9 Dorpstreet Complex		
type - hierarchy	Block		
status, survey date *	Checked: 31/03/2011 20/01/2011	construction year *	1977
ownership	- none -	purchase year	
management			
function	- none -	importance*	medium to hi
address	9 Dorp St	area - suburb	Cape Town
city	Cape Town	post code	8001 Google maps
addr.phone		fax	
addr.email			
contact		barcode / rfid	
cont. phone or email		GPS	gps 1: 18° 24 gps 2: 33° 55
construction type	Concrete frame	accommodation	Offices
floors	12	floor area (m2)	21784
floor level	2B+G+9	number of bedrooms	
udf 1:number of occupants	768	udf 2:occupied_by	Transport & Public Works
udf 3:building_condition	Good	udf 4:	
udf 5:size of ERF	2449		
data captured by (organisation)	- please select -	data captured by (name)	
cloned from		is template property:	no
admin dates:	created: 08/09/2010 13:23:	last modified: 10/06/2011 14:16:	

Figure 21: **Illustration of how property level information is captured**

(GAPP GIBB TALANI, 2013)

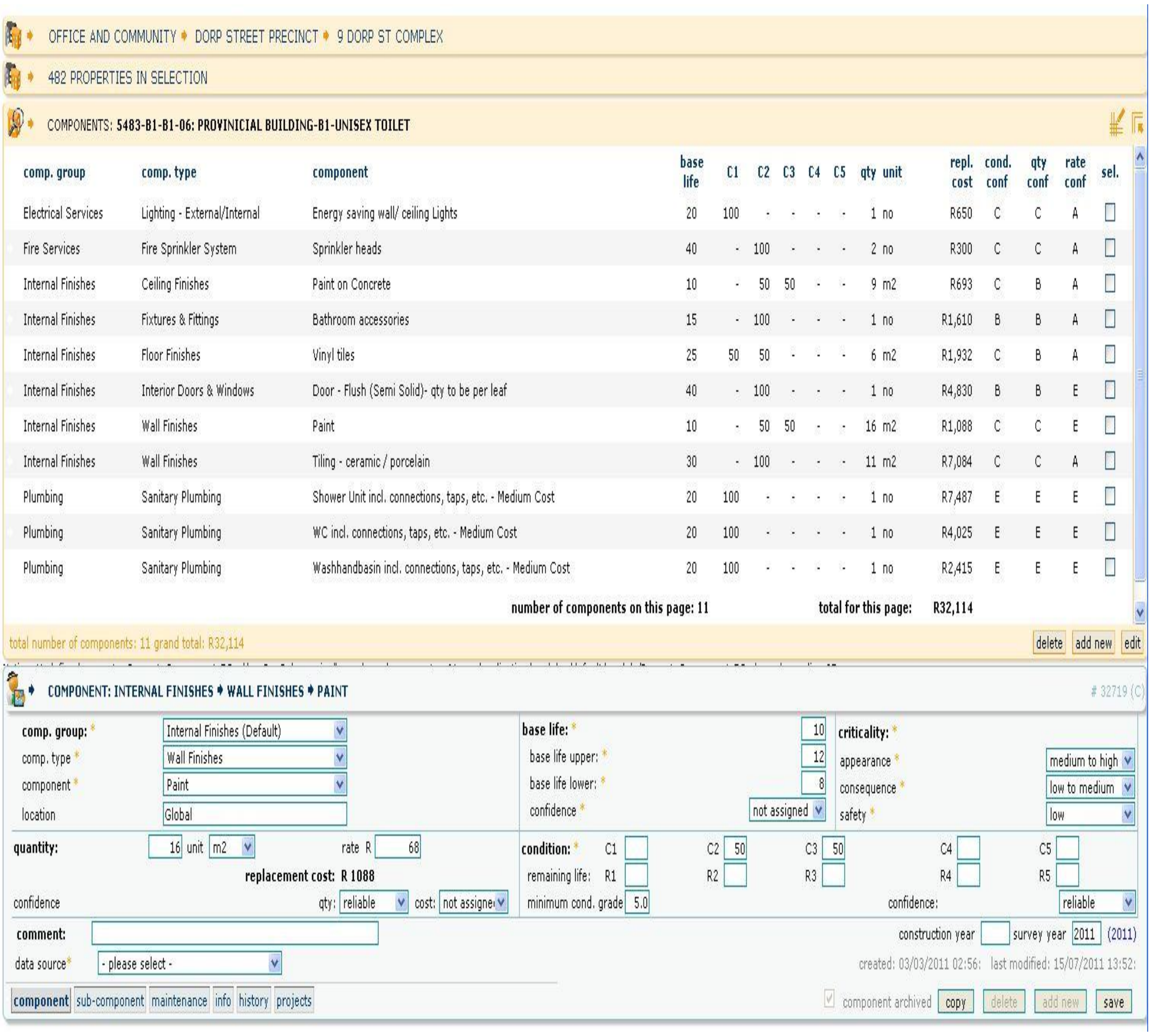
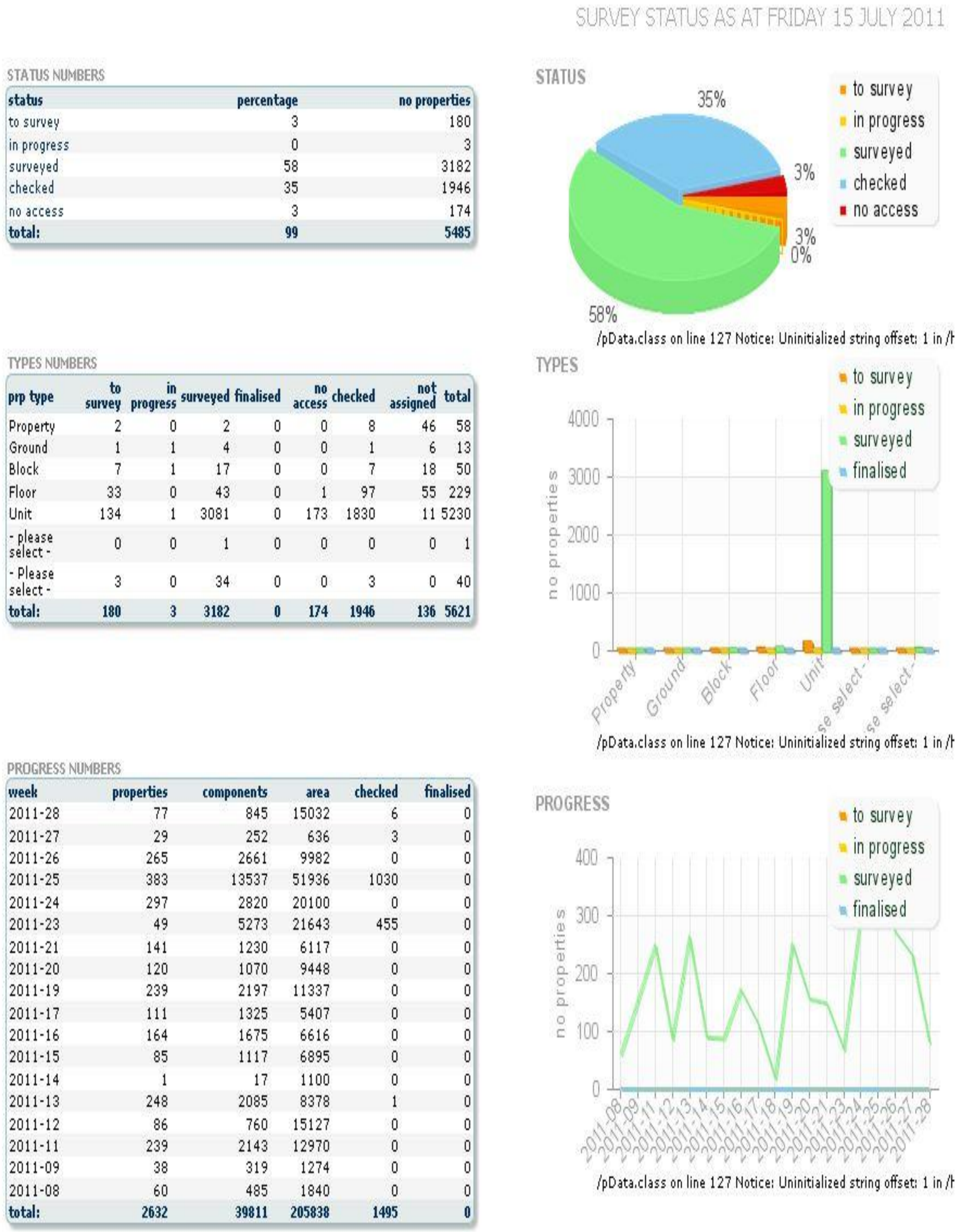


Figure 22: SPM Assets' ability to certify condition at a component level

(GAPP GIBB TALANI, 2013)

This data captured and certified at a component level by means of the mobile site survey devises is then used to automatically generate an overall data capturing status assessment indicating how much of the overall survey has so for been completed while at the same time providing a detailed breakdown of the total survey process as illustrated by *figure 23*.

SPM Assets is also capable of automatic data interrogation, provide performance shortfalls measurements (*figure 24*) and do valuations *(figure 25)* It is also capable of automatically generating reports either in a traditional printable format as illustrated in *figure 26* or in a dashboard format as illustrated in *figure 27.* All of this makes the ***SPM Assets*** software tool an extremely valuable asset management tool to have.



SURVEY STATUS AS AT FRIDAY 15 JULY 2011

STATUS NUMBERS

status	percentage	no properties
to survey	3	180
in progress	0	3
surveyed	58	3182
checked	35	1946
no access	3	174
total:	**99**	**5485**

TYPES NUMBERS

prp type	to survey	in progress	surveyed	finalised	no access	checked	not assigned	total
Property	2	0	2	0	0	8	46	58
Ground	1	1	4	0	0	1	6	13
Block	7	1	17	0	0	7	18	50
Floor	33	0	43	0	1	97	55	229
Unit	134	1	3081	0	173	1830	11	5230
- please select -	0	0	1	0	0	0	0	1
- Please select -	3	0	34	0	0	3	0	40
total:	**180**	**3**	**3182**	**0**	**174**	**1946**	**136**	**5621**

PROGRESS NUMBERS

week	properties	components	area	checked	finalised
2011-28	77	845	15032	6	0
2011-27	29	252	636	3	0
2011-26	265	2661	9982	0	0
2011-25	383	13537	51936	1030	0
2011-24	297	2820	20100	0	0
2011-23	49	5273	21643	455	0
2011-21	141	1230	6117	0	0
2011-20	120	1070	9448	0	0
2011-19	239	2197	11337	0	0
2011-17	111	1325	5407	0	0
2011-16	164	1675	6616	0	0
2011-15	85	1117	6895	0	0
2011-14	1	17	1100	0	0
2011-13	248	2085	8378	1	0
2011-12	86	760	15127	0	0
2011-11	239	2143	12970	0	0
2011-09	38	319	1274	0	0
2011-08	60	485	1840	0	0
total:	**2632**	**39811**	**205838**	**1495**	**0**

Figure 23: ***SPM Assets'* automatic data capturing status assessment capabilities**

(GAPP GIBB TALANI, 2013)

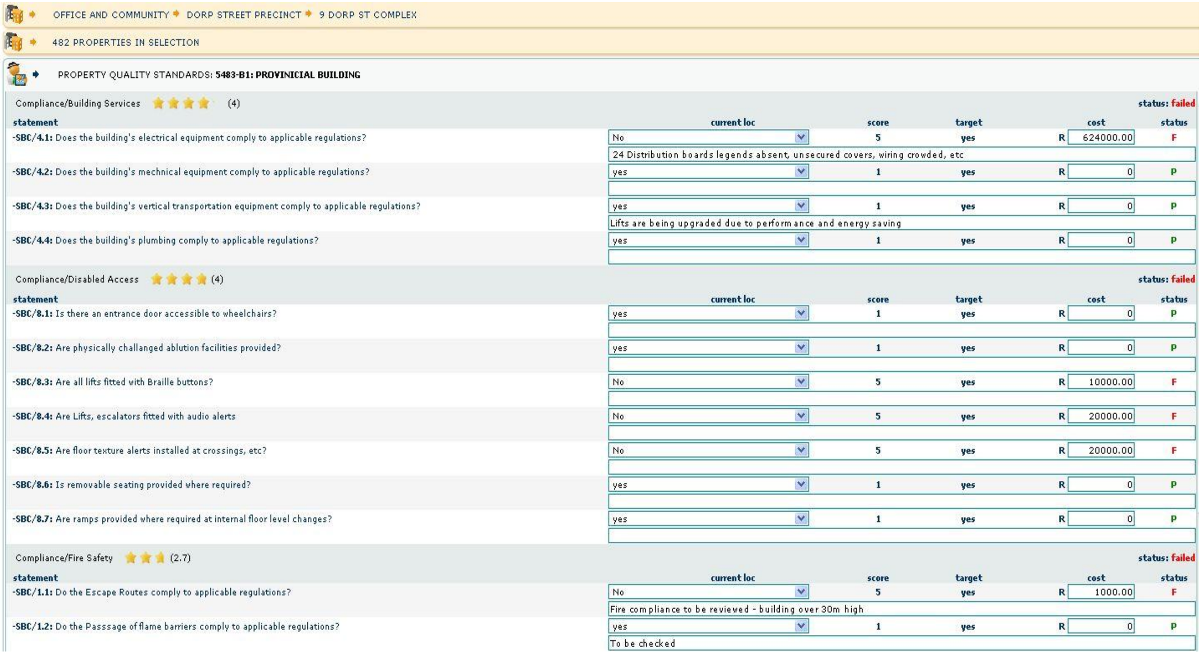


Figure 24: ***SPM Assets*** **ability to automatically measure performance shortfalls**

(GAPP GIBB TALANI, 2013)

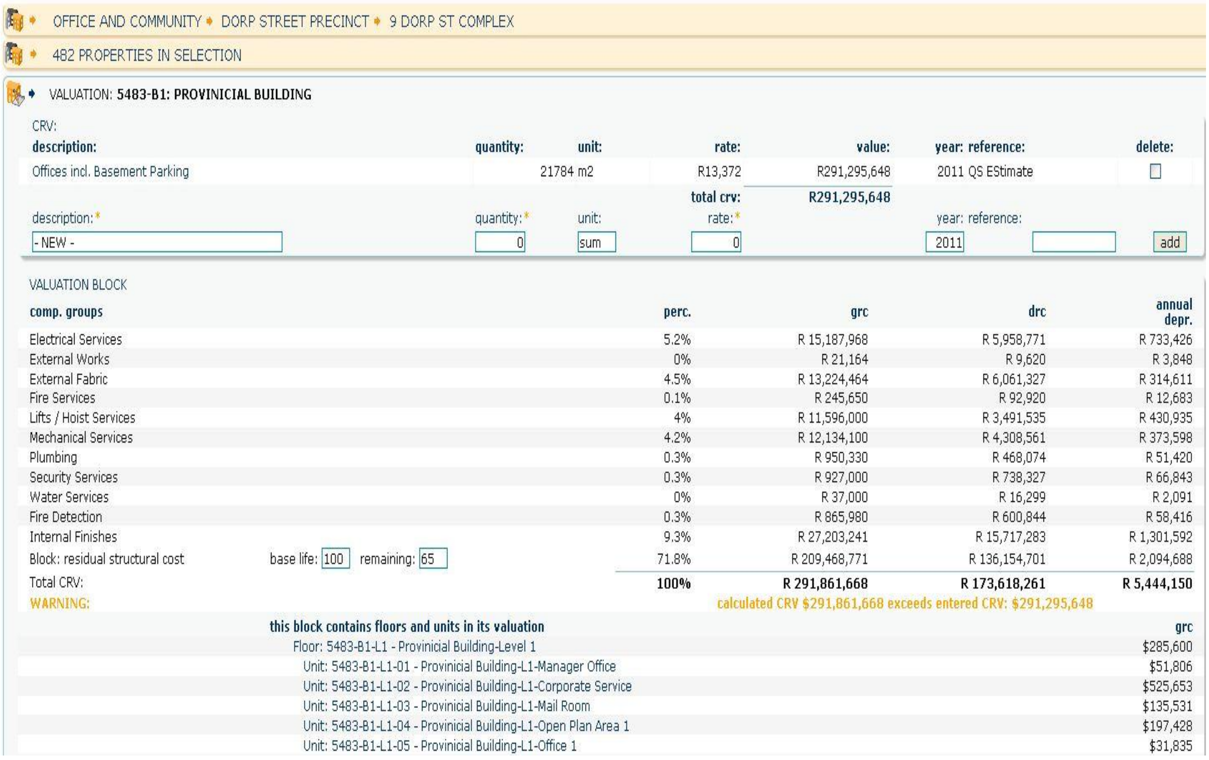


Figure 25: ***SPM Assets'*** **ability to automatically provide valuations**

(GAPP GIBB TALANI, 2013)

PROPERTY SUMMARY REPORT

printed: 15-Jul-2011 01:30

name: PROVINICIAL BUILDING

code: 5483-B1 (3.3)

address: 9 Dorp St

constr. year: 1977 floor area: 21784 m2 survey date: 20/01/2011

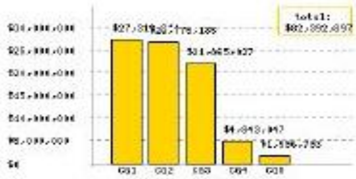
values

CRV:	R 291,861,668	std. components:	R 82,392,897
DRC:	R 173,618,261	spc. components:	R 0
residual:	R 209,468,771		

description

The building is located on 14 unconsolidated erven with a combined area of 2,449mÂ². It is a 9 storey building above ground, with two basements constructed with a concrete frame and masonry infill panels. The external finish is off-shutter concrete. Windows and shop fronts are aluminium, a combination of concrete and sheet metal flat roofs over the multi storey section, and a vaulted translucent roof over the entrance foyer. There are no site works as the building covers the full extent of the site.

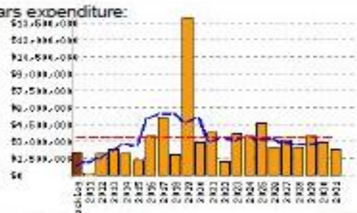
condition:



appraisal

The building is functioning well at the moment. In general the fabric is in good condition. The original design have many energy conservation features and as such, the building is quite sustainable in terms of the 'green' ratings in comparison to other buildings of its time.

20 years expenditure:



10 years AVG expenditure:	R 3,443,973
20 years AVG expenditure:	R 3,265,629
Planned maintenance:	R 1,688,541
Backlog	R 2,000,684

condition

Despite the 2m backlog, the building is generally in a very good condition. Almost half of the backlog comprises of the cost of replacing finishes and some electrical equipment.

expenditure

[empty]

property summary report page 1 of 42 SPM printed fri 15 jul 2011 01:31

Figure 26: Illustration of *SPM Assets* ability to provide printed reports

(GAPP GIBB TALANI, 2013)

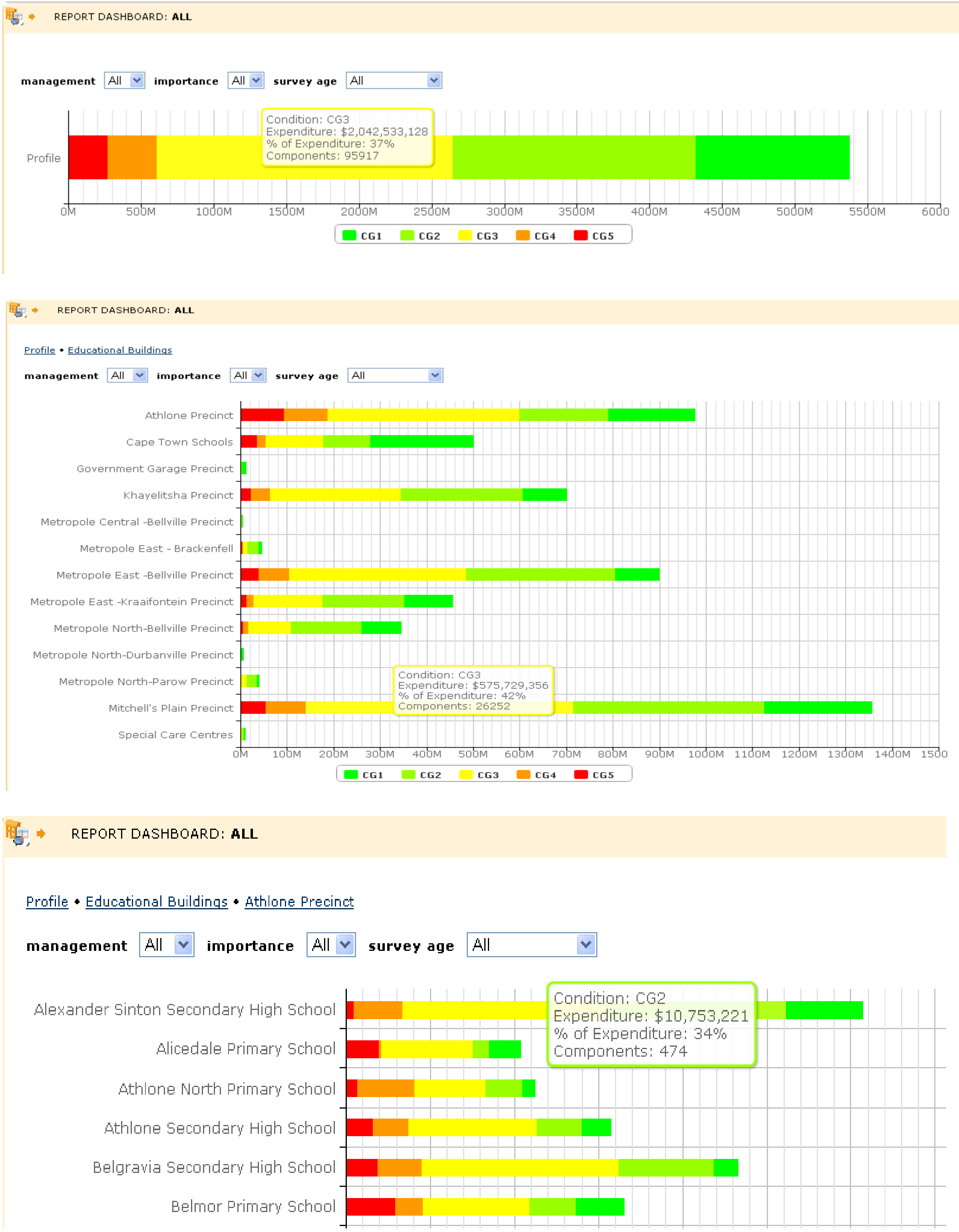


Figure 27: ***SPM Assets'* ability to do dashboard reporting illustrated**

(GAPP GIBB TALANI, 2013)

6.1.4 Achieved milestones of the PGWC asset survey to date

PGWC asset survey has achieved a number of milestones to date. Firstly the property data sources have been establishment where after the data collection process has been implemented. This led to the development and maintenance of a database, for data capture, management and reporting purposes. Shortcoming in the present asset management processes, in terms of GIAMA has also been identified and a suitable methodology, which is based on the IPEWA and SPM Assets software methodologies outlined above, has been identified and is currently being implemented in terms of the data that is being gathered for the remainder of the PGWC's property portfolio.

The key outcome of the PGWC immovable asset survey process, from an asset planning perspective, is the resulting projected expenditure budget capabilities, in terms of maintenance, refurbishment and replacement of buildings and equipment to ensure that a certain level of service is maintained and that sufficient budgeted funds are available to do this work.

Ultimately this asset management toolkit, that has been developed, is able to provide an objective basis for determining long term budgets that is required to meet the agreed Provincial Government's Level of Service Policies. By combining the budgeting feature with a systematic method of prioritising the deployment of annual budgets, it is possible to maintain the value and functionality of the PGWC's fixed assets in the most cost efficient way (GAPP GIBB TALANI, 2013).

6.2 PGWC's sustainability benchmarking pilot project

The SPM Assets' data management system developed for the PGWC immovable asset survey highlighted how difficult it is to establish the sustainability performance of the PGWC's immovable assets, which is required in terms of GIAMA. Central to the whole asset management process is the asset data tool, which in terms of the PGWC immovable asset survey, is the SPM Assets software database, providing the means by which both data and life cycle asset management tasks can be accomplished. This relationship is graphically illustrated on the left hand side of *figure 28* below. On the right side of this asset data tool, is the strategic asset management tasks listed and these strategic asset management tasks are directly dependent on the efficiency, effectiveness and environmental sustainability (*commonly known as the 3E's*) benchmarks, without which no strategic asset management can take place.

This strategic asset management *need*, was identified by the consultancy team, which led to the development of a benchmarking pilot-project, to provide a set of benchmarks on which future environmental sustainable targets can be based for the whole of the PGWC property portfolio. Thus provide compliance in terms of the requirements set out in GIAMA.

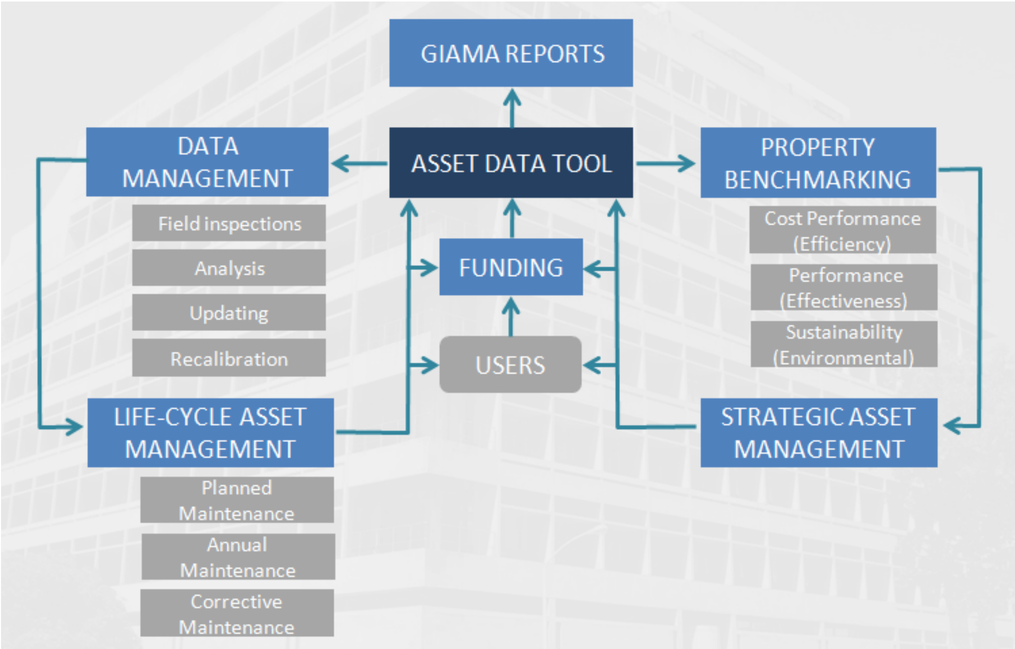


Figure 28: Typical Asset Management Process

(GAPP GIBB TALANI, 2013)

The primary objective of the PGWC's pilot sustainability benchmarking project was to review and establish the efficiency, effectiveness and environmental sustainability of a selected number of buildings, of the PGWC's property portfolio. Due to the lack of locally available skills, relating to sustainability benchmarking in South Africa, IPD (who was responsible for the development and production of the United Kingdom's State of the Estate reports) was approached to assist the consultancy team with the development of a suitable benchmarking process for the PGWC. This pilot benchmarking process, was aimed at the development, evaluation and benchmarking of key environmental indicators, in terms of IPD's Cost, Space and Environmental codes. A total 24 selected office and schools buildings, was identified to form the basis on which benchmarks on key environmental data, relating to water and electricity use, could be established, with waste stream benchmarking to be included into the future development of the sustainability benchmarking process for the rest of the PGWC's property portfolio.

In addition to these environmental sustainability baseline data, the efficiency and effectiveness baselines, in terms of these buildings space utilisation and their associated operational costs, of these selected buildings will also be established. The data gathered by the pilot project will then be analysed and reported on in terms of the environmental, space and cost codes developed by the IPD. Thus this pilot project aims to evaluate the suitability and implement ability of the IPD's environmental, space and cost codes in the South African context, with the purpose of this pilot project being, to establish an initial performance baseline for the PGWC's property portfolio.

IPD proposed a project methodology which is illustrated graphically in *figure 29* below. This methodology proposed that the scope, process and the time table of the project be established first where after, time will be spend to define the goals of the project, to identify and clearly define the Key Performance Indicators (KPIs) and establish which data will need to be collected by the pilot project. Only then will the data collection and validation period take place, which will be followed by a period where the data is analysed and reported on followed by a planning and action period where performance gaps can be identified and planed for. Before the whole process is repeated that will allow continues improvement process to be implemented.

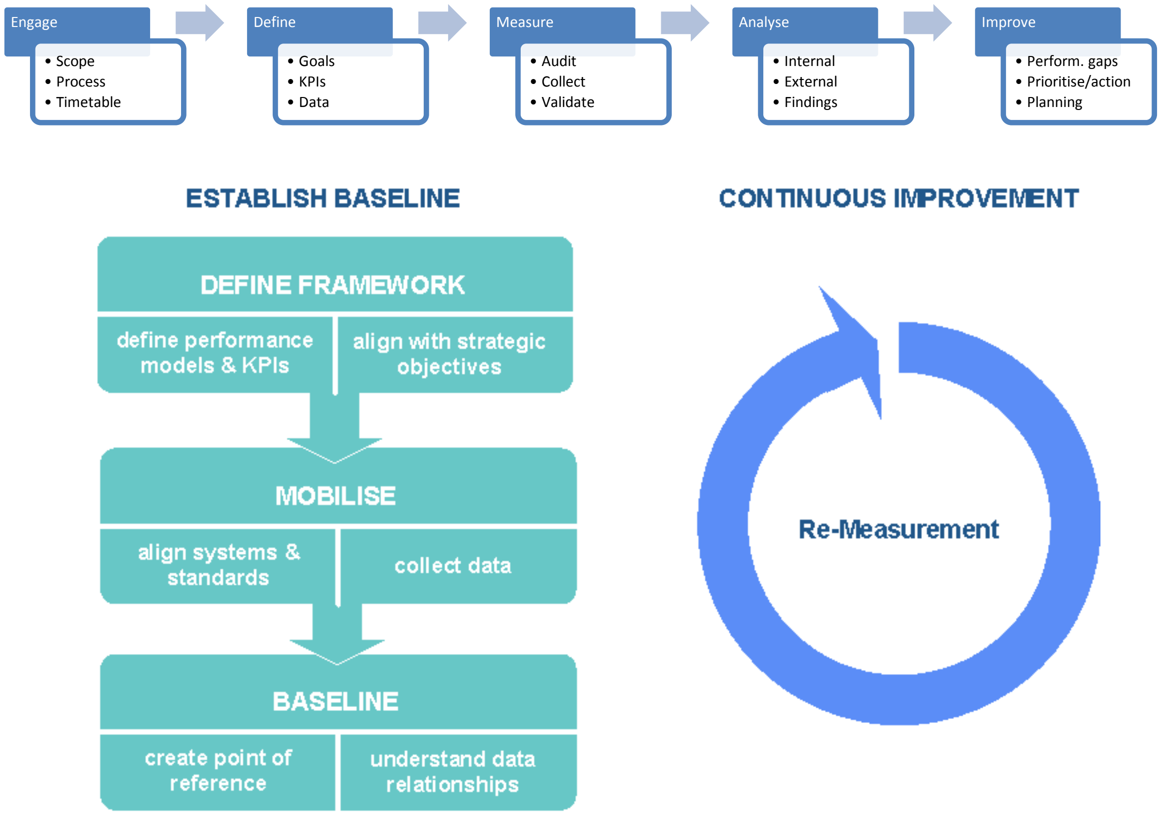


Figure 29: IPD's proposed project methodology

(IPD, 2012)

The final output, at the end of the pilot project, will be the publication of the first *PGWC State of the Estate Report*, which will not only provide a baseline that can be used for future measurements, but it will also reveal how the sample group of PGWC buildings fair in terms their efficiency, effectiveness and environmental sustainability in terms of currently established international baselines. The PGWC's pilot sustainability benchmarking process will follow a typical benchmarking process as illustrated in *figure 30* below.

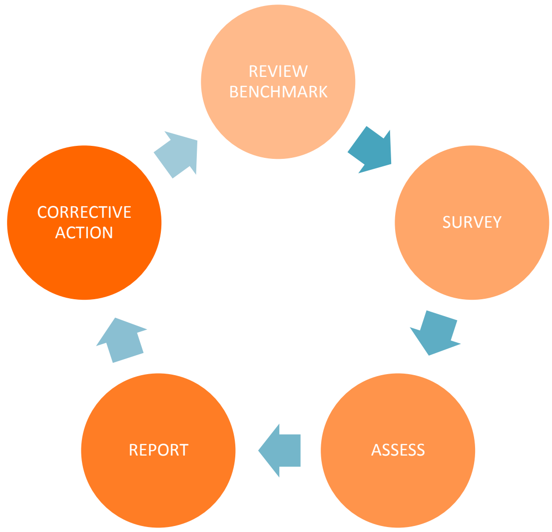


Figure 30: Typical benchmarking process

(GAPP GIBB TALANI, 2013)

IPD suggested that the pilot project should follow their standard and well defined approach to benchmarking. In this approach, buildings performance is established based on its efficiency performance which in turn is based on the type of building, its location, its tenure and whether or not it is air-conditioned. The buildings effectiveness performance is evaluated against the buildings work place condition and productivity. The environmental performance of the building is based on the measured environmental data of the building. *Figure 31* below graphically illustrates this benchmarking approach in more detail.

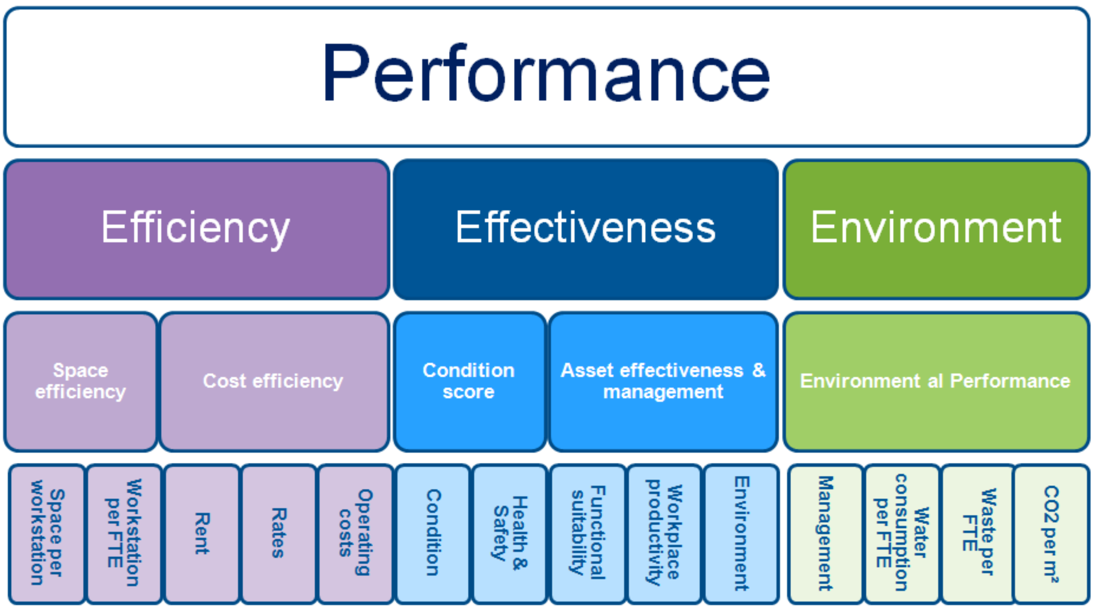


Figure 31: IPD's benchmarking approach

(IPD, 2012)

6.2.1 Project success factors

IPD also pointed out that what they have found in their experience to date and which was critical to the success of similar projects implemented in the UK, was that there is a great need for leadership and communication in such projects. Learning should also take place through the development of the infrastructure systems, processes and standards and that continued training and skills development should also be provided. Also critical for the success of any sustainability benchmarking project, is to start small, like is proposed for the PGWC's pilot project, which can then be followed by a phased roll-out over the whole property portfolio. This will allow time for proper training to take place, validation processes can be developed and communication protocols can be established.

Other important factor required for project success is to have senior management buy-in, making both strategic and benchmarking managers, accountable for the data that will be required and having a pro-active engagement with the property asset management teams. Here, ***zero*** tolerance in terms of participation, is seen as a measure by which to evaluate and monitor this.

Transparency is another important factor required for a successful project, this can for instance be achieved by reporting the finding of the benchmarking process in the public domain, like the State of the Estate Report (HM Government, 2012) in the UK. The last factor that the IPD sees as being required for success, is to link the indicators to external data for instance, measuring public building performance against private sector benchmarks (IPD, 2012).

In addition to the above it is also worth noting that robust and accurate data can enhance the management of a property. This is because it creates a common language that can be used to provide an invaluable strategic view of the property. It also helps to improve the quality of the data, increases the focus on value, raises the information profile, exposes opportunity and provides a tool that can demonstrate improvements (IPD, 2012).

6.2.2 Project dependants

The PGWC's sustainable benchmarking pilot project will ultimately depend heavily on inter-departmental by-in, co-operation and participation within the PGWC. In particular with regard to access to environmental data, like water and electricity usage, as well as the establishment of ways by which to measure waste streams, space utilisation and operational costs. In addition to requiring access to all available data, there is also requirement relation to the completion of questioner's for the establishment of the efficiency and effectiveness of the building operations. This will require that clear policy guidelines should be developed to deal with problems associated with the collection and interpretation of data. Ideally one person should be identified to take ownership of the data, and would steer the different departments and set up the structure by which the data from individual departments will be provided for incorporation of into the IPD Data Collection Template. (IPD, 2012)

6.2.3 Project deliverables and the data collection process

After a usage and service agreements was entered into between the PGWC and the IPD, the following sequential hierarchical project deliverables was defined and put in place. Twenty-four buildings, located in the City of Cape Town Metropolitan area, were identified as a representative sample for the PGWC benchmarking process. This sample consisted of 10 office buildings, owned by the PGWC, 9 rented office buildings, and 5 schools. A decision was made to limit the sample for this pilot project, both in terms of building type as well as the number of the buildings to be used. Thus other building types like for instance hospitals were excluded.

After the sample group of buildings were selected, the Key Performance Indicators (KPIs) were identified that this pilot project were to track and assessed over time. The IPD's Data Collection Template (2012) was used to provide a guide for this data collection process and all readily available data for the identified buildings were captured onto this template.

According to the Template the first set of data that were to be collected was the individual buildings property details. This consisted of the building name, the street address, its location in terms of neighbourhood, town or city, country and postal code. A unique reference number was also captured which identifies each property on each schedule or spread sheet, allowing information to be linked. In addition to this geographical information, information relating to the buildings specific tenure was also captured, in particular whether the building is owned or leased as well as the length of the lease, or is the building subjected to some other form of tenure. Information was also required on the buildings usage, for instance is it an office building or school, which department or business unit does it belong to, and whether or not the building is being used to capacity for more than 12 hours a day.

The location of the building is also provided specifically in terms of the following categories; is it located in the CBD area; or is it located in the town centre, but located outside of the CBD area; or is it located on a business park or estate; or is it located outside the urban area but not on a business park or estate. This in turn is followed by the capturing what the condition of the building is. Here the building is certified in terms of:

i. An '**A**' rating which represents a **Good** or "As New" condition, which can also be defined as a maintenance backlog or a building replacement value of less than 5% of the total value of the building.
ii. A "**B**" rating which represents a **Fair** or "minor defects" condition which can also be defined as a maintenance backlog or a building replacement value of less than 5-10% of the total value of the building.

iii. A "**C**" rating which represents a **Poor** or "major defects" condition which can also be defined as a maintenance backlog or a building replacement value of 10-50% of the total value of the building.
iv. A "**D**" rating which represents a **Critical** "unfit-for-purpose/mothballed" condition which can also be defined as a maintenance backlog or a building replacement value of more than 50% of the total value of the building.

Next the approximate year of construction which is defined as the area of the building which affects more than 50% of rental value of the premises is recorded. If for instance different parts of the building were completed at different times, then the majority of the building, as defined by the rental value of the building is taken as the construction year. Major renovations in principle do not alter the construction date, unless the building has been completely reconstructed behind the existing facade. This is followed by capturing the year in which any major renovation took place. For the purpose of the benchmarking exercise, a major renovation is defined as the approximate year in which the last substantial refurbishment, which affecting more than 50% of the total rental value of the premises took place. The nature of the major refurbishment would in principle be to improve the value of the premises in terms of its functionality as well as the actual building. A major refurbishment is commonly treated as a capital rather than an operational expense.

Capturing building specific attributed, which include the number of distinct floors of the building then follows. This should in principle include any basement and mezzanine floors which have a net internal area which is at least 50% of a typical floor. The total number of specifically designated parking spaces available on the site, public car parking facilities should be excluded from this total number. The heritage rating of the building is subsequently recorded, followed by whether or not the building is air-conditioned, have double glazing, have 24 hour manned security and if a canteen is available on site. It is also recorded what type of air-conditioning the building has, would it be fully air-conditioning, comfort cooling or heating of if no air-conditioning at all is provided. Details in terms of the total number of lifts serving the building are also captured, excluding goods lifts though.

The capturing of the core weekly operating hours of the building is then documented. Here options are provided to simplify the capturing of the data: i) **Extended** operating hours is defined as more than 60 hours per week. This will for instance include buildings which are regularly staffed over weekends and in the evenings. ii) **Standard** operating hours is defined as more than 45-60 hours per week and iii) **Basic** operating hours is defined as less than 45 hours per week. After which the achieved environmental certification grade is then recorded. This would of course include recording the type of the environmental quality system this building has been certified under. Next it is documented whether or not the building has a single or multiple occupancy profile, which is of particular relevance to rented building, as is the type of lease for the rented building, whether or not it is required that the tenant is responsible for the repair, maintenance and insurance of the building (IPD, 2012).

The second set of data to be recorded according to the IPD Data Collection Template relates to the buildings spatial data. Here the buildings gross internal area is determined in accordance with the decision to use the SAPOA (2005) method to calculate the areas required by the template, as it was deemed more important to use an area calculation method that everyone was familiar with and the SAPOA method is deemed to be the recognised standard for area calculation in South Africa. Next the net internal area of the building as well as the occupied and unoccupied areas of the building was determined, once again using the SAPOA method for calculation floor areas.

This was followed by establishing what the occupancy of the building is. Here, it was decided to use the number of workstations as defined by IPD, to reflect to number of occupants in the office buildings. The ***FTE*** (Full Time Equivalent) for the purpose of this pilot project was taken as the number of workstations minus the number of empty workstations. Where schools were concerned the number of students, teachers and general staff was used to establish the school's occupancy in terms of ***FTE***. Lastly it was recorded how many people moved during the assessment period. (IPD, 2012)

The next set of data that had to be captured in the IPD Data Capturing Template (IPD, 2012), is the financial data associated with each individual building. This data set included data associated with the total costs of rent, unitary charge, acquisitions, disposal and removal costs, local property taxes, parking charges, associated facility costs, occasional space costs as well as marketing and promotion costs. The annualized capital expenditure is then calculated by depreciating any capital costs over a straight line, without making any allowance for financing costs. The occupational property costs that include the direct cost of all labour employed as well as the costs of equipment, materials and external charges are also captured and all costs associated with staff is also included, this include employment as well as labour tax, pensions, allowances, annual bonuses, overtime, temporary staff, training, recruitment, travel, welfare, administrative, equipment and other costs (IPD, 2012).

The next set of data captured was the annual operating expenditure relating to renting a building. The annualized capital expenditure associated with occupying an owned building, which would normally also be captured, was not recorded in this pilot study, but should be recorded in the future. It is also worth noting that when rental figures for benchmarking purposed are collected, the type of rental figure used will need to be carefully considered as this will allow occupiers to understand what their occupational opportunity costs area. This is an important consideration in creating and assessing the real estates and facilities strategy for the building or the property portfolio, furthermore, the total rental income should be subtracted from total rental expenditure of the building or the estate (IPD, 2012).

The final set of data collected was the environmental data. Because no standardized systems and processes have been set up for accessing and verifying this data, it was decided to limit the environmental data to total water and electricity consumption data only. Municipal accounts were used as the most accurate verifiable source of this data. Future expansion of this data set will only be possible when standardized means of recording water and energy consumption as well as waste production as is outlined in IPD's Environmental Code (2010) as is illustrated in *figure 32* below.

	Non-renewable	Renewable	Annual Total
Electricity	Non-renewable electricity (EA1 - EA9)	Renewable electricity (EA5 + EA9)	Total electricity (EA1 + EA5)
Fuels	Fossil fuels (EA2)	Renewable fuels (EA3 + EA6)	Total fuels (EA2 + EA3 +EA6)
Other energy	Communal energy (EA4)	Renewable energy (EA7)	Total other energy (EA4 + EA7)
Energy	**Non-renewable energy (Total – Renewable)**	**Renewable energy (EA3, EA5, EA6, EA7, EA9)**	**Total energy (EA1-EA7)**
Carbon emissions (CO_2 equivalent)			**Total CO_2 (EA8)**
Water	**Sourced water (EB1 + EB2)**	**Harvested and recycled (EB3-+ EB4)**	**Total water (EB1-4)**
Waste	**Landfill and incinerated (EC1)**	**Recycled and composted (EC2 + EC3)**	**Total waste (EC1-3)**

Figure 32: IPD's Core Environmental Data

(IPD, 2010, p. 20)

The IPD's Heath Check was also not included in this PGWC's pilot project. The IPD Heath Check in short is a qualitative measurement tool for the measurement of the environmental performance of a building or estate. It provides a 5 star rating that can be provided, subject to how a building is scored. *Figure 33* below provides a breakdown of the basic categories contained in the IPD's Environmental Heath Check.

7 sections	50 questions	500 credits
Management	8 questions	80 credits
Energy	12 questions	120 credits
Water	4 questions	45 credits
Waste	5 questions	50 credits
Travel	6 questions	55 credits
Pollution	5 questions	50 credits
Health	10 questions	100 credits

Figure 33: IPD's Environmental Health-Check scoring and categories

(IPD, 2010, p. 20)

6.3 Conclusion

The project implementation plan for the PGWC sustainability benchmarking pilot project involved a three part approach for the collection of data. The first part consisted of the collection of specific energy and water usage data from primarily existing municipal accounts. This part proved to be extremely difficult as a number of irregularities was found. The idea of making use of municipal accounts proved to be challenging as there was no clear separation between the data of different departments or even building in some cases, and even groups of buildings were billed as one. Building identification codes also differed between different user departments, which made it difficult to verify any data that could be obtained.

The second part in theory consisted of a predominantly office based analysis of the usage of the particular selected buildings. This also proved challenging as accurate as-built building plans was not always readily available which resulted in having to rely on the condition survey data to establish areas, which was also questionable as not all areas was always accessible to the surveyors. The verification of this data was also not always that easy and created a logistical nightmare. The idea of using work stations as a basis of population density also proved difficult, as it was not always easy to identify whether a workstation is occupied and for how many hour a day it is in use.

The third part was the collection and analysis of operational costs of individual buildings. Here the initial proposal was to use existing financial records to provide the data required by the IPD data capturing template, but even here challenges relating to the clear separations between different departments and building were experienced. Once again different building identification codes were used by different user accounts departments, making it difficult to link and verify available data.

What the sustainability benchmarking process did identify is that there is a great need for uniform means of making required data easily available that can transcend the user department silos that currently exist and help to simplify the overall process. Maybe the GBCSA Energy and Water Benchmark Methodology (Bannister & Chen, 2012) will be able to provide the means by which this can be achieved, but this methodology still requires testing as well as expansion to include more than just capturing energy and water usage data.

Chapter 7: Conclusions

7.1 Introduction

Buildings greatly contribute to un-sustainability in the world today, and the presumption was that current existing building rating systems do not seem to adequately provide a means by which a buildings' overall sustainability can be measured. The main point of departure for this study was a combination of this presumption with the opportunity to develop a system by which the PGWC would be able to comply with the requirements of GIAMA, which among other things require that all government buildings be assessed in terms of their sustainability.

A two pronged research approach for the study was implemented. The first part was a literature review, whose primary aim was to establish and define the knowledge framework that the second, more applied, form of research used to develop and document the real life problems associated with the development of a sustainability benchmarking process for the PGWC. Here a brief contextual history was provided of the PGWC immovable asset survey, before principles of benchmarking was discussed to ascertain if a benchmarking process can be used to ascertain how sustainable an existing building is.

The final section to this study provides a breakdown of the research assessments, results and recommendations that can be applied and incorporated into future sustainability benchmarking projects.

7.2 Research results and observations

The initial theoretical literature review provided a theoretical baseline of contemporary ideas related to sustainability, sustainable development, sustainable design and ecological design. This created a theoretical knowledge framework on which the second part of the study could be built.

The literature on sustainability and sustainable development revealed that *Sustainability* can be seen as the goal of the *Sustainable Development* process. It also highlighted that sustainable development's aim is to achieve the future quality of life survival goal for future human generations and that the responsibility for the realisation of this goal lies with the current human generation.

The posed question 'how a future goal of sustainability would be accomplished', was investigated by an assessment of the world views on sustainable development and sustainability, which revealed that a number of different issues should be incorporated into the sustainable development process to achieve the goal of sustainability. This future sustainability goal was identified as being more complex in nature than the over simplified goal of human survival. In principle this goal suggests that humanity should strive to create a future that is not just better for future human generations, but is also better for the whole of the natural environments. Sustainability essentially is the outcome of a dynamic, complex and multidimensional sustainable development process which not only addresses issues relating to human existence but also address those aspects that impact the natural environment as well. This holistic view, in combination with a systems theory approach, to sustainable development should ideally be implemented to identify and study the relationships that exist between the different parts of the sustainable development process. This will allow humanity to make informed decisions which can lead to achieving the ultimate goal of sustainability.

The literature on ecological design created a theoretical knowledge framework around how building structures are created to satisfy the very basic human need for shelter. It identified the notion that buildings in a contributor to humanity, has become isolated from the natural world. It also focused attention to the huge environment cost that buildings pose on the natural environment.

This led to the posing of a still un-answered ancillary question relating to; '*if it is possible to fulfil the basic human need for shelter without isolating humanity or damaging the environment at the same time?'* In my opinion, the lessons that can be learned thorough benchmarking and reporting on sustainability in buildings might provide a clear answer to this question in the future, but much need to be done before this would ultimately be realised. For now, at least conceptually, it would seem possible to protect the world's natural recourses as well as prevent human isolation from the natural world by way of environmentally responsible design, coupled with manufacturing processes which are based on full lifecycle assessments and objectives. Using materials, water and energy conservatively, effectively and efficiently, re-cycling and preventing harmful toxins being used, are but a few ways that these objectives could be achieved. Finally a building or building product's end of life should be taken into consideration, in particular how to re-use, re-cycle, re-purpose and ultimately how to dispose of it in a sustainable way. The theoretical design philosophy of Sustainable and Ecological design provide the conceptual framework by which humanity might be able to re-connect and re-integrate with the natural world.

The literature also pointed out that even though great improvements have been made so far, in designing '*new*' more sustainable and ecologically friendly developments, greater emphasis need to be placed on what is to become of those buildings that already exist. It also proposes that these buildings might have a very important role to play in terms of the future impact of humans on the natural world.

The literature on building rating tools, in chapter 3 of the study, investigated the first question;

> *What lessons can be learnt from the different types of building rating systems that are presently being used to track and monitor the sustainability of buildings over time?*

It was found that numerous building rating tools exist, which design professionals, planners and developers can use to obtain certification to reflect the design, as-build and in some cases the existing building's impact on the natural environment. These building rating tools are currently though incapable of tracking and monitoring a buildings' sustainability over time. An assessment of the general categories used by these building rating tools to rate and certify buildings, based on the theoretical sustainability baseline established in the initial chapters , revealed that these assessment categories, focuses almost exclusively on a building's environmental impact only. The social, and to a some degree, the economic pillar of the sustainability challenges, to use the Brundtland commission's core basic definition of the sustainability challenge, is noticeably absent from the general categories used by these building rating tools to rate and certify buildings. For instance the social impact of a building is neither assessed, nor certified by these tools. It is evident that these building rating tools have been developed solely to rate and certify a building in terms of its environmental performance. This means that current existing building rating tools cannot be seen as a '*true'* reflection of building's sustainability.

Chapter 4 provided a basic overview of the theory on benchmarking. It found that benchmarking should be seen as a process which seldom remains static and in order for it to be effective, it needs to become an integral part of a continuous and on-going process that improves over time, while at the same time entire time keeping abreast of possible changes in terms of best practice principles. The literature also pointed out that care should also be taken to ensure that the most important factors are measured and that the number of KPIs should be limited, as too many KPIs can cause confusion and may result in reporting difficulties. The literature further more revealed that any data collected needs to be *accurate, consistent and verifiable*; the reason being that data in isolation will have limited value and can be without meaning. The meaning is provided to the data, by transforming the data into information, by way of creating relationships between different elements. Combining data into KPIs allow considerable value and meaning to be added, but the data only becomes truly significant when it is underpinned by the knowledge of relative performance measured against other buildings. This brings us to the next question posed by this study, namely:

> *What role can benchmarking play in establishing and tracking a building's sustainability over time?*

Here it was found that benchmarking can provide understanding by way of identifying the opportunities as well as the areas that can be utilised for action, and as such can help to bring about true sustainability in a building.

An important observation that emerged is that the relevant and reliable building performance data, which allows building owners and organisations to report on a building's overall environmental performance and management, has become more readily available due to the development and implementation of current building rating tools. Benchmarking will have a very important role to play, to not only establish what a buildings overall sustainability is, but also to track and monitor the sustainable performance of the building over time.

The next two chapters dealt with the practical aspects of how to sustainably benchmark a building. The first of these two chapters provided an overview of currently available sustainability benchmarking tools. This chapter revealed that sustainability benchmarking is a challenging exercise, which relies heavily on a process that assess as well as compare the sustainability performance of a building against other properties or pre-defined targets and benchmarks. It is not advisable to implement a predefined benchmarking process and that a process developed over time should take preference.

The primary benefit of a sustainability benchmarking process was revealed as allowing access and reporting in terms of the true impact of a building on the future goal of sustainability, whilst at the same time providing greater understanding of all the different operational aspects of a building. This essentially provides the answer to the next question that this study posed.

> *How can benchmarking help to identify which part of a building's overall sustainability is most in need of resourcing, to bring it closer to overall sustainability?*

Not only can sustainability benchmarking track and monitor the sustainability performance, but it achieves this in terms of the buildings' individual parts as well. This means that resources can effectively and efficiently be allocated to those aspects furthest from the sustainability goal. In essence it provides the means by which appropriate action can be targeted. The monitoring aspect of sustainability benchmarking provides the detailed information pertaining to the costs and benefits of any green investment or initiative, which answers the next question of this study:

> *How can the availability of detailed information pertaining to the costs and benefits of green investments in existing buildings help building owners to identify the best initiatives to invest in?*

Sustainability benchmarking thus makes it possible for building and estate managers, to not only set realistic targets and implement green initiatives, but to also be able to monitor whether or not these targets have been met, or if a green investment project has been successful. Sustainability benchmarking provides the means to improve, not only the sustainability of the building, but also the overall value of the building. This can essentially be done by utilising the capital and maintenance expense budgets to target specific sustainability inefficiencies, which answers the final question posed by this study:

> *How can capital and maintenance expense budgets associated with the building life-cycle effectively be utilised to bring buildings closer to overall sustainability?*

Developing sustainability benchmarking process presents a number of challenges which include; the collection of accurate, consistent and verifiable data, though it is possible to initiate the benchmarking process by using readily available data, then systematically over time increase the sophistication and robustness of the benchmarking process. Identifying the most appropriate matrixes, which will influence the right behaviour for the improvement of the buildings performance, also poses a challenge. So does the lack of agreed matrix definitions and problems relating to the availability of accurate, reliable and replicable data which sometimes prevent the use the most effective matrixes. Without these matrixes, the purpose of a sustainability benchmarking process, which essentially is to measure, analyse and report in terms of the buildings' space, cost and environmental performance over time, will be compromised.

7.3 Contributions to practice

The last two chapters of this study explored the more practical aspects of how to implement sustainability benchmarking in buildings. Besides the difficulties already mentioned regarding the ability to obtain accurate, robust and verifiable data, a best practice norm currently exists to employ a '*Graduated Approach*' (BBP, 2010, p. 15) to sustainability benchmarking. This norm suggests data should be collected over an adequate time frame that will allow trends to be identified and that the data collected should be accurate, consistent, verifiable and replicable. This will ultimately form the backbone of the benchmarking process.

It is also important to be absolutely clear from the outset what the intended purpose for the benchmarking process will be. Both the owners' as well as occupiers' data is needed, which requires that the owners and occupiers engage and co-operate with the data collection process and the subsequent implementation of any green investments, which makes an owner-occupier partnership essential for the ultimate success of any sustainability benchmarking process.

As there are many challenges that still need to be overcome, not to mention detailed decisions that will have to be made, the sharing of knowledge and experiences between those parties engaged in the development of sustainability benchmarking processes is essential.

Chapters 6 discussed the implementation plan for the PGWC sustainability benchmarking pilot project as a case study. A three prong approach was followed in terms of the collection of data. The initial part deals specifically with the collection of specific energy and water usage data which was primarily sourced from existing municipal accounts. This proved to be extremely difficult, because of a number of irregularities that existed. For instance, no clear separation between the data of different departments and in certain cases, even buildings, existed. Groups of buildings that house one or more user departments were billed together and building identification codes differed between different departments in the same building, making it extremely difficult to verify any data obtained.

The second part of the data collection process in theory consisted of a predominantly office based analysis of the usage of the selected buildings. Once again this proved challenging, as accurate as-built building plans were seldom available. This resulted in relying on the areas estimated as part of the condition survey, which is also not necessarily accurate, due to the fact that not all areas were always accessible to the surveyors to measure when they were on site. The decision to use work stations as a basis of population density, also proved problematic, as it was not always possible to identify whether a workstation is utilised, not to mention determining for how many hours of the day it is in use.

The third part was the collection and analysis of the operational cost of the selected buildings. The idea was to use the existing financial records to provide the data required, but similar difficulties were encountered to the ones already identified in the first part of the data collection process, making it very difficult to link and verify any available data.

What became evident throughout the data collection process of the PGWC's sustainability benchmarking process is that there is a great need for a uniform system to be developed that will make it easier to collect the necessary data. The GBCSA Energy and Water Benchmark Methodology (Bannister & Chen, 2012) might be able to pave the means by which this can be achieved, but this methodology still needs to be tested in practice, after which it will need to be expanded to include more matrixes than just energy and water usage data.

The analysis of the collected data indicated that on a cost per square meter basis, the average performance of the PGWC's office holdings is largely on par with South African corporate occupiers. However, when factoring in the efficiency of occupation, a cost of R46 000/FTE indicate that substantial potential savings are possible. The current cost /FTE is 54% above the South African corporate office occupier average (Western Cape Government, 2013, p. 4).

The average office space usage of the PGWC is 28 m^2 /FTE. This is significantly less efficient than the 14 m^2 reported by South African corporate occupiers. Occupancy is also well in excess of the PGWC's new workplace standard of 15 m^2 /FTE (Western Cape Government, 2013, p. 4).

Within the selected PGWC's portfolio on which this study was based, there are wide variations in performance. Some offices perform considerably better than others. The most space inefficient department uses over 40 m^2 /FTE in contract to the most efficient departments which operate with less than 20 m^2 /FTE (Western Cape Government, 2013, p. 4).

The PGWC's effort to deliver an environmentally sustainable property portfolio requires that monitoring and the reduction of energy and water consumption should take preference across the PGWC's property holdings. Understanding consumption will make a significant contribution towards this goal.

Currently the average energy consumption per FTE across the PGWC's sample offices stand at around 6 474 kWh/FTE, this is above the current corporate office occupier performance which is close to 4 300 kWh/FTE. Average water consumption stands at 14.6 m^3 /FTE, this again is above the average office benchmark of 9.3 m^3 /FTE (Western Cape Government, 2013, p. 4).

Rationalising the PGWS's office accommodation by implementing a 15 m^2 /FTE space standard could deliver significant savings. Considerable savings can also be achieved by improving the environmental sustainable performance of the portfolio are some of the potential sources identified which were that would allow the PGWC to realise savings. Better quality data would greatly help to target these future actions for implementation (Western Cape Government, 2013, p. 4).

PGWC will most likely have to make considerable up-front investments in its properties, in order to be able to deliver efficiencies in the medium term and to realise the full savings potential that will allow it to build and move towards a more efficient property holding.

For the PGWC to realise these potential savings they will have to embark on a programme which would include:

- Introducing standards for the cost per person cost per m^2, consumption of utilities, and the effectiveness and production of the working environment.
- Improving property performance monitoring and benchmarking as an integral part of strategic management of the PGWC's property portfolio.
- Reporting annually on the progress being made on achieving efficient, sustainable and effective buildings and
- Undertaking a strategic review of the PGWC's property portfolio, like for instance starting with the general infrastructure portfolio which can examine the scope for rationalising and reducing the number of buildings and for greater co-location in buildings.

7.4 Self-assessment

What this study established, is that a sustainability benchmarking process can provide the means by which to, assess and monitor the sustainability of existing buildings. It showed that legislation, in the form of GIAMA already exists and that this act requires amongst other, that all government buildings be rated and reported on, in terms of their sustainability.

It identified that there exist a missing link in terms of how to combine the theoretical ideas of sustainability benchmarking and the legislation requirements and that this missing link is the obtaining of accurate and verifiable dated for a benchmarking process. The development of a sustainability benchmarking system for the PGWC which will enable them to comply with GIAMA provided a valuable learning experience of how to develop a sustainability benchmarking process.

The problem statement of this study stated that:

> *Buildings contribute to global un-sustainability and present building rating systems, which focus predominantly on water and energy conservation and the reduction waste, do not seem to adequately address overall sustainability.*

With this problem statement in mind, this study showed through the literature on ecological design as well as by way of the case study on developing a sustainability system for the PGWC that buildings do contribute to global un-sustainability. It also found that the operation and management of buildings greatly impacts on the overall sustainability of these buildings and not just the building structures, as is implied by the current building rating tools which mainly focus on environmental sustainability issues.

The study also found, that even though the IPD benchmarking system provides the theoretical means by which all other aspects of the sustainability challenge can be assessed, monitored and reported on, there still exist a resistance to take the social impact of a building fully into consideration. This resistance is mainly due to a lack of willingness and funding, in part due to the general perception that the social aspects of the sustainability challenge are not as important as environmental and economic aspects. Building efficiency is perceived as efficiency which is measured in monetary terms and not in social terms. Related to this is the general misconception in particular in the building industry, that *Environmental Sustainability* is *Sustainability* and that a *Green Building* is the same as a *Sustainable Building.* The literature on Sustainability, ecological design and building rating tools, clearly indicate that these are very different concepts and should not be confused with one another.

Benchmarking differs from the current building rating and certification tools in that it provides a means by which not just the building but also its continuous operation and management can be measured analysed and reported on. As such benchmarking can provide far greater understanding by way of identifying the opportunities that exist and then subsequently monitor the implemented actions to ascertain if true and continuous sustainability has been achieved.

The study furthermore showed that sustainability benchmarking systems are not static, but dynamic tools which are capable of evolving over time, able to ultimately incorporate all aspects relating of the sustainability challenge. But due to the time constraints of this study, the documentation of all the final outcomes of the sustainability benchmarking process for the PGWC could not be included in this study, but some valuable lessons have been documented regarding the difficulties that exist in capturing accurate, reliable and verifiable data. By utilising a '*Graduated Approach*' all issues can ultimately be resolved, though the difficulty of such a process will depend on the practical experience gained as the pilot project for the PGWC is extended to the rest of its property portfolio.

7.5 Recommendations

With both the theory of a sustainability benchmarking process and the legislative requirements of GIAMA in place, focus should be directed to how, and in which format, the required accurate, verifiable data should be collected which is the current missing link in the benchmarking process. The format of the required data, in my opinion should ideally be formalised, standardised and legislated.

The GBCSA's work on *Energy and Water Benchmark Methodology* (Bannister & Chen, 2012) in conjunction with IPD's *Data Collection Template* (2012) might be able to provide a template that can be used to achieve such a standardised methodology, but this combined methodology still needs to be tested in practice. Providing a legislative backing to a standardised methodology will ensure that relevant and appropriate comparisons can be made in the future.

In an ideal world a singular internationally recognised standard should be developed, enabling comparisons to be drawn between different building types not only on a regional basis but also on an international basis. This will provide a shared knowledge base that will bring us one step closer to the shared goal of sustainability in the future.

In addition to the above, education is needed that will help to bring about a better general understanding of what Sustainability really means, negating the current general perception in society that *Environmental Sustainability* is synonymous with the *Sustainability* paradigm. It is about time that the understanding of the term *Sustainability* move form an academic debate to a term fully recognised and understood by all of humanity.

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