Cape Peninsula
University of Technology

HUMAN EXPERIENCES AFFECTING GOVERNANCE IN ENERGY-EFFICIENT BUILDINGS IN CAPE TOWN'S CENTRAL BUSINESS DISTRICT

By: Mary Wairimu Maina

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Supervisor: Dr. Mugendi M'Rithaa
Co-supervisor: Ms. Alettia Chisin

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DECLARATION

I, Mary Wairimu Maina, declare that the contents of this thesis represent my own unaided work, and that the thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

19th April 2011

Signed **Date**

ABSTRACT

Typically the design of interior environments in the commercial spaces are conceptualised and built to create artificial environments. These environments fail to take into account the amounts of energy used to perpetuate the conditions in the spaces used. The main area of misuse lies in the usage of the interior environmental systems by occupants, which contributes to the inefficiency of these components. The design of an office workplace is based mainly on the preferences of the client or the proprietor of the business. The occupants of the building, who are the ones that interact with the interior environmental systems, play a small role if any in the design process. It is the objective of this research to evaluate the role and influence of occupants' awareness of sustainability, as it relates to energy efficiency in office buildings. This is a qualitative study that uses a case study of a building situated in the central business district of Cape Town; interviews, observations and journaling are some of the techniques used to collect data.

The data revealed that the occupants of the building while interests into energy consumption are apparent they do not see the value of their individual role to minimise energy use as a collective in the building. The interaction of occupants with the design field and other relevant stakeholders in the built environment is one of the key issues that are raised. These interactions which can be perpetuated through the ethos of *ubuntu* (humanness) can play a fundamental part in the conceptualisation and design of office interiors. Additionally, the information gathered through these proposed forums can be disseminated through collaborative networks that can form knowledge hubs for interior designers during the research stage of the conceptual process. In so doing, interior design can then bring to the fore the 'person' in the culmination of an energy efficient office environment. This role of the individual in a systems oriented process of energy efficiency in buildings is significant due to its evident influence on promoting behavioural change in society. Through incremental innovation by using occupant experiences, the design process can transcend the areas of industry and policy and be inclusive thereby attaining a more holistic approach. This is suggested in the findings and integrates this approach of energy efficient strategies that promote ownership and responsibility for one's actions.

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I wish to thank God, from whom all life begins and ends. It is my hope that in articulating our part to play in the cycle of the environment we exist in, what we recreate in physical form plays its role in its designed life and reuse.

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DEDICATION

For my parents,

You have been the essence of *ubuntu* in my life

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GLOSSARY

Abbreviations /terms	Description
Awareness-Interest-Desire-Action (AIDA)	Model used to consider promotional objectives, suggest that the buyer or potential buyer passes through four key stages in the buying process (Lancaster & Withey, 2006).
Batho Pele	A Sotho translation for 'People First' it is an initiative to get public servants to be service orientated, to strive for excellence in service delivery and to commit to continuous service delivery improvement (DPSA, 2010).
Carbon-dioxide (CO_2) emissions	This is related to the burning of oil, coal and gas for energy use (OECD, 2009)
Central Business District (CBD)	The heart of a city where the main means of transport converge.
Control Development Mechanisms (CDM)	The Clean Development Mechanism is regarded as one of the most important internationally implemented market- based mechanisms to reduce carbon emissions (Cheng, C., *et al.,* 2008).
Department of Minerals and Energy (DME)	An arm of the government that deals with the regulations of mining in South Africa.
Design for Sustainability (DfS)	Design for Sustainability is the process of designing that takes into account the dimensions of sustainable development, and particularly; environment, economic and social aspects (Armstrong, 1997).
Energy Efficient Buildings (EEB)	It is a building that uses the minimum expenditure of energy to heat and cool the interior of a building with the added feature of making this space healthy and comfortable for human occupation.
Environmental Indoor Quality (EIQ)	Improvement that is expressed in terms of comfort and health and usually has significant impacts on its external environment (Mumovic, D & Santamouris, M., 2009).
Indoor Air Quality (IAQ)	Is a term referring to the air quality within a building and especially as it relates to the health and comfort of building occupants.
Intergovernmental Panel on Climate Change (IPCC)	The IPCC assesses the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced climate change.
Interior Environmental Quality (IEQ)	It refers to the quality of the air and environment inside buildings, based on pollutant concentrations and conditions that can affect the health, comfort and performance of occupants.

Abbreviations /terms	Description
Kyoto Protocol	An international agreement that aims to reduce carbon dioxide emissions and the presence of greenhouse gases.
Light –Emitting Diode (LED)	It creates light when electrons pass from one plate to another and a photon is created. Light is created with almost no heat or invisible light as by-products.
Methodology for Product Service Systems (MEPSS)	It aims to provide a methodology and toolkit to be used in the process of developing and implementing a successful and sustainable product-service system (Vezzoli *et al.*, 2005).
National Efficient Energy Agency (NEEA)	It prioritises and recommends energy efficiency and DSM projects to be undertaken in the country.
Product-Service Systems (PSS)	A marketable set of products and services capable of jointly fulfilling a user's need (Morelli, 2002).
Social Innovation	Refers to new ideas that resolve existing social, cultural, economic and environmental challenges for the benefit of people and planet. Ref: http://socialinnovation.ca/about/social-innovation
Social Oriented Partnerships (SOP)	A network created though a variety of stakeholders to promote effective and successful solutions (Manzini, 2006).
Strength-Weakness-Opportunities-Threats (SWOT)	An analysis of internal strengths and weaknesses and external opportunities and competitive threats (DeBenedittis et al. 2010).
Sustainable Consumption and Production (SCP)	"the production and use of goods and services that respond to basic needs and bring a better quality of life, while minimising the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardise the ability to meet the needs of future generations." (Norwegian Ministry of Environment, 1994).
Sustainable Development (SD)	"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Hanks *et al.*, 2005).

Abbreviations /terms	Description
Task-Ambient Conditioning (TAC)	"It is a method for providing occupants with control of a local supply of air so that they can adjust their individual thermal environment" (Fulkner *et al.,* 1999).
Ubuntu	Asserts that participation enables a person to reaffirm their own personhood and humanness through interaction with, and contribution into other peoples' lives. (Maina *et al.*, 2010).
United Nations Framework on Convention and Climate Change (UNFCCC)	The objective of the Convention is to stabilize atmospheric concentrations of greenhouse gases at safe levels (Cheng *et al.,* 2008).

CHAPTER ONE
INTRODUCTION

1.1 Developing the idea for the thesis and motivation for the study

Sustainable development is ultimately about radical change in the systems of consumption and production. Thus governance for sustainability can be said to be by definition about working through formal and informal institutions to bring about social change (Folke *et al.*, 2005:444). The use of particleboards and fibreboards is seen as a change from the use of timber to allow for a limited use of this slow renewable resource. According to the entrepreneur of 'Stark Joinery' a workshop in the Salt River area in Cape Town, products are used according to the specification of the client. Though these products are being specified as 'sustainable' products, their use is not monitored by either the manufacture or the end-user of the furniture. In this instance only one pillar of Sustainability, economic, can be seen to be an influence in its specification (Pillars: Economic, Social, and Environmental). This is due to the method of producing medium-density fibreboard (MDF), which is made from the dust and remnants which are by-products of timber boards. These remnants are then adhered using various glues to made fibreboards/particleboards. The material specification at this level is governed by the clientele, whose choice is influenced by; status, budget, trends etc. There is ignorance of the impacts of using resins and chemicals to manufacture wood polymer boards used by the ever growing global market.

An example of the determent of manufacturers using these wood polymers and fibreboards is the illness associated with the trailer homes provided for the Katrina Hurricane victims by the US government. *"Workers employed at plants that used or produced formaldehyde continue to show a possible link between formaldehyde exposure and death from cancers of the blood and lymphatic system, particularly myeloid leukaemia.* These were workers making moulded-plastic products, decorative laminates, and plywood - as may be found in house trailers" (NIH, 2009). After Hurricane Katrina struck the Gulf Coast of the United States in 2005, hurricane victims were temporarily housed in government provided trailers that exposed victims to dangerous levels of formaldehyde. As a result, trailer residents suffered from sinus infections, respiratory problems, and burning sensation in the eyes among many other symptoms (Tang *et al.*, 2009:1221). This shows that exposure to formaldehyde affects both the worker and the end-user of the products. These resultant effects are not seen to be factors that are known to the workshop visited. The question then arose as to what area of sustainability is practiced by designers and furniture manufacturers and the type of governance that regulates.

Governance is the structure and process by which people in societies make decisions and share power. Governance is the process of resolving trade-offs and of providing a vision and monitoring to provide feedback and synthesize observations to a narrative of how the situation has changed and might unfold in the future (Folke *et al.*, 2005:445). In South Africa and in particular in Cape Town's office design, sustainability is an aspect that is used to differentiate an organisation in the market. Right from the designers to the manufacturers and office buildings it is used hand-in hand with conflicting issues of the same said industry. In terms of furniture design, a local furniture designer was approached who has won a sustainable award for his

'Zulu Mama Chair'. This was due to the reuse of materials that would otherwise have been disposed while using local communities to manufacture. In the area of manufacturing sustainable furniture products, CN Business whose primary products are used in offices was approached. Their awareness of the health hazard formaldehyde poses to end-users has been introduced by their clients. But this added cost of importing formaldehyde free timber products is only offered to clients who approach them for this. Therefore, the information gained about the health risk the local products pose and the components imported from China containing formaldehyde are still used and sold to unsuspecting clients. The occupants of the office building who use these spaces have no inkling of the hazard they are exposed to. The products that are placed in the offices and systems used are not brought to their attention, nor is their influence warranted in the conceptualisation and design of the office workplace because they do not pay for the implementation.

In the ever changing markets and emergence of new materials, adaptation is necessary for survival. Resilience, defined as the capacity of a system to absorb disturbance and reorganise while undergoing change is an aspect that the social system should embrace in Cape Town. This is so as to retain essentially the same function, structure, identity and feedbacks in the system as were there before. Therefore, addressing only the social dimension of resource management without an understanding of resource and ecosystem dynamics will not be sufficient to guide society toward sustainable outcomes. Social sources of resilience, such as social capital, including trust and social networks; and social memory, including experience for dealing with change are essential for the capacity of social and ecological systems to adapt and shape change (Folke *et al.*, 2005: 443). One could say that sustainability is about locally suited options that are globally sustainable. But it is also about local awareness and behaviour that shares the larger agenda (Kemp *et al.*, 2005:4). In this light, the management of resources used in the design of the office workplace can be addressed in reference to awareness of the occupants. The changes being experienced in the industry in terms of new materials and socio-technical advancements in the interior environmental systems affects the well being of the occupant. The barriers seen in the implementation of principles that promote sustainability and individual responsibility can be seen to be perpetuated from within governance and management.

Adaptive management argues that a reason for failure lies in management stakeholders showing deplorable self-interest, seeing adaptive-policy development as a threat to existing research programs and management regimes, rather than as an opportunity for improvement. This is why it is important to address the social dimension and contexts for adaptive governance in processes of participation, collective action, and learning. Hence, social systems are structured not only by rules, positions, and resources but also by meaning and by the entire network of communicating individuals and organizations at different levels of interaction, representing the social system involved in governance. A clear and convincing vision, comprehensive stories and meaning, and good social links and trust with fellow stakeholders may mobilize several interest groups at several levels and start a self-organizing process of learning and social capital generation for management of complex adaptive systems (Folke *et al.*, 2005:448).

Finding ways to ensure that all players act coherently, effectively and with some efficiency in the pursuit of sustainability demands much higher ambitions and underlines the crucial role of informal institutions. A variety of tools are available including development of explicit common objectives; use of multi-stakeholder deliberation and decision mechanisms and making adjustments to business and consumer behaviour in the market place (Kemp *et al*, 2005:7).

In times of rapid change informal social networks can provide arenas for novelty and innovation and enhance flexibility, all of which tend to be stifled in bureaucracies. However, these network structures do not replace the accountability of existing hierarchical bureaucracies but operate within and complement them (Folke *et al.*, 2005:450). The advantage of having intermediary groups perform this role is that it allows professions and industries to police themselves. When self-governance is lacking, human behaviour must be controlled solely by the law. Part of the problem with relying exclusively on the law is that legal statutes cannot possibly cover all improper behaviour. A more serious problem, however, is that it fosters the attitude that anything goes as long as one does not violate the letter of the law, and thus encourages businesses to find loopholes in each law, leading to a vicious circle as the government struggles to plug each loophole with new statutes.

When individual people or businesses are blinded by greed and run amok, their colleagues should join in denouncing them as a disgrace to their profession or industry and deal with them appropriately, by barring them from the market (Hill, 2009).

1.2 Deriving the research topic from preliminary research

Informal social networks are seen to be initiatives in the industry that are governed by industry performers and players from the government. These networks should ideally have participation from all actors in the working systems; in this case the focus is on the occupants of the office workplace. The occupants of the office are subjected to indoor environments created by materials and systems that are certified without their contribution.

Self governance of society in which each group in the community is considered to be part of the social capital would lead to collective decisions. These decisions can be made in tandem with technical innovations and ecological management. The sequencing of events allows actors to take responsibility of effects as a measure for improvement in development within the industry.

According to Fuad (2004), "artists and designers are called upon to consider the nature of the change, to respond creatively and investigate ways of reconciling evolving understandings with the expressions and artefacts of art and design". To be relevant to the existing culture, such explorations must be unencumbered by many of the conventions of the past. Design must decouple itself from the existing drivers of the discipline if it is to provide a new paradigm for design. These existing drivers can be seen in the present approach of designing where the designer uses their intuition

through looking at trends and of styles according to the needs of the client to create interiors. A paradigm shift that sees the end user playing a more prominent role in the culmination of a design intervention is evolving.

In trying to understand the part that interior design has to play in the area of better production and consumption, the aspects of an economic, social and environmental influences should be addressed. Walker (2007:1) states that "many external influences are omitted from our economic models - such as pollution, waste, the denudation of natural resources, and the apparent link between industry and climate change. To explore ways of designing our material culture that address these issues we have to set aside our usual expectations that assume a design must be profitable, desirable, marketable etc." If one approaches the design process asking, "How can I grow prosperity, celebrate my community, and enhance the health of all species?" we see a growing concern to be inclusive both in how we treat our immediate environment and the conscious usage of the artefacts that emerge.

The growing awareness of the end user is a point of departure for the continuation of sustainable innovation in the built environment. When an occupant of a space acknowledges the systems put in place to reduce the use of natural resources, there is significant behavioural change in their use of space.

Through social learning networks perpetuated by platforms aimed at governance in industry, awareness can be a tool to enhance innovation. Social innovation can be done through the involvement of organisational responsibility in the implementation of sustainable materials and systems.

1.3. Identifying and articulating the research problem

1.3.1 Background of research problem

Offices are designed as a functional space that reflects the *image, culture and carries meaning* for the organisation within. These principles of design are stated by Ching (2005) as a road map to good design. The form that the artefacts take is: lighting, furniture, material finishes, space allocations or amenities is something the client (organisation) and the designer decide. The occupant of these offices often does not have a say as a participant in the co-design of the space they will occupy.

Design for sustainability in context to its social aspect is used as a lens to create healthy indoor environments for the occupant. This is done by allowing the occupant to be a part of the design process from concept through to design implementation. Through the influence of the end users' needs and wants a designer can integrate features into the office design that would be mutually beneficial for the organisation and the occupant. This is because a healthy indoor environment perpetuates better productivity.

By ensuring a healthy indoor environment, the economic and environmental aspects of sustainability are positively influenced. The reduction of energy use means low building maintenance for the organisation. This in turn would reflect on the environment by the building emitting lower carbon-dioxide (CO_2) emissions. This

cyclic cause and effect is initially begun by the occupant's willingness to take part in the installed systems and the organisation's investment on these said system.

Design for sustainability plays a larger role in the office workplace then just choosing green materials. It also constitutes areas concerning saving energy; reducing management costs in terms of equipment and reducing the carbon footprint of an organisation through innovative sustainable initiatives, all which fall under interior environmental systems. These systems include: heating, ventilation and air conditioning; water supply and sanitary drainage; electrical power and lighting; room acoustics and noise control. Bluyseen (2010) states that, "the WHO concept of health became significant for identifying the concept of a 'healthy building' in terms of building performances: i.e., indoor air quality, thermal comfort, lighting quality and acoustics". In integrating sustainability into the implementations of these systems, interior design can take up a new paradigm shift by integrating management, service design and product life cycle principles into the design process.

The integration of management skills comes through using principles that are concerned with applying a triple bottom line approach. This applies to endeavouring to apply economic, social and environmental strategies to the culmination of a design intervention. Service design plays the role of creating social innovations that create awareness through AIDA and SWOT analysis that allow for market and internal surveys.

Due to a growing need to assess the well being of the end user in the built environment some areas like task/ambient conditioning (TAC) systems are being studied and developed to respond to the increased requirements for local control of indoor heat load and to meet the thermal preferences by individuals. This is done to reduce the carbon footprint of the building. An example of this is, "a recommendation by the Japanese Government to set the air temperature in office building to be 28 C° in summer to reduce carbon-dioxide (CO_2) emission." (Akimoto *et al.*, 2010). Other ways of reducing the climatic effect of a building on the environment include less natural resources to recycle the grey water used in the building, or storage of run-off water from the roof into storage facilities.

The role of interior designers can then be seen as active participants in the effort to reduce adverse climate change. The end user also plays an important role, as the measures put in the building can only be ensured by their continual support of the systems in place.

1.3.2 Statement of the research problem

To decouple interior design from the present design process which is seen from the perspective of the designer, who creates what is to be a new design intervention. This can include new paradigm shifts that reconcile evolving understandings with the expressions of art and design to include the views of the stakeholders; subsequently leading to a design process that is human centred to include the end users' requirements and views into the conceptual stage.

1.3.3 Purpose of the study

The purpose of this study is to describe how the principles of DfS are implemented in the office workplace through the stakeholders in the built environment industry. The research will also take into consideration the various actors in the office workplace and the role their awareness of these principles plays in the installation and use of interior environmental systems in the office.

1.3.4 Research problem

How does the occupant's awareness of the principles in DfS reflect between the relationship of industry professionals[1] and the occupant of the office workplace?

Sub-questions:

a) How can occupant awareness of principles in DfS influence the design of the office workplace?
b) How do technical advances in lighting, thermal comfort and acoustics create new opportunities for meeting functional, aesthetic and sustainable objectives in creating office spaces?
c) How can the principles of DfS be incorporated into the office design and the organisation's governance to encourage knowledge transfer within the social networks?

1.4 General indication of the research design and methodology used to address the research problem

In addressing the research problem, an exploratory research was performed. The following techniques were used to collect data; interviews, observations and industry document analysis.

The interviews performed were of a furniture designer whose interest in sustainability covers the dimensions of social and environmental aspects. Interviews of proprietors of workshops dealing with timber, bamboo, particleboards and fibreboards were performed. Industry documents were gathered from a company dealing with the manufacture and sale of office furniture. Other documentation was reviewed.

1.4.1 Outline of reminder of the thesis

The thesis will be structured according to Yin's (2009) description of a case study reporting following a method of building momentum from the propositions mentioned in the research questions raised.

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[1] Industry professional in this context include; policy makers, engineers, designers, architects and furniture manufacturers.

The main topics of the thesis will be outlined according to the following:

i. *Literature review*
   a) The first section will give a brief introduction of the concepts used to bind the study within the relative concepts of sustainability in context to interior design.
   b) The second section will look at the literature covered by demarcating how the scholarly literature was chosen.
   c) The third section will discuss the literature read according to the sub-question topics.
   d) The fourth section will be a conclusion that states how the literature will inform and influence how the following empirical study will be performed.

ii. *Research Approach*
   a) The first section will be a definition of hypotheses and variables arrived at
   b) The second section will be a discussion of the instruments used in the study
   c) The third section will explain the sampling technique used and the criteria used in the choice of sample size.
   d) The fourth section will be a detailed account of the data collection process; gaining access to the subjects, data collection techniques and procedures used, dates and settings of data gathering.
   e) The fifth section will describe procedures used in capturing and editing data, post coding procedures, measures to minimise errors. A description of the rationale behind the selection of data analysis procedures as well as the actual procedure used to analyse the data. A discussion of the quality of data and gaps in the data will be done.

iii. *Data Analysis*
   a) The first section will detail how the chosen theory used for analysis relates to the research data collected.
   b) The second section articulates Activity Theory
   c) The third section creates meaning from the data collected sectioning it off using the research questions as a guide.

iv. *Discussion and findings*
   a) A discussion of the sample and its characteristics
   b) A description and summary of the main results using tables and other visual devices
   c) A discussion of the main trends and patterns in the data with reference to the research questions
   d) To draw the discussion together by interpreting the main findings and highlight both negative and positive aspects.

v. *Conclusion and recommendations*
   a) A discussion of main findings obtained in the study by drawing together the results from the pervious chapters.

b) Show a relation of the results from the study and the literature and theory by showing connections between the results and the literature reviewed in the literature review.
c) A discussion of any anomalies and surprising results showed in the results from the study. Confirm or deviate from the expected and give reasons for the latter being honest about the ambiguities in the data.
d) Show a larger relevance and value of the study and where gaps and uncertainties may still be.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

Sustainability is a concept that is used to market products for the commercial sector. The awareness of the occupants in the office of the principles of sustainability and how well they are implemented in the products assigned to their spaces is important. This aspect should be a well founded objective in the protocols followed by designers to ensure a holistic design.

Sustainability is used in different contexts in the industry of the built environment leading to many connotations that may be misleading. The role of the designer should be to facilitate the client with information that will lead to informed approval of products. Though this is an ideal approach of the design process, it does not always happen in this light. Due to a proliferation of 'sustainable' products and systems stating their positive environmental and human impacts, awareness is crucial. This awareness initiative within the occupant groups and the stakeholders that install and pay for these systems is preferable. This would lead to a decrease of products and systems that do not serve the economy, environment or society at large.

Sustainability is not "Green Marketing." It is not energy saving. It is not a social programme. It is all of these things and more. Sustainability is a collective term for everything to do with responsibility for the world in which we live. It is an economic, social and environmental issue. It is about consuming differently and consuming efficiently. It also means sharing between the rich and poor, and protecting the global environment, while not jeopardising the needs of future generations (McCann-Erickson Workgroup, 2002:14).

In the interior design industry, sustainability can be seen in the design and manufacture of furniture. An example of this is IKEA which is at the forefront of efforts by the furniture industry to encourage a sustainable approach to furniture manufacturing and retailing. The firm has removed PVC from almost all of its products, pioneered the use of energy efficient light bulbs and is a leading member of the Forestry Stewardship Council (Charter *et al.*, 2002:10). Herman Miller a manufacture of office furniture has been at the fore of innovation in their field. The company has taken on design for environment (DfE) as a core business strategy. One of its core strategies is building a database of materials that prioritizes existing environmentally friendly materials and spurs the development of new ones (GreenBiz, 2002:7). In doing so, have these strategies in the last past years made an impact on the quality of the indoor environment?

In order to answer that, we have to put 'environmental quality' in context to interior design. Environmental quality can be defined as the satisfaction of individual needs in a manner that will yield the maximum benefits to the individual while minimising the effects or changes on people and natural resources. This may be extended to the concept of 'quality of life' and 'well-being' – making the link between a person and his or her broader surroundings (Charter *et al.*, 2002:10). In doing so, interior design

would take into consideration the link between a person and the materials and components that are recommended for an interior space.

2.2 Demarcating the literature to be covered

This review is set to look at the general influences of DfS in the area of office design. Within the concept of Design for Sustainability (DfS) is the concept of product-service systems (PSS), which is culmination of sustainable solutions that couple a service with the product in the interior environment. The installation of a PSS would cause a change in the indoor environment, if the said system is concerned with: indoor air quality, thermal comfort, lighting quality and acoustical quality.

In the next section, the review will touch on the role technology has played in the innovation of interior environmental systems. This will then lead to the review of awareness of the occupants of the office and relative commercial spaces. It is the intention of this research to look at awareness programs that deal with informing end users of the role of sustainable systems and products. This will include curative measures that have to be taken to deal with unfortunate repercussions of end users' ignorance of material processes.

The literature that will be reviewed to cover the above stated objectives will include: literature from local government policies and endeavours of Non-governmental Institutions i.e. GBCSA and The City of Cape Town Partnership, to point out local presence of sustainability principles in the Built Environment industry; literature from both Europe and Australia that is concerned with the implementation of PSS in the office workplace as well as innovation in the area of office interior environmental systems.

These areas of literature were chosen for their inclusion of the end-user in the process of implementing sustainable principles. This was done by some in areas of conceptualisation, design, implementation or evaluation. The role of the occupant should be seen as significant in material choices of components and artefacts used in the office workplace.

The various actors involved in conceptualising and implementing sustainable solutions can be viewed through "solution oriented partnerships" (SOP). These can be seen as networks that work to offer high levels of accessibility, customisation and contextualisation while presenting a sustainable social environmental profile. These partnerships can exist between the client, occupant, designer and manufacture. Through these networks innovation can be set to fulfil the clients' and occupants' user requirements. Currently manufacturers have portfolios of the products and PDF documentation of manufacturing details that can be accessed on the internet. This information though available is not accessible to persons outside the given industry due to technical jargon. A more approachable and transparent documentation that is clearly designed for the client and occupant is ideal. This would serve to increase knowledge when making choices on implementing sustainable solutions in an office setting.

2.3 Sustainable Development: managing natural resources

"Sustainable development is ultimately about radical change in the systems of consumption and production" (Folke *et al.*, 2005;444). The rapid consumption of natural resources to provide office settings for the growing workforce in Cape Town is a looming reality. Perhaps by changing how we consume our natural resources and viewing these changes as a personal and individual contribution we can use these resources with better efficiency (Manuel, 2008). This means "changing the very nature of our current production methods and streamlining our consumption to better suit our ecosystems" (UNEP, 2005:4).

The Intergovernmental Panel on Climate Change (IPCC), created in 1988 to assess the scientific, technical and socio-economic information relevant to anthropogenic emissions, established in its second report in 1995 a link between these emissions and climate change, stating that "the balance of evidence suggests a discernible human influence on global climate". The release of this report culminated in the adoption of the Kyoto Protocol to the United Nations Framework on Convention and Climate Change (UNFCCC) in December 1997. In 2005 the South African government ratified the Kyoto Protocol moving the nation to a new era of conscious consumption cycles. In response to this provincial governments have initiated programmes and initiatives to further the objectives of sustainable development (Ahmad, 2004).

According to conclusions reached in the Johannesburg Summit on sustainable development, the Plan of Implementation contains:

> *Targets and timetables to spur action on a wide range of issues, including halving the proportion of people who lack access to clean water or proper sanitation by 2015, to restoring depleted fisheries and the preserving of biodiversity by 2015, and phasing out of toxic chemicals by 2005. The Summit also generated concrete partnership initiatives by and between governments, citizen groups and businesses. These partnerships are to bring with them additional resources and expertise to attain significant results where they matter - in communities across the globe* (Pascale, 2005:1).

These plans introduce a change in how stakeholder engagement is to be dealt with. Within the partnerships between various actors in the networks involved in conceptualisation through to implementation of sustainable development initiatives is systems management. This would involve the various actors in collaborative networks to enhance production and consumption cycles for better efficiency.

Sustainable Consumption and Production (SCP) can be defined as "the production and use of services that respond to the basic needs and bring a better quality of life, while minimising the use of natural resources, toxic materials, emissions of waste and pollutants over the life cycle so as not jeopardise the ability to meet the needs of future generations" (Norway Ministry of Environment, 1994). According to the National Round Table on SCP (2008:9), "The South African government under the Marrakesh Task Force is aiming at the following:

1. Development of an African eco-labelling scheme
2. Development and implementation of national/city-level programmes on SCP
3. A review on opportunities for leapfrogging in Africa".

Within the building industry the above objectives play a crucial role in the advancement of Energy Efficient Buildings (EEB). In order to meet the objectives as underlined by the SCP National Roundtable (2008:22) stated as: "protecting occupant health; improving employee productivity; using energy, water and other resources more effectively; and reducing the overall impact on the environment", the building and construction industry is set to adopt green building strategies. This was seen in the formation of the Green Building Commission of South Africa (GBCSA) in 2007 adopted from the Australian Green Building Council (GBC).

Figure 2.1: ANZ's headquarters in the Docklands Melbourne Australia

(Architecture today, 2010)

One such building that epitomises sustainability is the new ANZ headquarters in Melbourne's Docklands featured in figure 2.1. "The ANZ building houses 6500 people and no staff member sits more than 11 metres from natural light". In addition to this "The building's green credentials include wind turbines, solar panels, a green roof, gas-generated electricity, water recycling, proximity to public transport and bicycle spaces. It also recycles 90 per cent of the water in cooling towers for the air-conditioning" (Architecture Today, 2010).

Another building that is seen to be in line with following sustainability principles with the occupant at the fore is The Gauge in Melbourne's new Victoria Harbour depicted in figure 2.2 below.

Figure 2.2: The Gauge exterior and interior view (Wordpress, 2010)

The Gauge tackles Victoria's water-scarce future through intelligent design and water efficient technologies like cooling tower control systems that limit water wastage, high efficiency fixtures and fittings in urinal and toilet facilities, as well as a fire system tank that enables collection and reuse of fire system water. Energy efficient measures have been implemented on-site to reduce greenhouse gas emissions by over 30 per cent when compared with typical 5 Star Green Star rated buildings. A natural gas-fired cogeneration unit on the roof of the building generates more than 25 per cent of the base building's overall energy demand, using waste heat for pre-heating domestic hot water and air supply in the colder months (Green Building Council of Australia, 2010).

The GBCSA aims to drive the adoption of green building practices in South Africa and move building and construction industry toward sustainability. The association promotes the adoption of green building principles by creating awareness and knowledge transfer as well as making resources available (Buch, 2010).

Energy efficiency can be seen in BP's initiative to set high environmental, social and ethical standards in their office building built in 2002 at the foreshore fell in place with these aforementioned standards. In driving sustainability through efficient management of resources the building was designed and built to incorporate passive energy in its building envelop. This includes among others; ventilation stacks at the building's outer edge to lower solar heat gain, thermal solar panels and photovoltaic cells which generate 10% of the building's energy (Robertson & De Beer, 2005).

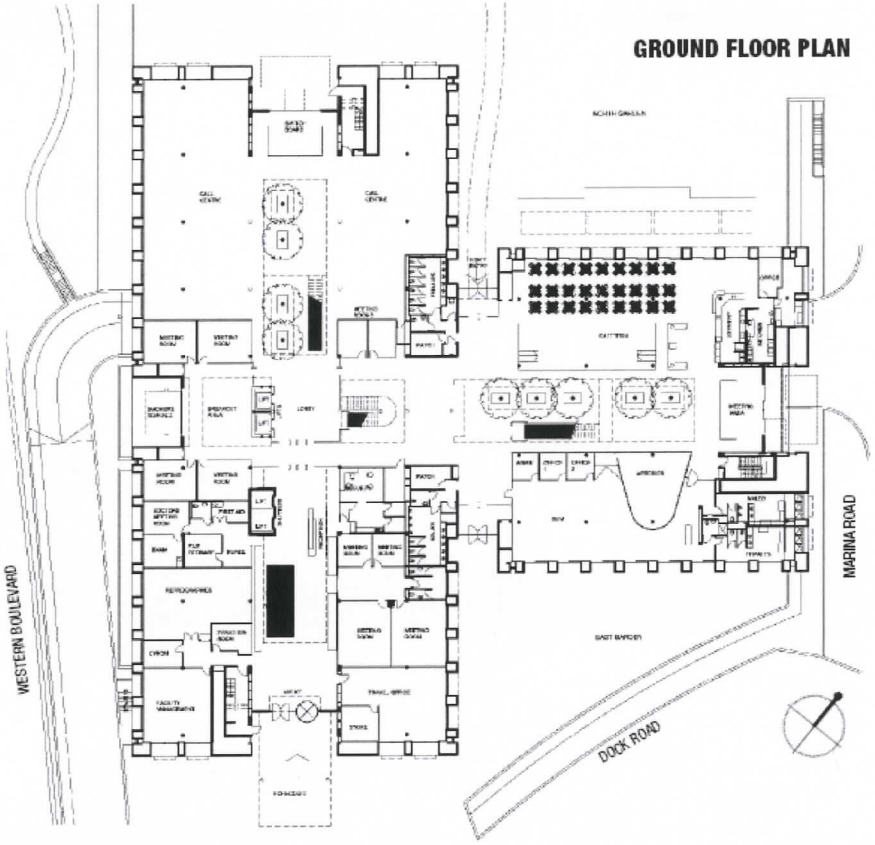

Figure 2.3: Ground floor plan of BP building at the foreshore, Cape Town (Robertson & De Beer, 2005)

Figure 2.4: Interior spaces of the BP building at the Foreshore, Cape Town (Robertson & De Beer, 2005)

To ensure the said systems were used to their optimum, the building management adopted the waterfront directory; a new way of working compiled by the Workspace change team that informed the occupants how to use the building. Staff were also briefed on the characteristics that building temperature, lighting and water employ to minimise the use of energy. A system displays the amount of energy consumed by the building, produced by the building's solar power array, the amount of carbon dioxide emission saved from being released into the atmosphere and water stored and saved (Robertson & De Beer, 2005).

Figure 2.5: Phase Two Nedbank building

(Van der Merwe, 2009)

This approach of knowledge transfer is commendable and aligns the principles of creating and EEB; not just through energy efficiencies but also in adopting efficient usage. To better understand the impetus of aligning the building and construction industry with sustainable principles, the occupants' well-being should be revisited. This can be done through reviewing projects and initiatives in related developing contexts.

2.4 Design for Sustainability (DfS): impacts on interior design[2]

DfS in context to its social aspect is used as a lens to create healthy indoor environments for the occupant in an office setting. This is done by allowing the occupant to be a part of the design process from concept through to design implementation. Through the influence of the end users' needs and wants a designer can integrate features into the office design that would be mutually beneficial for the

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[2] Interior design is "to be done for the purpose of protecting the health, safety and welfare of the public and increasing productivity and improving the quality of life" (Ching and Binggeli, 2005).

organisation and the occupant. This is because a healthy indoor environment perpetuates better productivity.

"These emerging, interwoven networks of individual people, enterprises, non-profit organizations, local and global institutions that use their creativity and entrepreneurship to solve problems, to open new possibilities can be seen to be taking some concrete steps towards sustainability" (Manzini, 2007). DfS can therefore be seen to play a larger role; firstly in the office workplace, to being more than just a tool when just choosing green materials. It also constitutes areas concerning saving energy; reducing management costs in terms of equipment and reducing the carbon footprint of an organisation through innovative sustainable initiatives, all which fall under interior environmental systems. These systems include: heating, ventilation and air conditioning; water supply and sanitary drainage; electrical power and lighting; room acoustics and noise control. Bluyseen (2010) states that, "the WHO concept of health became significant for identifying the concept of a "healthy building" in terms of building performances: i.e., indoor air quality, thermal comfort, lighting quality and acoustics". In integrating sustainability into; the implementations of these systems, interior design can take up a new paradigm shift by integrating management, service design and product life cycle principles into the design process.

The emergence of new systems to supply an interior with an ideal indoor environment is being currently coupled with a service. These initiatives are described as a product-service system (PSS). In terms of energy use in the fitting of electricity this can be seen as a deliberate move toward replacing incandescent light fittings with energy efficient LED fittings. This reduces the amount of carbon-dioxide (CO_2) emitted by the building while also reducing the electricity costs of the building. According to Scholtz (2010) 'The retro-fitting of buildings in Cape Town's central business district (CBD) is an initiative that has been taken up by the City of Cape Town, through The City of Cape Town Partnership'.

By ensuring a healthy indoor environment, the economic and environmental aspects of sustainability are positively influenced. The reduction of energy use means low building maintenance for the organisation. This in turn would reflect on the environment by the building emitting lower carbon-dioxide (CO_2) emissions. This cyclic cause and effect is initially begun by the occupant's willingness to take part in the installed systems and the organisation's investment on these said system.

2.4.1 Product Service Systems (PSS)

PSS is an integration of a product and service to better service a consumer. An example of this can be seen in a case study done by Ecobilan on a UK based lighting company and its supply of a PSS lighting solution. The figure below illustrated the various levels of PSS from a tangible product that the company offer to an intangible service.

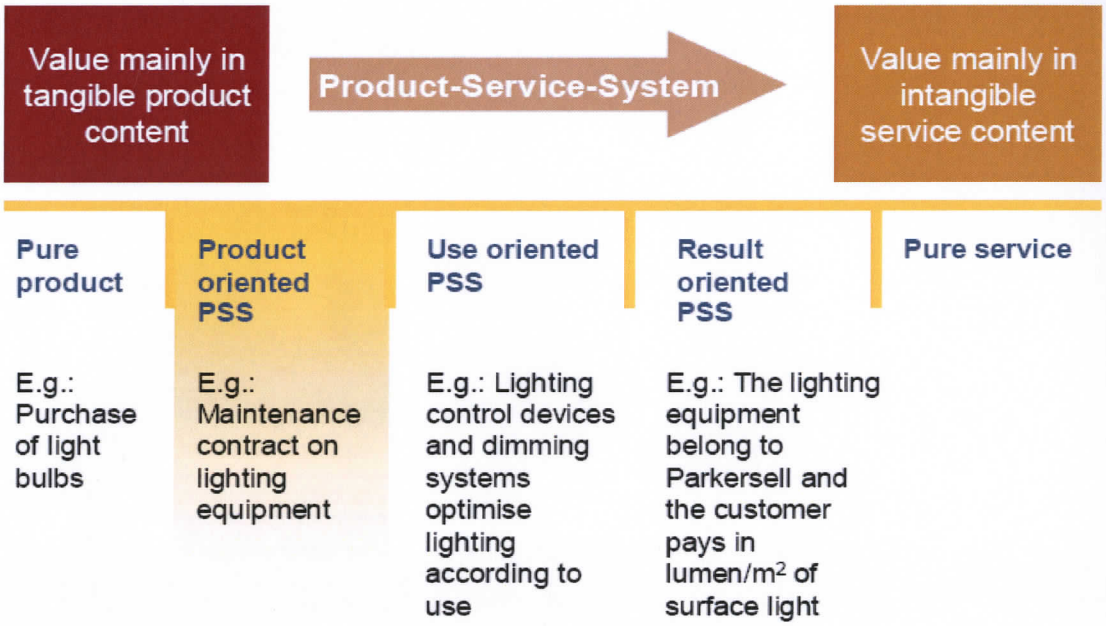

Figure 2.6: levels of PSS

(Ecobilan, 2004)

MEPSS illustrated in Figure 2.7 addresses the main issues of conceiving and implementing a PSS in a systematic and efficient way; analysing and accessing economic, social and environmental impacts; key factors of success or failure of a PSS (Ecobilan, 2004). With the implementation of these levels of PSS a stakeholder in the industry group can offer a level of sustainable consumption of natural resources to the built environment.

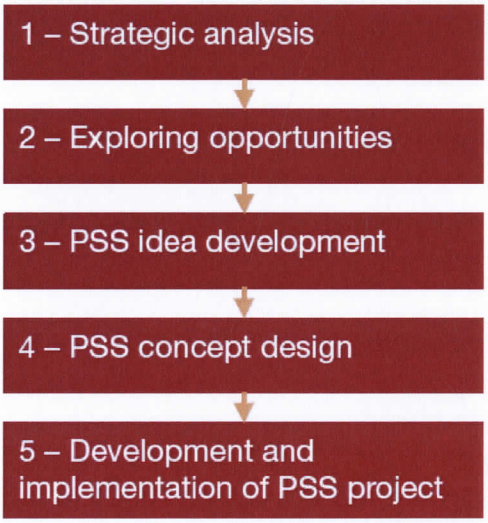

Figure2.7: Five phases of MEPSS

(Ecobilan, 2004)

According to the above levels of PSS illustrated in figure 2.6, the GBCSA has initialised a level two (Product-oriented PSS): use oriented PSS in Cape Town's CBD

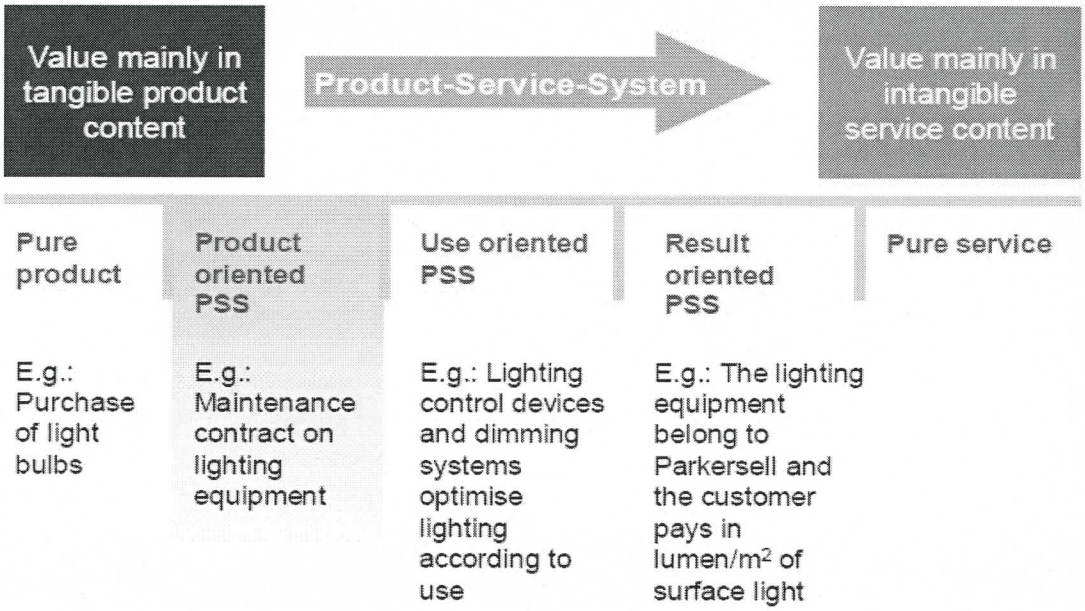

Figure 2.6: levels of PSS

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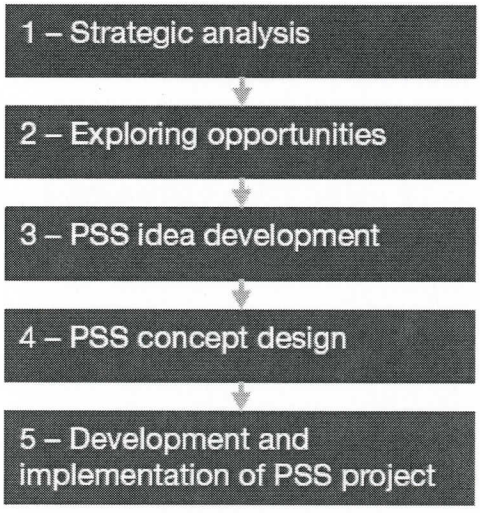


Figure2.7: Five phases of MEPSS

(Ecobilan, 2004)

According to the above levels of PSS illustrated in figure 2.6, the GBCSA has initialised a level two (Product-oriented PSS): use oriented PSS in Cape Town's CBD

according to the City of Cape Town Partnership. This was done through the retro-fitting of 20 buildings in the Central Business District with the assistance of the Dutch Government's aid body, CORAID (Scholtz, 2010).

2.4.2 Environmental Indoor Quality

Indoor environmental quality (IEQ) is a term used to refer to the environmental quality within a building or structure with a specific focus on the health and comfort of the building or structure's occupants. Indoor environmental quality generally includes air quality, acoustical quality, thermal comfort, artificial lighting and day-lighting (Van Wyk, 2009). Five years at the fore of the building environment professionals' strategies Mendell *et al. (2003:437)* comments that "no formal process exists for distilling professional experience into guidelines for protecting occupants". These gaps of addressing the importance of the role occupants play in the design process is now being addressed.

Following the dose related indicators as set out by Bluyssen (2010:816): Indoor Air Quality (IAQ); which refers to the odour, indoor air pollution and fresh air supply, Thermal Comfort; which refers to the moisture, air velocity and temperature, Acoustical Quality; which refers to the noise from outside, indoor and vibrations and Lighting Quality; which refers to the view, luminance ratios and reflections. IEQ in the office building shall be discussed as it relates to interior design.

IEQ is seen as a precursor to a sustainable building that is efficient in its energy use through both natural resource and human resources. According to Pyke (2010:2) "The green building community has begun the process of creating and operationalizing such systems for key environmental impacts, particularly energy and water consumption. However, systematic attention to human experience and health outcomes as explicitly testable phenomena lags behind." It is therefore the intention of this research to evaluate the occupants' experience in the office workplace as it relates to IEQ indictors as outlined above.

Occupants in 'green buildings' have been instrumental in the attaining of relative results of the function played by sustainable devices. As mentioned by Abbaszadeh *et al.* (2006:370), "through subjective variables experienced by the occupant in green buildings i.e. thermal comfort, air quality, lighting and acoustics." The occupants' satisfaction is gauged and a tentative relationship can be observed. It is at this juncture that a convergence of interests can be seen to cause a rise in occupant input to the 'greening' of buildings.

An example of this can be seen in the relation occupants have to windows in an office building as articulated by Menzies and Wherrett (2005):

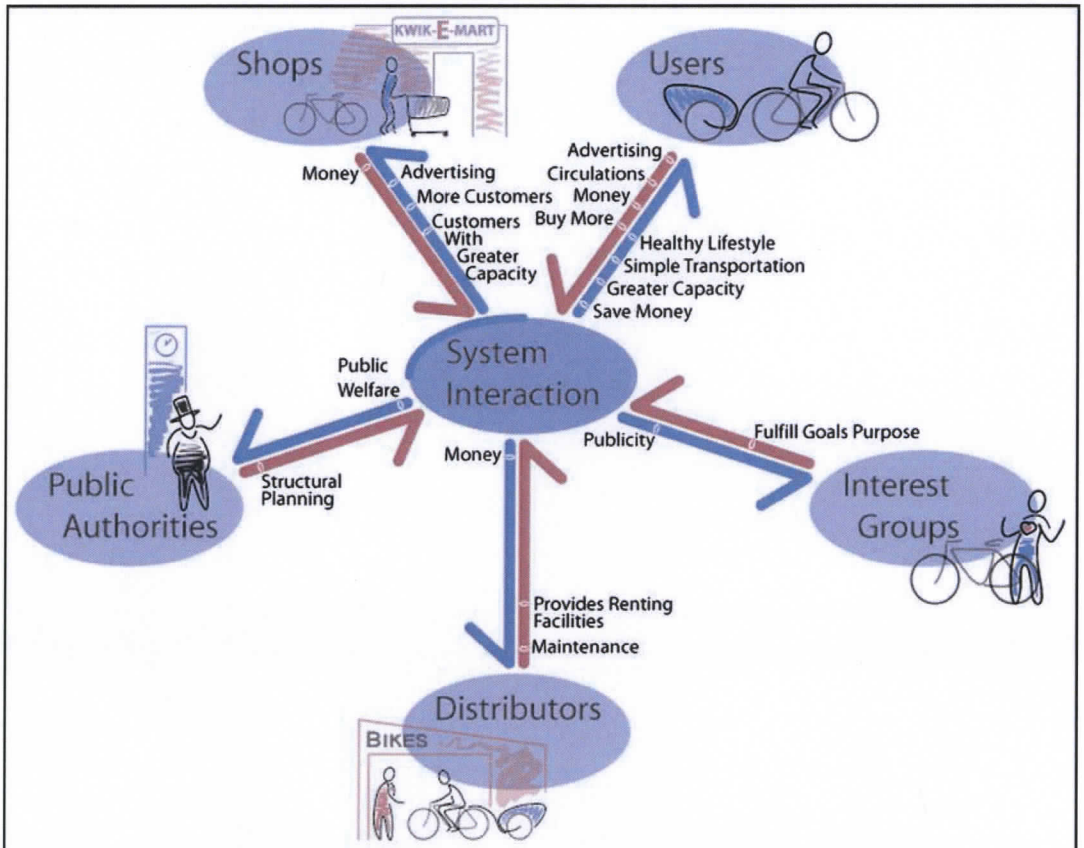
1. The *visual quality* that is enhanced by day-lighting;
2. The change in *indoor air quality* that can be enhanced by natural ventilation;
3. Recommendation of glazing attributes that can control solar heat gain and thus improve *thermal comfort*;
4. The attenuation of noise transference through an air cavity in between window glazing can be seen to enhance *acoustic quality*.

By engaging the occupant who experiences these spaces a more efficient design can be achieved as observed by Menzies and Wherrett (2005:624), "feedback is not routine in the construction industry; major failures are noted by designers and builders but disappointing performance is often forgotten and mistakes are repeated". If these feedback data were to be noted and made available to the relevant stakeholders sustainability would be attained at a greater efficiency level. These areas perpetuated in practice can have a positive impact in theory and industry sections and thus improve the quality of life in buildings.

As observed in the recommendation of glazing to an office space all areas of the interior environmental systems are affected i.e. lighting quality, indoor air quality, thermal comfort and acoustical quality. It is this inter-relationship of devices and the stakeholders involved in their implementation that is drawn upon. In the next section the area of partnerships in the built environment shall be reviewed with the objective of articulating how this salient information can be used in the design process. Within these observed relations is the underlying principle of *ubuntu* which is a cornerstone in the building blocks of the local government structures.

2.4.3 Sustainable social environmental profiles through Social Oriented Partnerships (SOP)

"The partnerships created by the convergence of different stakeholders for the generation of a solution have been defined as *solution oriented partnerships"* (Morelli, 2006:1495). The glue of such partnerships is attractive designed PSS solutions. An example of an interaction map depicting this is shown in figure 2.8.



Local authorities could administrate a system much like the city-bicycle services offered in some European cities. This would increase the use of bicycles for transportation and reduce automotive traffic in city centres
The authorities set a large amount of money aside for these projects. Therefore this solution will be very realistic, especially in Denmark where the experiences with public founded campaigns have been successful.

Figure 2.8: Example of an interaction map

(Morelli, 2006)

"Historically building occupants have been under utilised as a source of information on building performance" states Zagreus *et al.* (2004). This has been remedied by involving the occupant in post and pre-occupancy audits. The role to be played by a continuous interaction of the occupant with the stakeholders in the built environment is paramount. As mentioned by Hui *et al.* (2009), using the occupant dissatisfaction of the indoor environment to identify problematic Indoor Air Quality (IAQ) in Environmental Indoor Quality (EIQ) can be a basis for screening buildings.

As observed in the interaction above in Figure 2.8, users of a service are seen as a vital part of the system and not just as a product of the system. The creation of environmental social profiles can be seen in the adaptation of 'green teams' in a business. These teams are seen to combine social activities with environmental concerns that involve the organisations' employees to combat their impact on their ecosystem (Fleischer, 2009).

The resulting interaction can be seen as a SOP in the advancement of devices used to regulate EIQ. In this interaction there has to be a regulatory body that sees to the

equity of benefits to stakeholders involved. The South African government in the Western Cape has ingrained in all their service providers the ethos of *Batho Pele* (putting people first), which signifies an inclusive form of governance and service provision. The eight main principles of *Batho Pele* are: access, openness and transparency, consultation, redress, courtesy, service standards, information and value for money (Cape gateway, 2010).

These principles main concerns are to:

1. Working together as teams with fellow colleagues so as to empower a working environment;
2. Caring for people we render services to therefore treating people with dignity and respect;
3. Going beyond the call of duty and consequently going the extra mile to put people first (*ibid*).

By working together as teams within the government a SOP can be seen to work toward coalitions within varing government departments, thus working with similar goals at the fore of chosen objectives in each case. An example of this is the retro-fitting of office buildings in Cape Town's Central Business District (CBD) in 2006. This was done through the Cape Partnership, CORAID a Dutch Non-governmental body and the Western Cape Government. This partnership proved that the empowering of stakeholders to push a collective gain can be viewed as the use of *ubuntu* principles. There was at the background of each group their main objectives, but for the benefit of all stakeholdes involved, by putting the collective above the individual's needs, was considered (Nazeem, 2010).

The next section looks at the relation between the *batho pele* principles in the governement service provision and the ethos of *ubuntu.* As these are very similar approaches to service delivery and inclusiveness of participating partners in a collaboration of performing intiatives. How then does design integrate these principles of *ubuntu* into the processes involved in recommending and implementing interior environments in an office work space.

2.4.4 Designing WITH, FOR and BY society

Designers then have to recognize promising cases of social innovation, to make them more visible and to better understand them (that is: their strengths and qualities, on one side, and their weak points and difficulties, on the other). By working with the principle, 'Design in the designing networks, designers can participate in peer-to-peer with other involved actors in the generation of more efficient, accessible and promising initiatives. In this modality designers have to consider themselves as social actors endowed with specific design knowledge and skills to facilitate the convergence of different actors towards shared ideas and potential solutions. That is, to promote and enhance specific co-design processes (Manzini, 2007).

Bearing its roots in participatory design, co-design, which is according to Chapman and Gant (2007), a fruit of the labour movement in Scandinavia in the 1950s and it has gone through various evolutions. With its essence at being a design approach predicated on the concept that people who ultimately use a designed artefact are

entitled to have a voice in determining how the artefact is designed. It also involves a mutual learning in a multi-stakeholder (actor) engagement. One of these evolutions is 'transformation design' done by the RED group at the UK Design Council (Burns *et al.*, 2006).

Another parallel movement to that of co-design that sees its root at the heart of the African culture is *Ubuntu*. M'Rithaa (2009) asserts that participation enables a person to reaffirm their own personhood and humanness through interaction with, and contribution into other peoples' lives. This people-centred, inclusive and participative spirit of *Ubuntu* is what Africa shares with the rest of humanity (*ibid*). This means not merely acting individually towards one's own endeavours, but as a collective to bring about change that benefits the society as a whole. *Ubuntu* can be seen to work within similar principles of both co-design and transformation design. Therefore, in the culmination of co-design in design practice, in context to South Africa, *Ubuntu* can inform the quest for sustainable expressions of social equity and cohesion.

2.4.5 Entrepreneurship though the social and public domains

Social entrepreneurs are described by Dees as (2001:4) "change agents in the social sector who; adopt a mission to create and maintain social value, recognize and relentlessly pursue to serve that mission while engaging in process of continuous innovation, adaptation and learning. In addition to this they act boldly without being limited by the resources at currently in hand and exhibit heightened accountability to the constituencies served and for the outcomes created." While, according to Klein *et al.* (2009) public entrepreneurship "identifies goals, establishes terms, and otherwise sets a framework for the pursuit of private interests and other public interests. Public entrepreneurship establishes rules of the game (for good or ill), and private entrepreneurship is the play of the game".

Social and public entrepreneurship can be used as vehicles to drive social innovation though interconnecting communities through awareness initiatives. This platform is one that the provincial government allies with as it enhances collaboration and promotes knowledge transfer, enabling actors within the network to empower themselves. Through these collaborations both public and private interests can be aligned with each other through the principles of *ubuntu* to ensure a gainful venture for involved actors (Anon 3, 2010).

Public entrepreneurship in relation to the government can be seen to be organisations seen to be established to govern the use of natural resources. Some of these initiatives to regulate and assist in governance are articulated below:

The National Electricity Efficiency Agency (NEEA)

The National Energy Efficiency Agency (NEEA) was officially established in March 2006 through a directive issued by the Minister of Minerals and Energy. As such it is lead by the Department of Minerals and Energy.

The Electricity Regulation Act

The Electricity Regulations for Compulsory Norms and Standards for Reticulation Services[41] (Regulation No. 773 of 8 August 2008) have been issued in terms of The Energy Regulation Act[42] (Act No. 4 of 2006) introduced by The Presidency. The purpose of these regulations is to maintain good quality of supply to ensure stability of the electricity network, to minimise electricity load shedding and avoid blackouts but it will also impact the energy efficiency of buildings.

South African National Standard SANS 204; Energy Efficiency in Buildings

The establishment of this standard came as a directive from the Department of Minerals and Energy (DME) as well as the Department of Housing. The South African Bureau of Standards (SABS) has developed the SANS 204 series of standards to provide a framework for energy-efficient buildings:

SANS 204-1 – General Requirements;

SANS 204-2 – Energy Efficiency in Naturally Ventilated Buildings; and

SANS 204-3 – Energy Efficiency in Artificially Controlled Buildings

The CIDB Best Practice Project Assessment Scheme

The Construction Industry Development Board (CIDB) Act (Act 38 of 2000) requires that the Board must establish a Best Practice Project Assessment Scheme based on the best practices identified by the Board. All construction contracts above a prescribed tender value will then be subject to an assessment of compliance with best practice standards and guidelines published by the Board.

Green Star SA

The Green Building Council of South Africa (GBCSA) was established in 2007 and has to date launched the Green Star SA Office rating tool for new office construction projects and base-building refurbishments.

Cape Town Partnership Energy-efficient Initiative

This is an initiative of a collaborative venture between the City of Cape Town and the Sustainability Institute in Stellenbosch. Seed funding for the project has been obtained from CORDAID, a large Dutch foundation.

The aim of the energy-efficient project is to "consolidate and fast-track the delivery of energy-efficiency projects in buildings in the Cape Town Central Business District (CBD) in a way that reduces operating costs for building owners, the consumption of grid electricity, and the total environmental impact of the Central Business District (CBD). A longer term aim is to redirect a proportion of the savings into pro-poor infrastructure development and the establishment of a self-financed agency to manage energy-efficiency projects within the Central Business District (CBD). The project will also investigate the possibility of implementing energy-efficient equipment on new buildings or buildings undergoing complete refurbishment."

2.5 Summary

In closing, managing natural resources can be viewed as a means toward sustainable production and consumption cycles in the built environment. This efficient use of resources can be aligned with the concept of design for sustainability through implementing PSS to attain healthy indoor environments. The focus of occupants and their relationship with IEQ can be instrumental in designing better systems. These systems depend on the positive interaction between various stakeholders. These interactions through SOPs and the implementing of ubuntu and B*atho Pele* principles can be part of what derives public and social entrepreneurship. The next chapter takes these areas into consideration in assessing how a chosen case study has dealt with retro-fitting their office workplace. The interrelations of the occupants with their environment and the effect of knowledge transfer through social and industry collaboration is a subject of interest in this research study.

CHAPTER THREE

RESEARCH APPROACH

3.1 Introduction

Design is about people and their surroundings, placing people first in every endeavour. To better understand how and why occupants of a space interact in a certain way with their environment, a research approach that is based on a subjective stance is used. As stated by Creswell (2007:54)"The subjective view of the world derives from the assumption that while the social world is perceived as external to individual cognition, it is made up names, concepts and labels that are social and historical creations – human-constructed entities."

As discussed in the previous chapter, these human constructed entities can be seen as governance bodies. In the office workplace governance is an economic, environmental and social endeavour. These can include: social clubs, collaborative investment groups or environmental teams. Subsequently, in-order to fully understand how these social networks impact the design of the workplace, a qualitative research method was chosen.

These research aspects were seen to be viable in the chosen case study at the Central Business District (CBD) offices of Basileus Capital.

3.2 Qualitative research design

3.2.1 Ontological perspective

Ontology is the study of nature or reality. The subjective view of the world derives from the assumption that the social world is perceived as external to individual cognition (Creswell, 2007). The utility of these entities is based upon their convenience as tools for describing, making sense of and negotiating the external world. Therefore, in our study the research will centre on the occupant as the creator of the reality in the office workplace. To thus better understand the forces behind the choices of interior environmental systems, the well-being of the occupant as a point of departure will be taken. The ability of the said occupant to utilise social networks to communicate with the external forces that enact policies and laws that govern the physical components in the office space will be discussed. Therefore a qualitative research design is the preferred outline to follow in assessing these social issues.

Burrell and Morgan (1979) state that qualitative research paradigm focuses on the social construction of people's ideas and concepts - how and why they interact with each other, and their motives and relationships. It is assumed that reality consists of an individual's mental constructions of the objects with which she/he engages, and that the engagement impacts on the observer and the situation being observed. In the case of the office workplace these interactions are between the occupant and the interior environmental systems. These would also include devices implemented to better access the usage of energy by the occupants when in the office. The research will therefore be more concerned with how the occupants view the sustainable measuring devices and components. Simultaneously, the relationship between the industry professionals and the policies that govern these components will be

discussed. The social networks created by the government and the non-governmental bodies to conduct sustainable audits will be accessed in relation to their impact on the awareness of the occupants.

Burrell and Morgan (1979) also refer to qualitative research as being about 'deeper' meanings of social actions; how these are interpreted, understood and approached by individuals and groups and how they have been shaped over time by a series of social, political, cultural, economic, ethnic and gender factors and then crystallised into a series of structures that are taken as 'real'. The external world is 'real' because that is how we have constructed it to be and how we experience it. In so saying, awareness in one group can cause change in the wider society. Design can then be used to introduce change in the office workplace through involving the occupants' views in the design process. In order to do this one must first understand the position of the actors in the network and their inter-relationships.

The implication is that human life can only be understood from within and not as some form of external reality. Social life and reality as constructed entities are their purely human products and the human mind is the purposive source or origin of meaning. The social world does not exist independently of the human mind and is not predetermined by some independent law of nature. 'Reality' as portrayed by qualitative researchers therefore tends to follow the constructivist use that reality is a social construction; it accepts that the researcher cannot be separated from the research; it asserts that research findings are created rather than discovered. Truth is therefore not an objective phenomenon that exists independently of the researcher (Marshall & Rossman, 2006).

3.3 Epistemological stance

The proposed study will follow an interpretivist-constructivist stance. In this research concept the foreground is the meaning that individuals or communities assign to their experience. (Mouton, 2001)

Interpretive studies generally attempt to understand phenomena through the meanings that people assign to them. An insert from Maree (2007) states that; Human life can only be understood from within; Social Life is a distinctively a human product; the human mind is the purposive source or origin of meaning. Epistemology relates to how things can be known – how truths, facts or physical laws, if they do exist, can be discovered and disclosed. It therefore looks at how one knows reality, the method for knowing the nature of reality, or how one comes to know reality - it assumes a relationship between the knower and the known (McNeill, 1985). This relationship is articulated in the research through interaction that is geared toward creating awareness within the groups that form the network in the design process.

Qualitative researchers believe that the world is made up of people with their own assumptions, intentions, attitudes, beliefs and values and that the way of knowing reality is by exploring the experience of others regarding a specific phenomenon-an attempt to see how others have constructed reality by asking about it (McNeill, 1985). Therefore, to better understand how the occupants' awareness in relation to their

space and the components that constitutes it, we engage with them. Thus using a qualitative approach, the research will endeavour to ascertain the influence or lack thereof of the occupants' view in the design process of the office workplace. Qualitative research therefore acknowledges an interactive relationship between the experience and how they have constructed reality based on those experiences. These personal experiences, beliefs and value-laden narratives are biased and subjective, but qualitative research accepts them as true for those who have lived through the experiences. The stories, experiences and voices of the respondents are the mediums through which we explore and understand (know) reality (McNeill, 1985).

3.4 Research method – case study research

Case study research can be used to understand a real-life phenomenon in depth, but such understanding encompasses important contextual conditions - because they were highly pertinent to your phenomenon of study. Because the phenomenon and context are not always distinguishable in real-life situations, other technical characteristics, including data collection and data analysis strategies became part of what defines a case study (Marshall and Rossman, 2006).

To study the phenomenon of the influence that occupants can exert to interior design in context to indoor environmental quality, a single case was chosen. It is as stated by Lee (2007:9) that:

> *A larger number of case studies with favourable results, just like a larger number of experiments with favourable results, do not provide any greater 'proof' that the theory being tested is correct. We may never prove a theory to be true; we may only show it to be false, or not yet false. And when the theory fails, the single case or single experiment is sufficient to do this.*

3.5 Case study protocol

Sampling

The unit of analysis was chosen using a purposive sampling technique. This was done in order to focus the research on active members of the private sector of business who align their work environments with sustainability principles.

Overview of the case study project

The organisation under consideration is Basileus Capital, young equity company whose competencies are in investing in local entrepreneurs in industrial and natural resource ventures. Basileus Capital is situated in the heart of Cape Town's CBD at the corner of Long Street and Hans Stridjom Street within the heart of the Icon building, taking up a space of two floor levels are the contemporary and modern offices that house the company's 36 employees.

Objectives

The aim of the study is, to ascertain the role and importance of the occupant to the conceptualisation of the office workplace's interior environmental systems. Within the design of these systems is the overarching principle of embedding sustainability in the energy use and considering occupant well-being. The objectives of the case study research are as follows:

- Review the underlying factors in DfS that have seen to the radical change of design approach to introduce sustainability into the office workplace design.
- Investigate the influence of occupant awareness to PSS initiatives in the installation of the interior environmental systems in the office workplace design, currently in Cape Town.
- Extrapolate design characteristics in modern office designs that have been influenced by technological advancements: solution oriented partnerships.

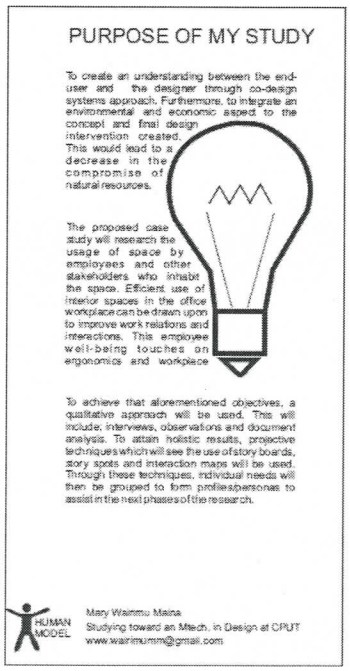
Case study issues

The company has recently between September 2009 and March 2010, retro-fitted the lighting in their office workplace. This made the organisation a preferred case study for analysing the behavioural changes of occupants in an office workplace that has retro-fitted their building.

Field procedure

Presentation of credentials

This involved introducing the research topic to the occupants in the office workplace. Through the distribution of a pamphlet shown below, appended at the end of the document, the occupant was given an overview of their proposed interaction with the investigator.



Appendix A: Introduction of research topic to case study site (author's construct, 2010)

Access to the case study site

An ethics consent form clearly stating the objectives, goals and desired outcomes of the research were tabled out for a contact person to review and sign. This was to ascertain that the participants of the research are informed of the investigator's intentions and their voluntary participation in the research study. The consent is attached as part of appendix A.

Sources of data and procedural reminders

The source of data needed for the case study will be acquired from the occupants of the office. This will include only the employees of the organisation who have been designated an office at the case study site.

Case study questions

The research question as stipulated in the introduction is as follows:
How does the occupants' awareness of the principles in DfS improve the relationship between the designer and the occupant of the office workplace?
This led to the subsequent sub-questions:

a. *How can occupant awareness of principles in DfS influence the design of the office workplace?*
b. *How do technical advances in lighting, thermal comfort and acoustics create new opportunities for meeting functional, aesthetic and sustainable objectives in creating office spaces, and how can office design accommodate the changes?*
c. *How can the principles of DfS – economic, social and environmental – be incorporated into the office design and the organisation's governance to encourage knowledge transfer within the social networks?*

The propositions of this study are;

- The client (who in this case is the proprietor of the organisation) installs features related to DfS in their offices because of their personal preferences.
- The occupants within the junior ranks in the organisation's hierarchy may not be aware of the implementation of DfS principles in the interior environmental systems.
- The client has installed technologically advanced equipment in their office spaces without being privy to the technical background of the said systems.

Consequently, to align the desired outcome of the research with the information to be gathered from the participants, Yin's (2009) level of questions was applied to the data collection strategy. Therefore, accordingly a level 1 question is asked directly to the interviewee; verbal line of inquiry, while level 2 questions are asked of the individual case to the investigator; mental line of inquiry. Figure 3.9 tabulates the verbal line of inquiry and mental line of inquiry in addition to suggesting potential sources of data.

		General staff	Junior associates	Senior associates		
Verbal line of inquiry	Awareness of indoor environmental system's advancements	X	X	X	Mental line of inquiry	Are the occupants involved in the selection of the systems?
	Use of indoor environmental systems		X	X		Do the occupants view any value in the placement of the systems?
	Implementation of indoor environmental systems			X		How is the engagement between the occupants and other actors in the network?

Figure 3.9: Table of inquiry at the case study site

(author's construct, 2010)

A guide for the case study report

The case study report will be embedded in the data analysis, where a discourse of the data collected and industry perceptions will be done. Using 'activity theory' as a lens to review social change in the network of the built environment, sustainable issues as seen from the occupant's perspective will be addressed.

All interviews, observations and journaling transcribed for the use of the case study research will be coded to ensure participants' privacy. The transcribed data will append to the document.

Collecting case study evidence

Eisenhardt's replication logic in theory building from case studies is similar to maintaining a chain of evidence from Yin (2009:123)

In a single-case study, the challenge of presenting rich qualitative data is readily addressed by simply presenting a relatively complete rendering of the story within the text. The story typically consists of narrative that is interspersed with quotations from key informants and other supporting evidence. The story is then intertwined with the theory to demonstrate the close connection between empirical evidence and emergent theory. This intertwining keeps both theory and evidence at the forefront of the paper... Write the theory in multiple ways. First, sketch the emergent theory in the introduction. Then, in the body of paper, write each proposition (implicitly or explicitly stated), and link it to the supporting empirical evidence for each construct and for the proposed relationship between the constructs. When the research is well done, the propositions will be consistent with most (or even all) of the cases because the researcher has effectively "pattern-matched" between theory and data. It is also crucial to write the underlying theoretical arguments that provide the logical link between the constructs within a proposition. These arguments can be drawn from

case evidence (e.g., an informant explaining the logic) and/or from more detached logic (Eisenhardt & Graebner, 2007: 29).

Three principles of data collection

1. **Use multiple sources of evidence**

Multiple sources of evidence are used to crystallise information in case study research. This triangulation of data according to Patton (2002) can be discussed in four types when doing evaluation, the triangulation:

1) Of data sources (data triangulation)
2) Of perspectives (theory triangulation)
3) Of methods (methodological triangulation)
4) Among different evaluators (investigator triangulation)

In the case study research undertaken the first three types of triangulation were used in the collection of data.

2. **Case study database**

This included; a data or evidentiary base; and a report of the investigator either in article, book or report form. The database is described in four components; notes, documents, tabular materials and narratives.

3. **Maintain a chain of evidence**

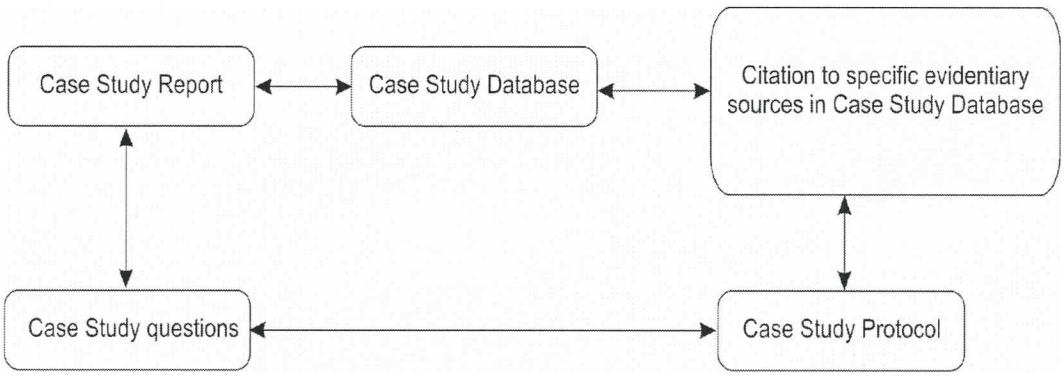


Figure 3.9: Chain of evidence

(Yin, 2009:45)

The chain of evidence as shown in Figure 3.10 is a tool that can be used to address the methodological problem of determining construct validity, thereby increasing the overall quality of the case study (Yin, 2009:25).

The report itself should have made sufficient citation to the relevant portions of the case study database by for example; citing specific documents, interviews or observations. Second the database upon inspection should reveal the actual evidence and also indicate the circumstances under which the evidence was

collected in this case the time and place of an interview. Third these circumstances should be constraint with specific procedures and questions contained in the case study protocol to show that the data collection has followed the procedures stipulated by the protocol. Finally a reading of the protocol should indicate a link between the content of the protocol and the initial study questions.

3.6 Sources of evidence

These are adapted from Yin (2009) as guidelines for a case study research.

Interviews

During the unstructured interviews and in-depth interviews an interview schedule was appropriated to guide the conversation. This included both level 1 and 2 questions which are used in reference to Yin's (2009) principles of questioning interviewees. The level 1 question is asked directly to the interviewee; verbal line of inquiry, while level 2 questions are asked of the individual case; mental line of inquiry.

Observations

Direct observations: these can range from formal to casual data collection activities. This can involve observation of meetings, side walk activities, factory work among others. Less formally, direct observations might be made throughout a field trip visit, including those occasions during which other evidence such as that from interviews is being collected (Silverman, 1993).

The observations done included formal observations of: shared offices, single cell offices and transitional spaces. Additionally, there were informal observations done during interviews and journaling.

Document analysis

Analysis of schematic and construction drawings as well as specifications for interior finishes.

Physical artefacts

The technological devices placed to enhance indoor environment were observed when in use by the occupants. Concurrently, observations of models introduced to reduce the use of natural resources in the amenities area were made.

Archival records

Site allocation maps which include: Street maps, geographical (contour) map of the building's site were accessed. This was to verify the builder's use of the land to efficiently utilise the natural orientation when designing the building.

Journaling

'Full descriptions of ones own experience which can be bracketed off from those of the interviewees' is one technique that can be used to ascertain 'construct validity by ensuring different sources are differentiated'. This self-examination permits the researcher to gain clarity from their own misconceptions, and 'is part of an ongoing process rather than a single fixed event' (Marshall & Rossman, 2006; Yin, 2009).

Central to building theory from case studies is replication logic (Eisenhardt, 1989b). That is, each case serves as a distinct experiment that stands on its own as an analytic unit. Like a series of related laboratory experiments, multiple cases are discrete experiments that serve as replications, contrasts, and extensions to the emerging theory (Yin, 1994). The theory-building process occurs via recursive cycling among the case data, emerging theory, and later, extant literature.

Data collection in the case study was iterative to ensure the case's validity. To sequence this cyclic process the use of a matrix tabulating the sources of evidence against the case study questions was used.

		Interviews	Observations	Document analysis	Archival records	Physical artefacts	Journaling
THEORY	Awareness of indoor environmental system's advancements (IES)	X	X			X	X
PRACTICE	Use of indoor environmental systems(IES)	X	X	X			X
POLICY	Implementation of indoor environmental systems (IES)	X		X	X	X	

Figure 3.10: Source of evidence and case study matrix (author's construct).

During the case study, Bluyssen's (2010:816) framework for health and comfort as shown below was adopted. The verbal line of inquiry was then articulated using the framework to guide the data collection process.

Performance indices integrating (conscious and unconscious) health and comfort aspects	An indoor environment that guarantees a high basic level of health and comfort	Performance on demand, anticipating wishes and needs during different activities and over time	End-user focused Multi-disciplinary

Figure 3.11: Framework for health and comfort (Bluyssen, 2010: 816)

Engagement with occupants in the design process (co-design)

This involved the ascertaining of knowledge about indoor environmental systems. This was done through interviews, observations, physical artefacts and journaling.

The basis of this was to perform an informal post-occupancy audit of the workplace after the installation of the energy saving lighting devices.

Source of evidence	Location	Date	Relevance to research
Interviews	Floor 2: Icon Building. Corner of Long & Hans Stridjom St. Cape Town.	March-May 2010	To acquire first hand information of the occupants' perspectives of their environment
Observation	Floor 2 and 3: Icon Building. Corner of Long & Hans Stridjom St. Cape Town.	February-July 2010	To observe the occupants of the office using the devices related to IEQ
Physical artefacts	Floor 3: Icon building. Corner of Long & Hans Stridjom St. Cape Town.	February 2010	To familiarise with the office layout and the adjacencies of activity areas.
Journaling	Floor 2 and 3: Icon Building. Corner of Long & Hans Stridjom St. Cape Town.	February- July 2010	To note down the perceptions drawn in-order to separate them from observed data.

Figure 3.12: Matrix of engagement with occupants

(author's construct, 2010)

Socio-technical assemblages in IES

This involved interviews, observations, document analysis and journaling. These were performed to ascertain the technology used to ensure efficient use of energy; the technical detail passed on to the client and thereafter the occupant from the industry professional and to note the impact of the any, or lack thereof, of knowledge transfer. The main indicator in IEQ observed was; visual quality, as this was the aspect retro-fitted in the office workplace.

Source of evidence	Location	Date	Relevance to research
Interviews	Floor 2: Icon Building. Corner of Long & Hans Stridjom St. Cape Town.	March-May 2010	To acquire first hand information on how technology has changed the engagement between the occupants and the office workplace.
Observation	Floor 2 and 3: Icon Building. Corner of Long & Hans Stridjom St. Cape Town.	February-July 2010	To observe how well the devices installed are utilised by the occupants.

Source of evidence	Location	Date	Relevance to research
Document analysis	Floor 3: Icon building. Corner of Long & Hans Stridjom St. Cape Town.	February 2010	To document the information availed to the client by the designer or engineer who installed the systems for better IEQ
Journaling	Floor 2 and 3: Icon Building. Corner of Long & Hans Stridjom St. Cape Town.	February- July 2010	To note down the salient engagements observed during the interviews and observations.

Figure 3.13: Matrix of socio-technical assemblages

(author's construct, 2010)

Social innovation: collaborative governance networks through Ubuntu

This involved interviews, document analysis, physical artefacts and archival records in bringing to the fore interdependencies between key actors in the built environment network.

Source of evidence	Location	Date	Relevance to research
Interviews	Floor 2: Icon Building. Corner of Long & Hans Stridjom St. Cape Town.	March-May 2010	To acquire first hand information of any social communities in the office
Document analysis	Floor 2 and 3: Icon Building. Corner of Long & Hans Stridjom St. Cape Town.	February-July 2010	To clarify if the occupants have a social network and how active it is
Physical artefacts	Floor 3: Icon building. Corner of Long & Hans Stridjom St. Cape Town.	February 2010	To familiarise with the office layout and the adjacencies of activity areas.
Archival records	Floor 2 and 3: Icon Building. Corner of Long & Hans Stridjom St. Cape Town.	February- July 2010	To note down other relates communities affiliated to the organisation

Figure 3.14: Matrix of social innovation: collaborative governance networks through ubuntu (author's construct, 2010)

3.7 Rationale behind data analysis procedure

The analysis of the information gathered during the fieldwork in a case study is a crucial part of the process of research. This will be determined by the questions asked at the start of the research process. The ability to define the purpose of the research in terms of whether the result is meant to describe, explain or define is important to the choice of analysis tool to be utilised. In this case due to the subjective nature of the research design as a whole, and its concerns of the 'person' as opposed to the process or the object, thematic coding and thereafter, thematic analysis will be used to draw out nuances that differentiate the various positions and perspectives of stakeholders in the built environment. Thematic coding is a form of

pattern recognition within the data, where emerging themes become the categories for analysis. This approach complemented the research question by following the process of deductive thematic analysis while allowing for themes to emerge direct from the data using inductive coding. The coding process involved recognizing (seeing) an important moment and encoding it (seeing it as something) prior to a process of interpretation (Boyatzis, 1998). A "good code" is one that captures the qualitative richness of the phenomenon (*ibid*). Encoding the information organizes the data to identify and develop themes from them. He defined a theme as "a pattern in the information that at minimum describes and organises the possible observations and at maximum interprets aspects of the phenomenon" (Boyatzis, 1998:161).

To assist in this analysis, activity theory will be employed as a tool with which to study social change. Social change as it relates to behavioural change of the occupant in the office workplace is seen to a pivotal step in the implementation of sustainability principles in the design of office buildings. These techniques used to access occupant experiences in an efficiently sustainable building will assist in describing their interaction with the interior environmental systems.

3.8 Pre-coding procedures

In addition to the inductive approach of Boyatzis (1998), in our analysis of the text in this study, we also used a template approach, as outlined by Crabtree and Miller (1999). This involved a template in the form of codes from a codebook to be applied as a means of organizing text for subsequent interpretation. When using a template, a researcher defines the template (or codebook) before commencing an in-depth analysis of the data. The codebook is sometimes based on a preliminary scanning of the text, but for this study, the template was developed a priori, based on the research questions and the theoretical framework articulated in the case study protocol.

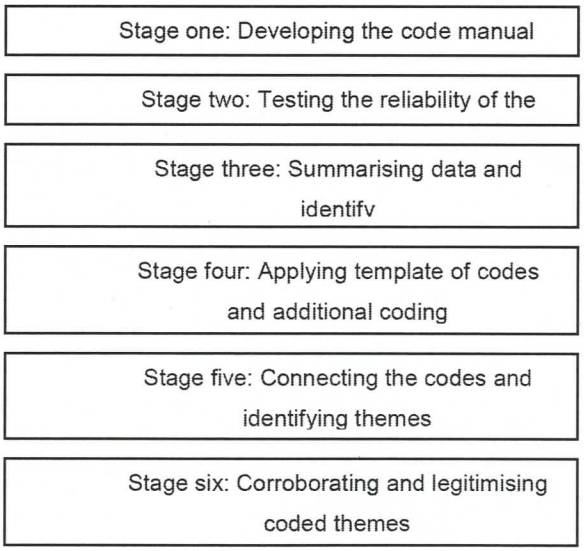


Figure 3.15: Stages undertaken to code data (Crabtree & Miller, 1999)

Stage one: Developing the code manual

The choice of a code manual for the study was important, because it served as a data management tool for organizing segments of similar or related text to assist in interpretation (Crabtree & Miller, 1999). The use of a template provided a clear trail of evidence for the credibility of the study.

For this study, codes were written with reference to Boyatzis (1998:31) and identified by

1. The code label or name,
2. The definition of what the theme concerns, and
3. A description of how to know when the theme occurs.

THEME	PROPERTY	CODE	EXAMPLE	DEFINTION	DESCRIPTION
Familiarity with concepts of EEB	Knowledge	KNW	...then there is the construction, maintenance and operation of a **building in line with sustainable global practices** in terms of green sources. So that would entail: **water usage, temperature control, the use of your lights, carbon emissions**...	Knowledge of sustainability	Related to the principles of EEB.
	Social factors	SFC	The one thing is the lights, they have motion sensors... Though they seem to go on even though you pass by an empty office. **Yeah...but you can close the door**	Curiosity of the general workings of sustainability devices.	General curiosity to why the devices work as they do and changes in habits of the occupant and the resulting effect on the devices.
	Personal factors	PFC	And I don't need the actual heat; **I wear a jersey in any case, so I leave it off**. But that's only in winter, summer it's on all the time. **Other then when I go home I switch it off**.	Desire to apply knowledge	Declaration of transmuting interest into tangible input in the office
	Proactive factors	PRF	**I don't use it (air-con), unless it is exceptionally hot or cold.** Yes, well the temperature suits me just fine.	Action through tangible input	Actual involvement in proactive EEB initiatives in the workplace.
Identification of occupants' experiences	Physical components	PHC	...if a person comes in at around 2200hrs and switches on the lights then **after an hour they will automatically go off, which is quite a nice feature.**	Which devices are used	Physical components that have been retrofitted or replaced for more efficient ones.
	Temporal factors	TFC	When I make coffee I **use the boiler all the time** instead of heating water in the kettle.	How often are the devices used	Identification of relative use of EEB components
	Spatial factors	SPC	**Office spaces** as opposed to shared communal areas.	Where in the office space are they used more often	Identification of spaces where EEB components are primarily placed
	Iterative factors	IFC	Water: by using the **filter and putting your water in a bottle**; and **the boiler when making coffee**	When are they most used	Declaration of reuse of components in everyday workplace life
Engagement of actor networks in the built environment	Personal interest	PER	No, **I have a bottle so I just fill it** from the **water filter**, coz **I have one at home as well**.	Interest in applying sustainability principles	Evidence of sustainability principles being applied.
	Industry interest	IND	The **lighting engineer suggested the retro-fitted sensors** for the purpose of being efficient in the long term for the company...	Professionals interested in EEB devices and components	Evidence of sustainability principles being applied
	Government involvement	GOV	There are also **no incentives offered by the government to motivate privateers**	Applied government interest in EEB	Evidence of sustainability principles being applied
	Industry groups	IGP		Industry group interest in EEB	Evidence of sustainability principles being applied
Integrated and interdependent approaches in EEB	Technical knowledge	TKN	So that would entail: **water usage, temperature control, the use of your lights, carbon emissions**	The technical factors that drive EEB	Specifications that carry ideology of EEB in devices and components
	Political factors	POL		Factors relating to how informal power structures are formed	Structures' responses to issues relating to EEB
	Collaborative initiatives	COL	...idea that stemmed from the lighting engineer... **This will reflect both on the economic and environmental aspects for the organisation**.	Specific interaction of different groups with a common interest toward EEBs.	Examples stated of involvement of a group in communicating EEB principles
	Enacted laws and policies	ELP	There is also the fact that the **penalties felt from ESKOM**	Factors to how formal power structures are formed	Structure's response to issues relating to EEB

Figure 3.16: adaptation of Crabtree and Miller's thematic matrix (author's construct)

3.9 Critique of analysis tools

Benefits of using Thematic Analysis and Activity theory as analysis tools

The office workplace is an environment of intricate social activities that can be seen to intermingle with each other on various levels. These levels of interaction can be derived using interviews, observations and journaling as empirical evidence instruments. *By using Thematic Analysis method these social activities can be categorised and the subjects placed into relevant collections during analysis of data.* Activity theory can then be used as a lens to observe these social activities that lead to social change. This is due to its ability to see activity as a collective phenomenon that is brought about by various actors in a community.

Shortcomings of using Thematic Analysis and Activity theory as analysis tools

As tools that deal with filtering out peripheral information and dealing with data that can be categorised and grouped sufficiently, these tools can cause some information to be underutilised. Subsequently, gaps that may occur due to this will be outlined in order to be true to the research's liability.

Quality of data and gaps

The information was collected using the following research instruments: interviews, observations, physical artefacts and journaling. Simultaneously, the chain of evidence as outlined by Yin as seen in Figure 4 (2009:45) was be used to validate and authenticate the data collected to minimise errors. In addition, unempirical data was used in the compilation of archival records and documents analysis.

Some of the gaps in the data include; the unavailability of the proprietors of the organisation to sit for an interview or fill in a questionnaire, the inability to perform awareness campaigns due to lack of funds.

3.10 Summary

In this chapter, the epistemological stance which will guide the reminder of the research was detailed. Within these theoretical boundaries a method seen to fulfil the desired outcomes of the research questions was chosen. The case study research method was then used to itemise the procedural structure of the data collection process under the 'case study protocol' (Yin, 2009:40).

CHAPTER FOUR

DATA ANALYSIS

4.1 Introduction

Thematic analysis consists of deriving codes according to the themes/concepts that are seen to occur in data (Crabtree and Miller, 1999). The themes in this analysis were directly linked to the research questions articulated in the Case Study Protocol. These themes were then grouped into the occurring categories observed in processing sustainability principles in design processes. The properties of the themes are sections addressing the different state of mind of the stakeholders whilst engaging with an Energy-Efficient Building (EEB).

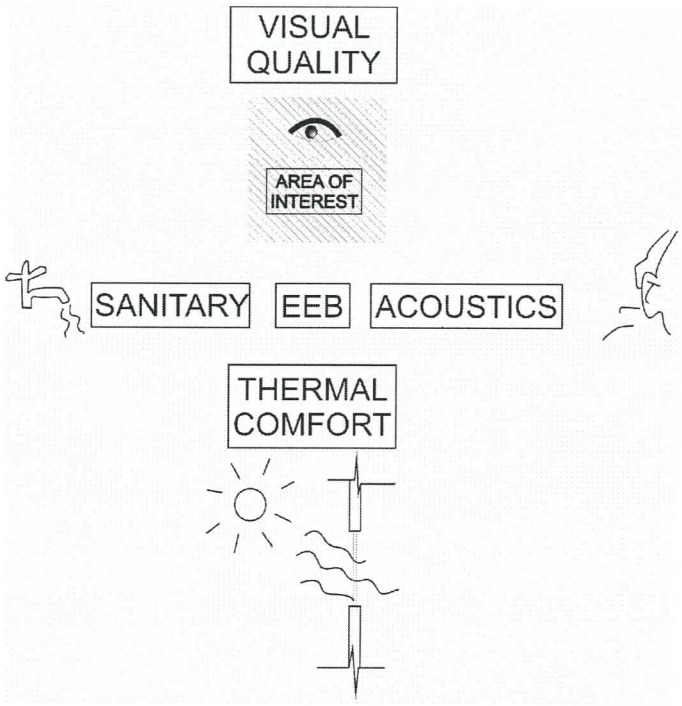


Figure 4.17: Interior Environmental systems in an Energy-Efficient Building (author's construct)

Using a narrative format and Activity theory as a lens to observe social change, the concepts of sustainability in an EEB will be addressed as they arise in context to visual quality depicted in figure 4.17. This is due to the fact that this aspect of the interior environmental systems is the one addressed by the case study chosen. As retro-fitting is a labour intensive challenge to existing buildings in Cape Town's Central Business District, converting buildings into sustainable environments is done in phases.

Figures 4.18 and 4.19 are a plan representation of the building taken into account in the case study that was outlined in the previous chapter.

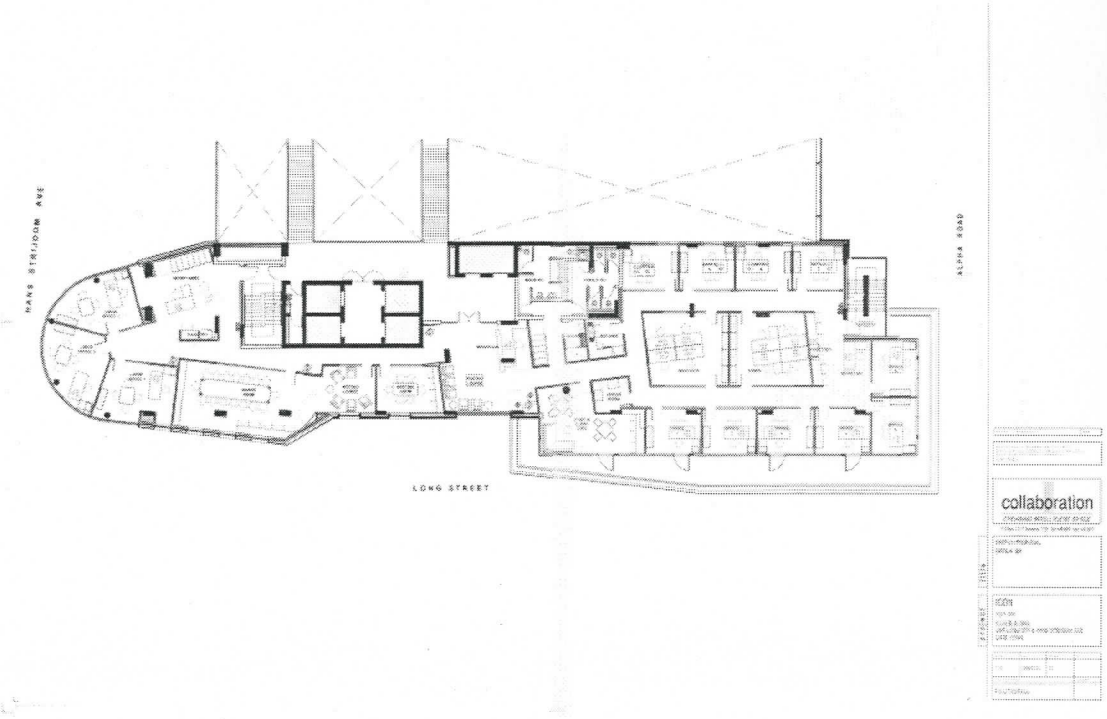


Figure 4.18: Ground floor plan of Basileus office

(Basileus, 2009)

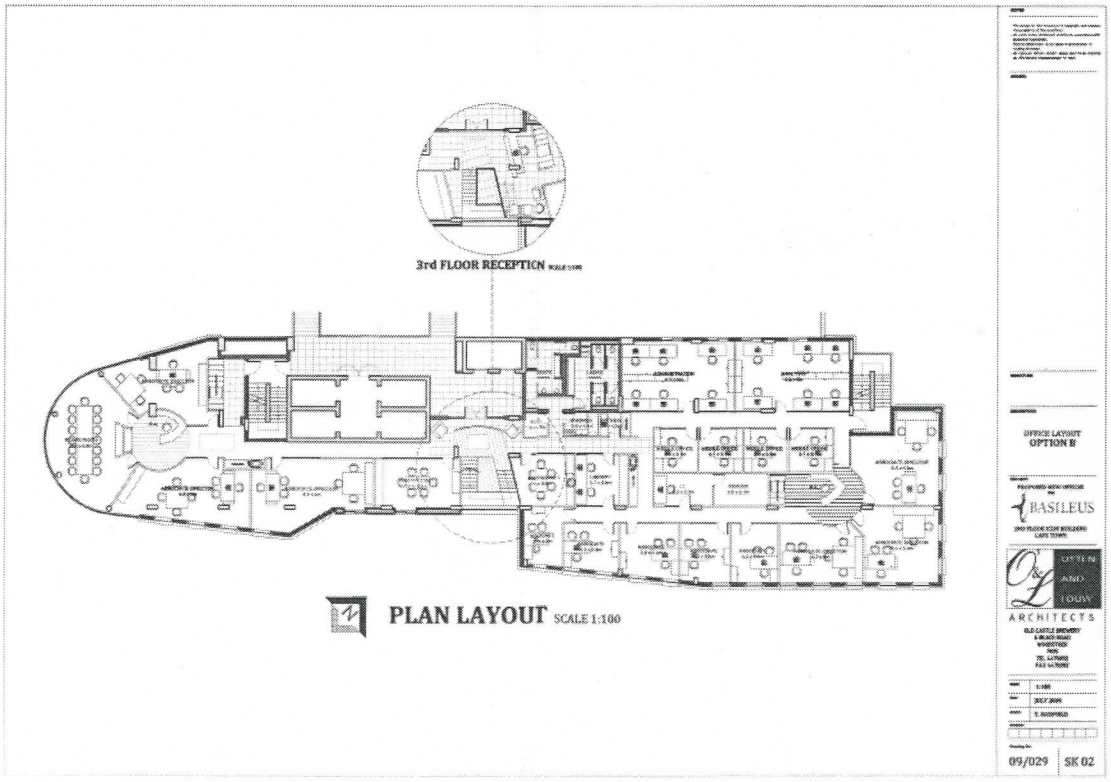


Figure 4.19: Upper floor plan of Basileus office

(Basileus, 2008)

4.2 Activity theory: a lens to observe social change

As stated in the previous chapter, activity theory is based on the assumption that man and artefacts form a dual process of shaping and being shaped by its social and physical environment (Engestrőm, 2001) to produce an outcome. It can therefore be said in this instance that the artefact and therefore the physical environment is the interior environmental systems in the office workplace adjusted for better efficiencies. The occupant's experience of these artefacts in the office is the social aspect being observed.

In Activity Theory, the unit of analysis is an activity. Activity consists of actions which are conscious behaviours with defined goals, performed by individuals or a group. To further understand these activities the groups have been divided into: practice, policy and industry. This is done to facilitate the stakeholder engagement to be derived from the interaction between these stated groups. *Actions* are always connected to a frame of reference created by a corresponding activity. The frame of reference is therefore seen in this instance as sustainability principles in an EEB. The actions connected to these principles are performed at different levels by the subjects within the groups. These levels are created by using the level of technical knowledge and transfer of this knowledge from one individual to the next. The subject follows procedures called *operations* when doing a certain task. The tasks are then aligned to what purpose they serve in terms of facilitating transition to an EEB. All the elements must fit together in a systemic way, characterised as the mode of operation of the activity. Operations can be seen as actions to start with, but as actions are repeatedly done, they become operations, as illustrated in Figure. 4.20 (Engestrőm, 1987; Korpela, 2004; Kuutti, 1991).

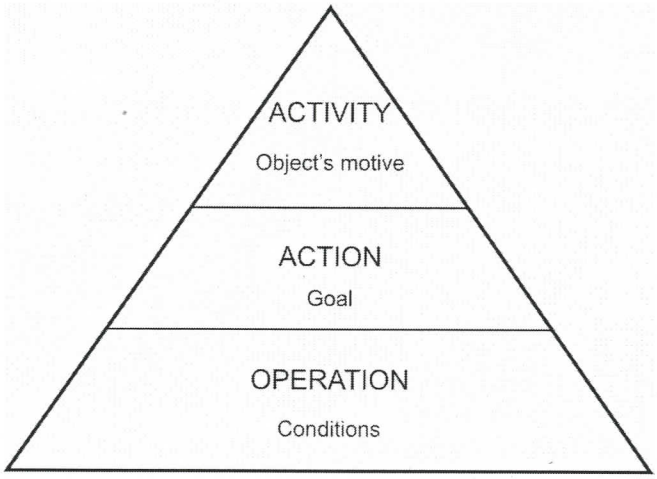


Figure 4.20: Leontiv's activity theory triangle
(Mwanza, 2002:58)

4.3 Basic Principles of Activity Theory

An activity is composed of a *subject, object, actions* and an *operation*. Each object of an activity is brought into existence by a need or a desire to which the activity is an answer. In this respect the object is then seen as the components and features that enable sustainable use of resources in an EEB. These components are brought about by the desire of the client to engage with the concept of sustainability at a

tangible level. In so doing the building's occupants are exposed to the resultant environment of implementing sustainability principles in a workplace raising the issue of their experiences in these spaces. An object can therefore be said to be concrete or elusive, like a plan or a common idea. A subject is a person or a group engaged in an activity, which as mentioned before are the actors in the groups: practice, industry and policy. An object is motivated by the subject, which motivates an activity. The end result of an activity is an *outcome*. An activity is, therefore, a collective phenomenon. This idea brings into existence what Engestrőm (2001) called an activity system. Such a system connects the *subject*, *object* and the *community* which are mediated by *tools, rules* and *division of labour* and can be represented as a meditational triangle construction as illustrated in Figure 4.21 (Mwanza, 2002).

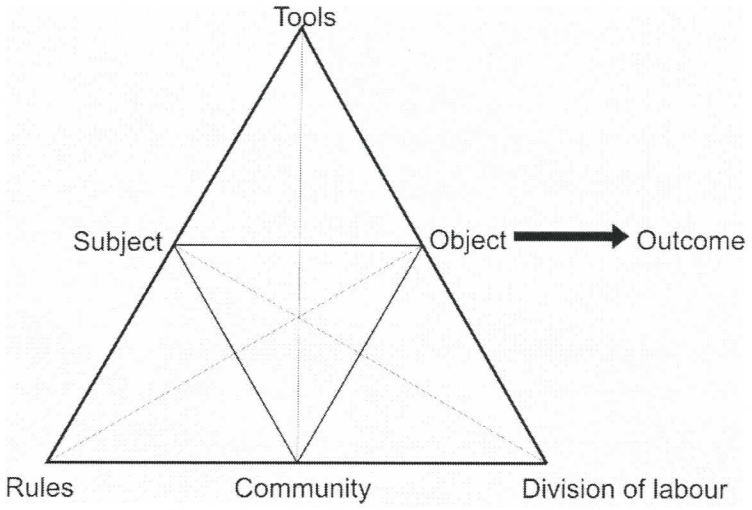


Figure 4.21: The meditational structure of an activity system (Engestrőm, 2001)

In context to the research problem which is based on occupants' experience of EEB in the workplace. Activity theory is seen as a tool that can be adapted to observe the complex interaction of the groups and their influences on an EEB. Within these interactions the various aspects illustrated in the *activity system* above in Figure 4.21, can be used to promote and create a platform for improved interaction and knowledge transfer.

Therefore, by using thematic analysis to derive meaning from the data and create a systematic format for data coding. Activity theory can in conjunction, be used to track the process of knowledge transfer from one group to the next noting the role of the occupant as the subject engaging with the object to produce an outcome. The occupant's experience is then at the core of the process of reaching an outcome that will result in an EEB that addresses a healthy and comfortable environment.

4.4 Creating meaning from collected data

Concepts of EEB are seen to be derived from various schools of thought but are primarily known to deal with; social, economic and environmental factors (UNEP, 2006; Manzini, 2004; McDonough, 2008). In this instance our primary interest is to observe how the social aspect, as it related to the occupants' experience, is affected

by the economic and environmental aspects of sustainability in office buildings as shown in Table 2. To this end, the data collected is grouped according to the perceived mental states of the stakeholders in this engagement. These groups are: *awareness*, *utility*, *network* and *implementation* in an EEB.

Collected data

The occupant and client form the micro-environment, while the lighting professional and the government representatives form the micro-environment interviewed in the built industry illustrated below on Figure. 4.22.

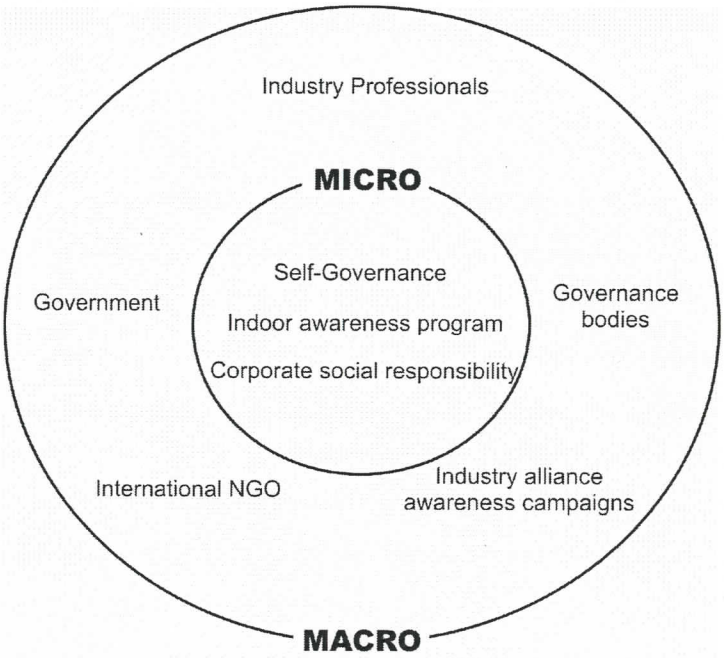


Figure 4.22: Interaction map depicting micro and macro environments (author's construct, 2010)

4.5 Awareness: Familiarity with concepts of Energy Efficient Buildings (EEB)

Within the theme of familiarity with concepts of EEB, awareness is a departure point to sustainable conscious behaviour within the stakeholder engagement. To further understand the awareness created within the stakeholders, the properties; knowledge, social factors, personal factors and proactive factors will be used to address the issue. These properties were derived inductively from scanning the transcripts and linking the arising issues with the research questions articulated in previous chapters. This review of the occupants' experience of the environment created in an EEB can be viewed as a *post-occupancy audit*. This audit was done to frame the effects of sustainability principles on the occupants' environment. Within this framework of a post-occupancy audit the properties were used to articulate the engagement of the occupant and the devices installed to perpetuate energy efficiencies in the office building. This is illustrated in Figure 4.23.

Analysis of awareness as seen in the theme: familiarity with principles of EEB

a.

PROPERTY (variable)	CODE	THEME (unit of analysis) Familiarity with principles of Energy Efficient Buildings (EEB)		
		OCCUPANT (PRACTICE)	LIGHTING PROFESSIONAL (INDUSTRY)	GOVERNMENT REPRESENTATIVE (POLICY)
Knowledge	KNW	...then there is the construction, maintenance and operation of a **building in line with sustainable global practices** in terms of green sources. So that would entail: **water usage, temperature control, the use of your lights, carbon emissions**...	The new laws in Europe, you can check, **they don't use incandescent at all** they are going fully on energy saving lamps.	...properly identified as we know all the synthetic stuff; and the fumes coming off; the noise, and that type of **pollution issue all this makes the indoor environment not always a safe and healthy work environment.**
Social factors	SFC	The one thing is the lights, they have motion sensors... Though they seem to go on even though you pass by an empty office. **Yeah...but you can close the door**	Every room, your radio, your blinds has an IP address ... But, like I said from a power consumption perspective, you will be saving. **Because you will be able to check what section is using...**	And where you have that it's a sensitivity issue, and that also it's not right which means **that the beam angle needs to be set**.
Personal factors	PFC	And I don't need the actual heat; **I wear a jersey in any case, so I leave it off**. But that's only in winter, summer it's on all the time. **Other then when I go home I switch it off**.	...the lamp is like R30. And for mine that I have had for like **6 yrs and I have never changed it**... it's pretty amazing and	...a **huge gap** between what the occupant/worker/**user is supposed to get and what the architect**/ department/ client **is buying**.
Proactive factors	PRF	**I don't use it (air-con), unless it is exceptionally hot or cold.** Yes, well the temperature suits me just fine.	I have the compact fluorescent for example in my kitchen...and **I was thinking to myself why didn't we change a bit earlier**? Because I have never once been bothered by it	... We have gone a step or two backwards in terms of the usage of resources and energy to make paper. But I have come to realise in my wok that the **paper issue is important.**

Figure 4.23: familiarity with principles of EEB

(author's construct)

b. Knowledge (KNW)

Definition: Knowledge of sustainability

Description: The ability of an actor within the networks to mention principles of EEB and confirm knowledge within the area of sustainability adapted for an innovative initiative. These initiatives have to be directly related to the enhancement of an office interior where occupants will be exposed to the change in environment.

Outline: The amount of knowledge possessed by the occupants in the building range from no information to a high degree of knowledge base. These differences were seen to occur in accordance to the hierarchy of organisational structure. The more senior staff being at the higher end of the awareness state of sustainability principles. According Anon 1_HB (2010) sustainability in a building should include "the construction,

line with sustainable global practices in terms of green sources. So that would entail: water usage, temperature control, the use of your lights, carbon emissions." This was indeed the case as they are responsible for the retro-fitting and consulting with the industry professional in relation to the implementing of new and efficient devices in the office workplace.

The industry professional was well informed in terms of technical information. This included the parts that constitute the systems needed to articulate an efficient lighting system in an interior environmental system. The knowledge was acquired from visits to international workshops and their corresponding shops especially in Europe. There was a lot of information from local luminaries' and light accessories manufactures. They offer lighting experts a set of pamphlets and booklets stating use, implementation and technological advancements in the sector. Due to this new information "industry professionals are able to implement and test these new devices so as to use first hand experience in their marketing strategies as seen in the showroom" (Anon 17_T, 2010).

The government sees that the properties that entail a safe and healthy interior environment fall under the jurisdiction of policy. "This is therefore the duty of the [proprietor or] client responsible for the design to ensure the occupants have a healthy and safe workplace" (Anon 16_V, 2010). This awareness of the pollution in the workplace by government officials who deal with environmental systems should ideally be communicated sequentially as policies are drawn and revisited.

b. Social factors (SFC)

Definition: Curiosity of the general workings of sustainability devices.

Description: This is general curiosity displayed by the occupants in context to the devices and components installed in their workplace. The individual seeking of an optimum result to the desired efficiency of the interior environmental systems installed.

Outline: The occupants of the single office cells have more leeway to "interact with the interior environmental systems" (Anon 6_J, 2010). This is because the shared spaces have their systems controlled from a central point. Due to this slight differences can be seen in the nuances they observe and try to adjust through different behavioural habits. These changes are a positive impact on how they use new and recurring information gathered from this interaction with the office space.

The industry professional in tandem with this growing interest from use groups to regulate the impact of changes in their interior environment is adapted into new technologies. The ability to perform scheduled checks by using the internet is a bold move in new interface interaction with one's physical environment. This is especially true as "these interactions can be observed from anywhere in the world by simply using an IP address" (Anon 17_T, 2010).

The government though implementing policies to govern these uses of natural resources in commercial buildings is "not as well informed of new methods of auditing the interior environment" (Anon 16_V, 2010). With their vast technical knowledge on the devices being implemented and the impact of government policy on other stakeholders, the government has a greater role to play in enhancing social collaboration between the various affected stakeholders.

c. Personal factors (PFC)

Definition: Desire to apply knowledge

Description: The desire to apply knowledge that the occupant has acquired from another activity environment e.g. home, gym, social club among others in the workplace

Outline: Personal choice of how an individual uses the interior environmental systems is seen to be closely related to their knowledge of sustainability principles. The more information the occupant has on the impact of their unchecked use of natural resources acquired from other areas of their life, the more efficient they use the devices. This awakening and impetus to make a conscious choice in behavioural changes makes an impact on the building's use of energy (Anon 11_ME, 2010).

The industry professional has through business knowledge and observing how well the devices work at the showroom, the ability to transfer the knowledge to their private spaces. These personal experiences work better than advertising done by the manufactures, whose technical jargon is not understood by the end user or client (Anon 17_T, 2010).

The government as the body that works with the policies that govern the products in the market can see the difference of what is meant to be there and what is. This heightened awareness is an important factor to help ascertain to what extent the manufactures and technical experts put to the fore the occupants needs. This is as opposed to recommending

devices that need secondary components or consultations with experts in the field (Anon 16_K, 2010).

d. Proactive factors (PRF)

Definition: Action through tangible input

Description: This is the tangible changes wrought by the occupant to further save energy in their workplace.

Outline: Dealing with the environment in terms of anticipating changes so as to adapt one's choice of clothing is one way to deal with efficient use of interior environmental systems in the workplace. The other choice is to not "habitually turn on, for example the air-conditioning" (Anon 1_HB, 2010). In most cases the environment in single cell offices can do without the assistance of air changes done by the air-conditioning system. This may not be the case where several occupants share a space. According to Anon 6_W (2010), "the air-con [should] have sensors where the temperature can be personalised and controlled individually.

As an industry professional, one may neglect to transfer the knowledge learnt from their professional area to their private space. The ability of one to take the initiative to adapt the energy saving principles that they trade in is not often seen. This separation of ones private and personal life should be bridged if the resulting behavioural change would have a positive effect on the environment.

In policy making and consideration of the conservation of natural resources, issues of higher technology surpassing the need for sustaining eco-systems should be addressed. The government can therefore play an important of bringing to the fore all three pillars of sustainability; that is economic, ecology and social. These pillars can be reassessed to attain a better production and consumption cycles.

4.6 Utility: Identification of occupant's experience

When general awareness has been ascertained in the various stakeholders, it is important to note which devices are used for how long and where they are situated in the building. This is used as a yard stick to gauge how effective the energy efficient initiative is.

The main aim of installing sustainable devices is not only to save resources but to inform occupants of efficient energy use. As these devices are promoted by both government and the private sector, it is imperative that the occupant understands their role. Not only does the occupant perpetuate the devices utility, but they also pose as a resource of improvements to the workplace energy efficiencies.

The properties derived from the theme are to inform the interaction between the occupant and the sustainable components and devices in the office workplace. This is clearly illustrated in figure 4.24.

PROPERTY (variable)	CODE	THEME (unit of analysis) Identification of occupant's experiences		
		OCCUPANT (PRACTICE)	LIGHTING PROFESSIONAL (INDUSTRY)	GOVERNMENT REPRESENTATIVE (POLICY)
Physical components	PHC	...if a person comes in at around 2200hrs and switches on the lights then **after an hour they will automatically go off, which is quite a nice feature.**	Because your DALY transformer is numbered, you will know the number on the circuit, and **you will know that the guy is pushing and using 250watts a day**	We have **a huge gap** between what the occupant/worker/user is supposed to get and what the architect/ department/ client is buying.
Temporal factors	TFC	When I make coffee I **use the boiler all the time** instead of heating water in the kettle.	And you can **control the whole house from a central point.**	Because the **dynamic is there** all that we need to do as building engineers is to design the space.
Spatial factors	SPF	**Individual office spaces** as opposed to shared communal areas.	The normal board...will be able to tell you what the **whole house consumption** is, you won't know what room consumption is.	Because the offices have been **converted from cellular offices** where we had people walking around with files
Iterative factors	IFC	Water: by using the **filter and putting your water in a bottle**; and **the boiler when making coffee**	...if you are **overseas, your computer has an IP address. Every room, your radio, your blinds has an IP address,** so he (client) is looking at it that way, you can also for example link up the irrigation system to the automation system.	But because nobody is really taking **an active interest** and no one knows about how to maintain a resource room and tell you that we have now bought a new book and this is where it is.

Figure 4.24: Identification of occupant's experiences (author's construct).

Analysis of Utility as seen in the theme: Identification of occupant's experience

a. Physical components (PHC)

Definition: Illustrate the devices are the used.

Description: These are the components and devices installed by the industry professional under the approval of the client into the office workplace.

Outline: In terms of the lighting devices, which are our area of interest, the kill switch and motion sensors made the most impact with the occupants? This was mainly because it made the use of the office in the night time easier as the lights would go off without the occupants' physical input. These devices were made known to all occupants who work in the building from the junior staff to the senior staff. Their use was observed especially in

light of working nights which according to Anon 2_MA (2010) is practical "if a person comes in at around 2200hrs and switches on the lights then after an hour they will automatically go off, which is quite a nice feature." The motion sensors are on the other hand working a little less efficiently as stated by Anon 1_HB (2010) "The one thing is the lights, they have motion sensors though they seem to go on even though you pass by an empty office." This was mainly assessed to be due to errors in the beam angle, the sensors in the single cell offices go on as each passer-by walks past. This error causes the efficiency of the devices to be low. Though some of the occupants have made the distinction that by closing the door the sensor stays off (Anon 15_K, 2010).

The industry professional in terms of lighting and efficiencies is keener on the systems' working efficiencies. Their concern is how well the devices work together to tally the energy use of each grid area connected to a transformer. These components can be grouped to singular areas right down to personal offices, though this would be cause the price to higher, in terms of cost. By using this system's analysis the industry can together with the client conform much easier to policies and improve efficiencies of energy use in the workplace (Anon 17_T, 2010).

The government's role in the recommendation of physical components in the building is tied quite closely with the policy acts that are recommended for industry. By better understanding the reason behind the components function i.e. its economic, environmental and social impacts. The government can make all inclusive policies that touch on these areas and cause positive feedback to each area. Through this component's impact on the industry and its use by the occupant, government policy can reassess the utility of devices in context to its function.

b. Temporal factors (TFC)

Definition: An observation of how often are the devices used.

Description: This refers to the usage of the EEB devices in the office workplace. How often are the devices used?

Outline: The occupants' use of devices that alleviate the use of natural resources can be seen to be closely related with time factors. The user sequences appropriate requirements in accordance with the devices implemented in the workspace. Thus the use of the boiler to make tea and coffee as opposed to the kettle

which would take a longer time. This is time efficient as a first instance, and then only as a second instance is it accepted as a means to save energy (Anon 2_MA, 2010).

The industry has thus capitalised on the users' need to be time efficient by allowing centralised control on the devices installed into a space. By being able to adhere to proposed objectives laid out before the system was put in place, a time consumption analysis and consequent improvements can be followed through (Anon 17_T, 2010).

The government sees its part to play as an instigator of appropriate action toward energy efficient design in office spaces (Anon 16_V, 2010). There already seems to be high interest levels in industry as well as the occupants in their heightened awareness of sustainability principles and their influence on spaces. The dynamics of integrated approaches of involving various aspects of human well-being in the design of office spaces is but a matter of collaborative efforts.

c. Spatial factors (SPF)

Definition: Where in the office space are they used more often?

Description: As the whole office was retro-fitted some activity areas are used more often than others; including their EEB devices.

Outline: The occupants view the single office space as a better environment because of "the ability of the single user to change the environment as they see best" (Anon 8_J, 2010). This is not the case for the shared space where alternative methods of "either donning on clothes or removing is one of the ways to combat a change in the interior environment" (Anon 9_H, 2010). To this end there is a better chance of using energy more efficiently if responsibility can be brought down to an individual level.

The industry in relation to this looks into clarifying the delineation of energy use in terms of space divisions. As technology increases and more subtleties can be gained from devices, one can be more thorough by applying individual systems to personalised grid systems.

The government in turn has to realise that with the move toward into collective spaces in office design, there has to be a change in the enacting of building policies concerning sustainability and energy efficiency. Due to this the amount of

time and energy used to perform tasks has risen and therefore the interior environment has had to adapt.

d. Iterative factors (IFC)

Definition: When are they most used?

Description: How often have the EEB devices being incorporated into the daily life of the occupants in the office workplace.

Outline: The occupants in the building as concerns the use of lighting devices do as a general rule use them all the time as they are built into the physical space and work on an automation system. The ability of the utility to be widely accepted as a norm especially after the kill-switch system has been activated is a process. The occupants though appreciate the systems ability to switch off after a given time which means they do not have to physically go to the main switch. The same applies to other areas of saving natural resources where one has to take personal responsibility to utilise the devices in place continuously to make a visible impression (Anon 2_MA, 2010).

The industry has thus taken a keen interest in making the repetitive motion of using these sustainability devices easier for the end user to apply to their desired space. "Through the use of interfaces which are then laid out in familiar set-ups like the IPad, a user can log in repetitive usage of components in their space. This means that even when occupants are away they can control their interior environmental systems in accordance with their desired energy efficiency objectives" (Anon 17_T, 2010).

The government sees the role of hierarchy in the perpetuation of a system (Anon 16_K, 2010). For a set of sequences to evolve into a repetitive activity which would see design objectives become a norm. This would lay the responsibility of maintaining the system or design on an individual or set team. Though this seems to be a preferred method of attaining desired outcomes, it negates the input of individual occupants in the workplace. For a system to run at its most optimum, all who are directly and indirectly affected need to participate.

4.7 Post-occupancy audit

Overview

A *post-occupancy audit* is primarily for ascertaining that the building is fit for the function it was intended. In this case the *post-occupancy audit* is to access the practical functioning of the EEB devices; in this case it will be the lighting components that have been recently retro-fitted. This was done through performing interviews of

15 office personnel which is 50% of the total individuals who at any one time use the building facilities.

Human experiences in an Energy Efficient Building (EEB)

The above mentioned themes namely; familiarity with sustainability principles and the identification of occupants' experience falls under the research question:

a) How can occupant awareness of principles in DfS influence the design of the office workplace?

A post occupancy audit allows the interior designer to glean into the workings of the interior environment as it is. These experiences of the occupant and their interaction with the system to in accordance to their varying awareness levels can be useful in the design process. During the conceptualisation of a project the needs of the occupant are analysed and directly inform the direction a design takes. Though occasionally the resultant design is influenced by the client's ability to see the value of a healthy and comfortable environment for the occupant, it does not negate the impact the economic aspect has. In the office workplace, the client is more often than not part of the occupants who use the space. This allows for a more vested interest in the choice of devices and components. Therefore it is within this frame of thinking that a more contentious approach to the choice of devices and components used in the office workplace can be reached.

Interests of the various stakeholder groups in the actualisation of energy efficient buildings vary amongst them. Divided into the areas of practice, policy and industry, this allows for a study in relation to technical and social grouping of stakeholders. In so doing the ability to confine related properties to the actors' knowledge base and implementation of this said knowledge can be done.

During the interviews of the occupants in the case study, a division was seen to occur according to the hierarchy observed in the organisational structure. This hierarchy had direct influence on the knowledge of sustainability principles that were observed during the research. To better understand these hierarchies the following groupings were created: general staff; junior staff; senior associates. In essence the availability of the objectives and goals of the organisation are available the higher up the hierarchy of organisation. Consequently, the understanding the organisation is not just based on the information you can gather, but on the insight the occupant can draw from their position. In addition to this there is an influence felt on the projects the employees are involved in. The degree of involvement of sustainability principles applied to the job; be it economic, ecology or social, is carried forward to the workplace. This knowledge transfer into utility is where the interest of the research lies.

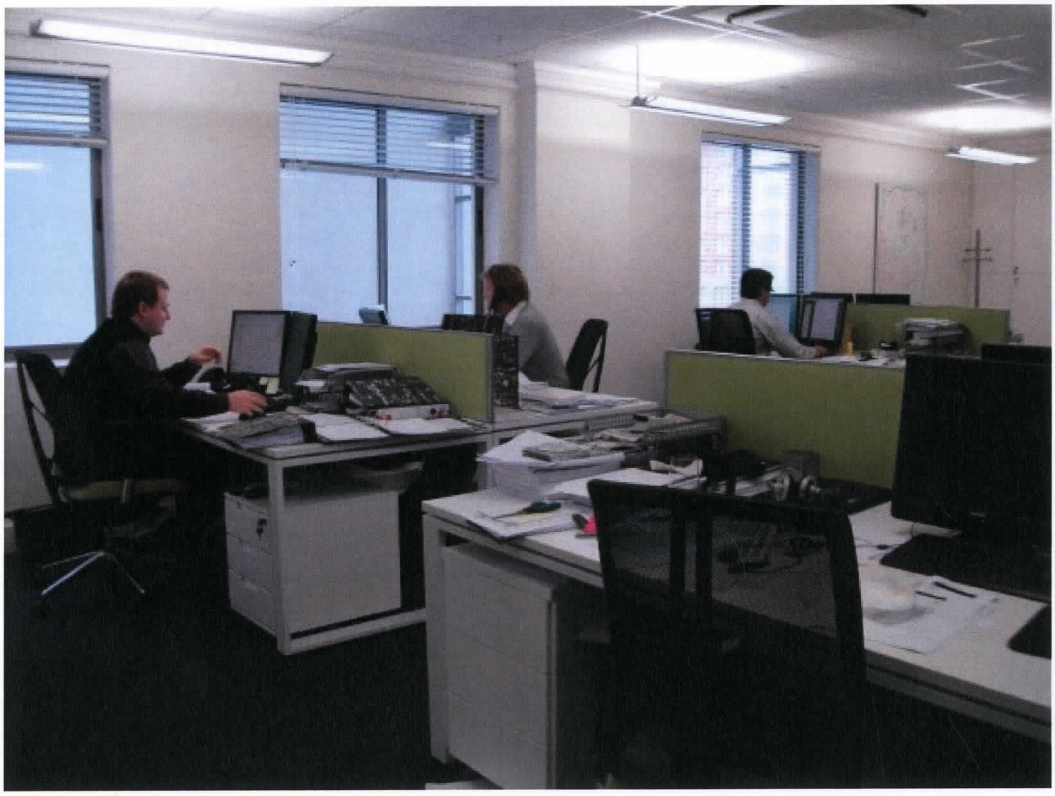


Figure 4.25: Depiction of a shared office at the case study

(Maina, 2010)

The junior staff members have a limited knowledge of the sustainable devices in their workspace and to some extent do not know the reason behind the retro-fitting of the office. For energy efficiency habits to be prolonged and integrated into the core principles and everyday working of an office workplace, there needs to more knowledge transfer. The hierarchy observed in the organisational structure ought to be used to promote efficiency to lower management. This is mainly because a majority of the business projects that are headed by upper management include one or more aspects of sustainability as concerns the management of natural resources.

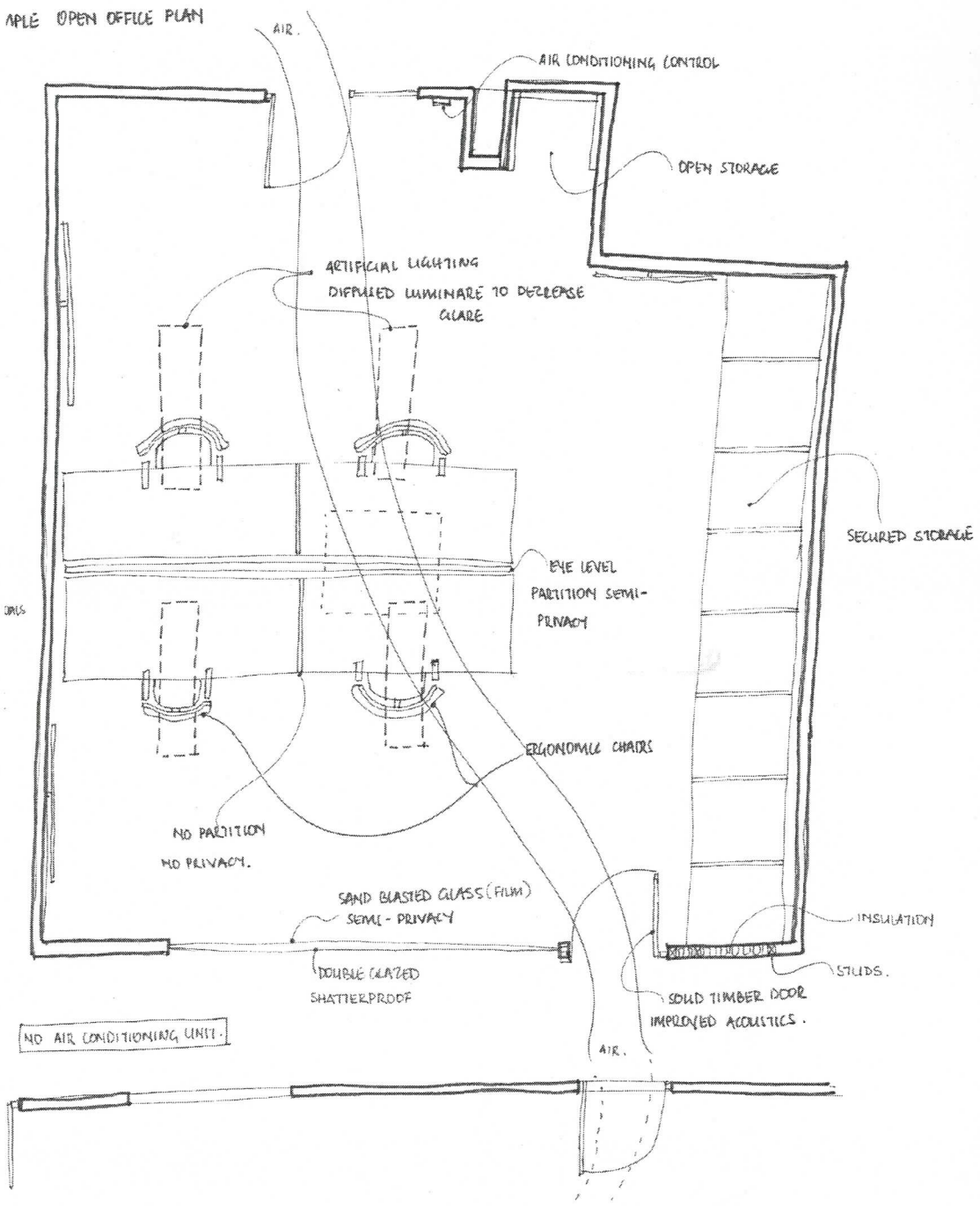
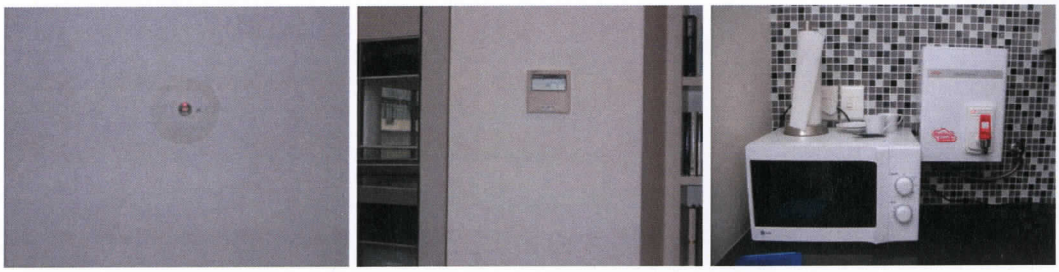


Figure 4.26: Observation sketch of shared office space (author's construct)

During the field work observations done included analysing the flow of the interior environmental systems in the office workplace. The above sketch illustrates the space and its furniture, systems and basic circulation. The occupants of this shared space have direct interaction with the air-conditioning system which has an adjusting panel. There is also a motion sensor beam that detects occupants which then leads to the lighting being switched on. The other system they use quite often is the water boiler in the kitchen to make tea and coffee thus saving energy by not using the kettle to heat water. These above mentioned devices are illustrated in the figurers below.



Figurer 4.27: Energy saving devices observed in the office workplace (Maina, 2010)

Section summary

The policies that the government expects to be followed in an EEB; what the industry professional sells to the client; the information the occupant receives at the end of the design process.

The purpose of performing the *post occupancy audit* is to frame the main contribution of the research. This is informing and initialising participation of the occupant in the governance of EEB. The next section will look into stakeholder groups and how they engage with each other in the built environment industry.

4.8 Network: Engagement of stakeholder networks in the built environment

Overview

The stakeholder networks refer to groups that are observed during the research to occur within the industry. These groups are observed to isolate themselves using language (semiotics), hierarchy and exclusive forums. Due to these isolations there is little information that filters out into open and inclusive forums that are used to inform the initiatives of various stakeholder groups that improve efficiencies of EEB.

PROPERTY (variable)	CODE	THEME (unit of analysis) Engagement of stakeholder networks in the built environment		
		OCCUPANT (PRACTICE)	LIGHTING PROFESSIONAL (INDUSTRY)	GOVERNMENT REPRESENTATIVE (POLICY)
Personal interest	PER	No, **I have a bottle so I just fill it** from the **water filter**, coz **I have one at home as well**.	Okay so you have your down-lighter, compact fluorescent tubes. I **have the compact fluorescent for example in my kitchen**... Maintenance is just two clips in and out I can do it myself and then we can just change it.	So now they are bringing little tubes with the air, **a little outlet for where you sit and work, you can direct the air to where you want**, so we are going to do spot cooling not total air-conditioning. Now that is new technology.
Industry interest	IND	The **lighting engineer suggested the retro-fitted sensors** for the purpose of being efficient in the long term for the company... Your answer would depend on the marketing, if you have got differentiation of a product which means sustainable and non-sustainable then, yes labelling does work.	it comes to your energy saving lamps, **the moment you have more than five in one you can't dim it**... you can dim but you can only dim by voltage.	So, yes when it comes to spaces we can say so much, and we were just **talking now about the Health and Safety issues**. And I mean again, those are about the space that we occupy and they **are not being taken into consideration, and those are issues that affect you at work.**
Government involvement	GOV	There are also **no incentives offered by the government to motivate privateers** to initiate sustainable programmes into their businesses.	The task lighting now you can change the inside lamp to fluorescent tubes. Especially **with the new laws in Europe**, you can check, they don't use incandescent at all they are going fully on energy saving lamps.	You start with the basis, **the law says this; the manager/employer must provide a safe and healthy environment**. In your study a safe and healthy environment means; lighting, ventilation etc. and therefore these occupants need to be consulted
Industry groups	IGP		Yes, there's **a pamphlet on energy saving** ....here it is.	

Figure 4.28: Engagement of stakeholder networks in the built environment (author's construct)

Analysis of Network as seen in the theme: Engagement of stakeholder networks in the built environment

a. Personal interest (PER)

Definition: Interest in applying sustainability principles

Description: Evidence of sustainability principles being applied.

Outline: The occupant through attaining knowledge and applying the principles learnt from their personal experience outside the workplace can now transfer this knowledge to the office environment (Anon 12_E, 2010). This shows that the indirect influences of personal inferences made in other environments can play a role in active engagement. Through this engagement the role of the occupant becomes more distinct in

being the perpetuator of sustainable devices and components in the workplace.

The industry's role of making accessible the knowledge so as to ease the implementation of these principles can be seen in their application to personal interior environments. This salient network that is formed between the personal environment and the information gathered at the workplace can be used to ingrain sustainability principles beyond the apparent use of professional spaces. This ingrained knowledge that is carried forward to the 'home' environment can then be used to impact others within their sphere of influence (Anon 17_T, 2010).

The government's role of applying theory to the professional environment so as to ratify the use of sustainable devices can be motivated further through networks (Anon 16_V, 2010). These networks are seen currently in the forums and networks between different government departments (Buch, 2010). These networks inform the workplace design directly as they are the precursor to policy and amendments of building codes. According to the government representatives these forums exist but there is little interaction between the desired stakeholders who are targeted. If these forums are to work in accordance with their objectives a more transparent and collaborative design needs to be adhered to.

b. Industry interest (IND)

Definition: Professionals interested in EEB devices and components

Description: Evidence of sustainability principles being applied in the office workplace through direct or indirect influence from the industry.

Outline: The occupants' environment which is controlled directly by the client's choice is seen to be indirectly influenced by the industry's interests. In this case it is the impact made by the recommendations made by the engineer involved in the project (Anon 3_EG, 2010). Since the industry is undergoing a change in the usage of energy in commercial buildings, these changes are then transferred to the interior environmental systems in the office workplace. The occupants' role can then be seen as an accountability tool set against the goals and objectives set in the recommendation and implementation of these sustainability devices.

The industry professional has the role of understanding the limitations of the devices in the market (Anon 15_K, 2010). In due course they should ideally transfer this information to the client and thereafter the occupant through governed networks.

The recommendation and use of sustainable products can be controlled by transparency of information initialised by the industry professionals. The industry's interest can then be governed by stakeholder groups whose interests lie in the industry's sphere of influence.

The government's role in terms of where and how the industry can voice their new products and any concerns stemming from these can be mediated by government aided forums. According to Buch (2010), "these forums though they exist are run independent of the industry and are primarily formed by government departments." If these forums could identify representatives in industry and incorporate them through collaborative initiatives this would further consolidate the built environment objectives and goals toward more efficient and energy conscious buildings.

c. Government involvement (GOV)

Definition: Applied government interest in energy efficient buildings

Description: Evidence of sustainability principles being applied

Outline: The occupants feel that the government needs to be involved in a more tangible manner, by offering monetary and other manner of incentives (Anon 4_ME, 2010). This would go a long way in showing the government's commitment in providing a more sustainable future. These incentives are seen to be a primary way of introducing sustainability principles as they would ease the monetary burden of initial instalment of these devices and components in an old building.

The industry, through they have a closer connection to the government through policy and by-laws in the building industry, see a lack of proactive action by the local government. This According to Anon 17_T (2010) "leads to them using international laws to justify to their clients the use of sustainability devices and components". Due to this gap in the policies involving new technology brought about by sustainable products in the market, there is a possibility of low standard materials infiltrating the market.

The government feels that by adding new laws and policies concerning energy efficiency in buildings would not solve the problem of implementation. It is according to the government representative, the responsibility of the client or employer to provide a healthy and safe environment (Anon 15_K, 2010). But with the evolution and emergence of new pollutants and more efficient process of property management this new

responsibility is too heavy a burden for the proposed stakeholders. As it is in the government's mandate to police the emergence of new devices and components that affect the social, environmental and economic aspects of society. It is only natural that this mandate to integrate sustainability into policy be under their sphere of influence.

d. Industry groups (IGP)

Definition: Industry groups interest in energy efficient buildings

Description: Evidence of sustainability principles being applied

Outline: The occupant due to their role as an integral part of the built environment being side lined, has been poorly represented in industry groups that assist in the governance of the interior environments they access. Due to this disuse of the intrinsic knowledge acquired by the occupant in their sustainable environment, pertinent knowledge of user interaction is lost to the industry groups (Anon 3_EG, 2010).

The industry, whose role in the industry groups is clearly mapped out in the fact they form the primary representational quota. This means that in the network the industry group will endeavour to uphold the objectives of the industry representatives to other relevant stakeholders. This also includes informational portals or websites that may be created to assist in information access.

The government's role in the industry groups is usually to guide in the adherence of industry professionals to the policies enacted to control and provide excellence. These groups are initialised with the help of government but run independent under the auspice of selected individuals (Buch, 2010).

Stakeholder engagement

Networks

Knowledge transfer networks as observed in the case study

The occupants in the office workplace were observed to have different levels of awareness that created various networks that facilitated knowledge transfer. These transfers are modelled below in figure 4.29.

The shift of knowledge from the home or personal setting to the workplace was seen to be prevalent in the junior staff members whose energy saving methods stemmed from using by adjusting how they use devices. This was mainly in the areas of water, thermal comfort and lighting. These areas information were gathered from other people within their sphere and information highways on the internet.

The theoretical background information was mainly transferred by the technical experts as they recommended devices in the office workplace. There was also information from the government representatives that was driven by technical know how. These two experts form a formal network governed by policy and law that accords how and when in the building process they connect. The resulting decisions from this network then directly affect the workplace and therefore the occupant. This is due to the technical application of evolving methods and products that are created in the industry. These products are seen to be a culmination of how the industry professionals and the government representatives decide on which products shall enter the market.

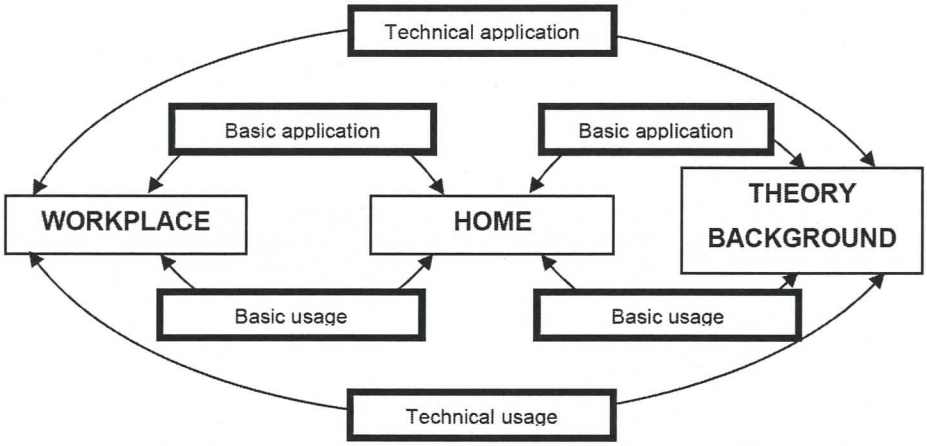


Figure 4.29: Knowledge transfer of stakeholder (author's construct)

Interaction maps

Networks within the industry that influence the way stakeholders engage with each other are represented in interaction maps. These mapping representations of stakeholder networks can be used to simplify organisational knowledge transfer in order to access change. An example of this is illustrated in figure 4.30.

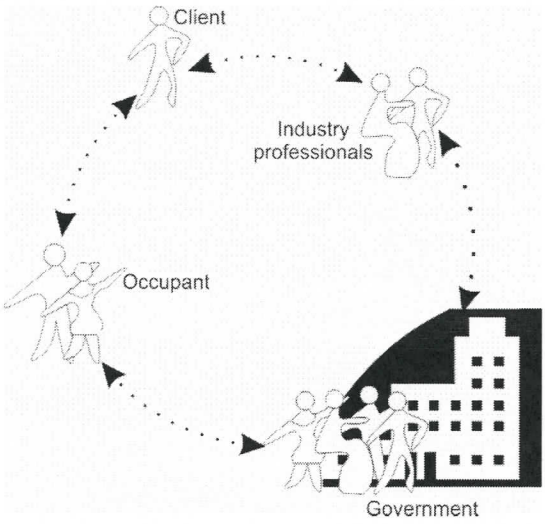


Figure 4.30: Interaction map: stakeholder engagement in design process of an office workplace (author's construct, 2010)

The interaction between these stakeholders' groups as observed shows a disconnection between the various groups. This can be mitigated by creating networks where representatives from the various groups can meet and exchange ideas. The alienation of the occupant from actors who have a direct impact on their environment can be addressed. Subsequently these actors can evaluate and gain consensus on the positive or negative impact sustainability principles have on the occupants as a fundamental players in the design process.

The cross pollination of stakeholder groups is seen as a directional move toward creating knowledge hubs that can be used to bridge the gaps seen in the interaction map. By providing information on sustainability and its impacts on office environments various groups can access how best to improve and advance whilst sharing and interacting with concerned actors.

1 Stakeholder network logic model

Different stakeholder groups have differing methodologies but seem to have similar goals and objectives. The similarities can be accentuated to draw out an engagement guideline, which will be further articulated in the discussion that follows in the next chapter. In this section the research will endeavour to link these above mentioned similarities between the stakeholders and articulate the differences that can be used to promote diversity, as shown in figure 4.31.

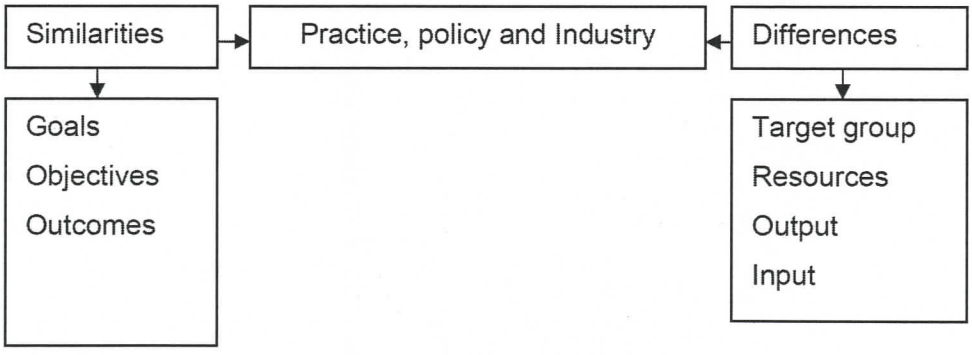


Figure 4.31: Interaction matrix

(author's construct)

As seen in the figurer 4.31, the main similarities are at the beginning of the design process and form the foundational steps that constitute the onset of a project. The involvement of industry and policy in the practical implementation of sustainability principles in practice as observed in the office workplace. The role the occupant in this process is to include the dimension of the user as an important part of the design process. A collaborative network can assist in articulating how the different actors can use their varying skills to find solutions that offer input to the whole process of the design process outside their sphere of interest. This sharing of knowledge can be used to create more holistic approaches to recommending and implementing sustainable products in the office workplace.

A schematic of the above mentioned engagement can be seen in figure 4.32. The engagement of each stakeholder group will be accessed in the following section using activity theory as a lens to observe social change in the built environment industry.

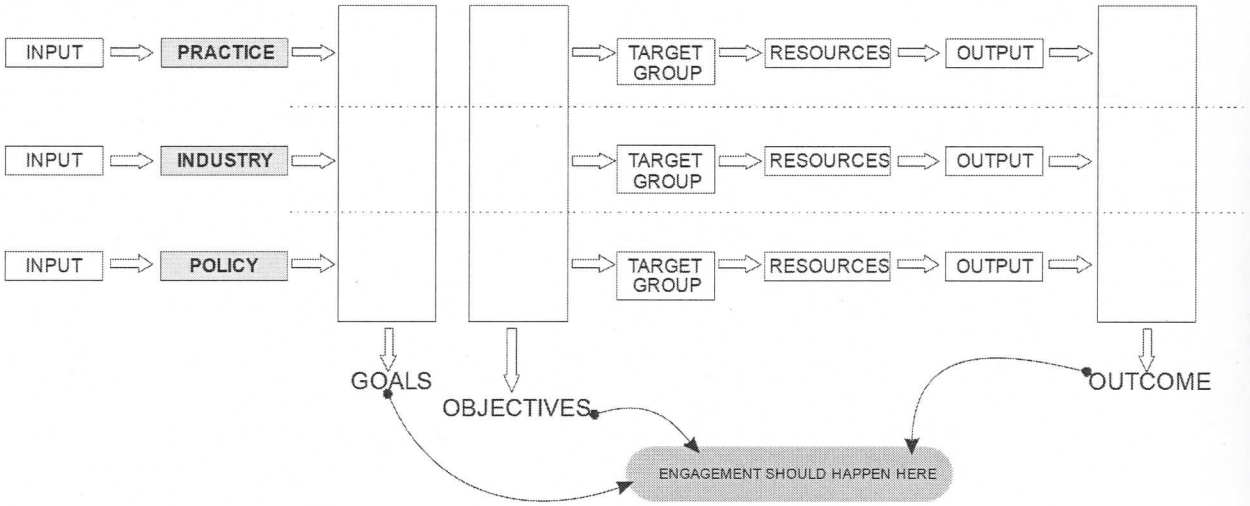


Figure 4.32: Stakeholder network group logic model

(author's construct)

As shown below, the target group of each area is different but if their goals and objectives are similar the target can be approached using similar forums that allow networking amongst them. In the process of this networking there are resources that come into play. The input groups have differing human and monitory resources which may limit how much they can do for as singular units. This limitation can be adjusted by combining some of these resources under a common banner.

The greatest impact on the built environment that can be felt from these networks comes from the outcome. This outcome has an impact on all input groups in varying ways. In terms of *practice,* the influence of how the end user connects with the sustainability products and allows these principles to pervade the change in behaviour. As it relates to *industry* the ability to make a positive impact on their business vision and allow for rapid technological advancements that are driven by

organisation's need to differentiate them in the market. The *policy* area that is controlled by government is seen to be the arm that has power over the products that are in the market and their use in public environments.

Section summary

Networking in the built environment is seen in fragmented sections that do not relate to each other using a common forum. These networks that are created in the groups that were divided as *practice, policy* and *industry* work well within these boundaries. The main draw back of delineating the sections is the lack of knowledge sharing or transfer within the actors in the groups and amongst the groups as entities. Creating collaborative networks where networking can be brought about by the shared goals and objectives can provide a platform for engagement of concerned actors.

This stakeholder engagement can be accentuated by using joint resources in a forum that can be run using government related departments as vehicles to drive behavioural change in society. This would complement design as design is about people and their environment. By relating with other actors in the industry, social change can mean a direct influence on the design outcome of office workplace environments. This would ensure that innovations and technological advancements that are introduced into the industry are not only evaluated by the industry and policy makers but by the occupants themselves. Through this shared responsibility of sustainability products introduced into the local market, networks can perform the dual role of providing a governance tool.

4.9 Implementation: Integrated and interdependent approaches in EEB

Overview

Using public entrepreneurship through policy as a vehicle to drive stakeholder network initiatives perpetuated within industry to raise awareness and inject social change in practice. The designer must then act as a social entrepreneur and facilitator of this social change. These integrated networks can be used to improve policies and inform the stakeholder network groups.

PROPERTY (variable)	CODE	THEME (unit of analysis) Integrated and interdependent approaches in Energy Efficient Buildings		
		OCCUPANT (PRACTICE)	LIGHTING PROFESSIONAL (INDUSTRY)	GOVERNMENT REPRESENTATIVE (POLICY)
Technical knowledge	TKN	Operation of a building in line with sustainable global practices in terms of green sources. **So that would entail: water usage, temperature control, the use of your lights, carbon emissions**	We do automation as well but the problem is the costing wise you are **going to need a DALY. Each and every lamp you use its going to use a normal di-chroic.**	Yes, we design office air flows in terms of changes… So it is designed around a parameter.
Political factors	POL	The organisation looked into different ways to imbed sustainability into the office design. Some of the innovations were too expensive in relation to their **return on investment.**	. So you have one that sitting on lights on your computer system and you have to have **a special DV board** now.	And that is a crucial dilemma in our industry; you have already mentioned the client gets the cheapest item in the market, **not what the occupant wants (needs). And that is a legal issue.**

Collaborative initiatives	COL	The sensors that are retro-fitted in both floor of the office workplace were an idea that stemmed from the lighting engineer... **This will reflect both on the economic and environmental aspects for the organisation.**	They have energy saving rooms and they are connected to the iPad and you can control all the lights from here. **How they create awareness is by having samples for people to see.** Having displays on counters and actually taking the time to show how the lights work.	...collaboration and awareness raising. **That is where then it becomes quite critical because then you should have everybody sitting around** and saying; listen what you have done, or come and look at what we have got here
Enacted laws and policies	ELP	There is also the fact that the **penalties felt from ESKOM** for using electricity as opposed to passive energy are low.		Now that **safety and healthy environment is not defined in law**, then its up to you and to your specialists research to say that there must be lights.

Figure 4.33: Integrated and interdependent approaches (author's construct).

Analysis of Implementation as seen in the theme: Integrated and interdependent approaches

a. Technical knowledge (TKN)

Definition: The technical factors that drive energy efficient buildings

Description: Specifications that carry the ideology of energy efficient buildings in devices and components

Outline: The occupant awareness of the basic technical knowledge of what concerns efficient energy use shows an interest that lies beyond knowing what devices are installed in the building. This interest in attaining basic technical specifications that are related to their surrounding according to Anon 12_E (2010) shows that "[an ability to] voice opinions on relevant issues [outside their sphere of] professional knowledge to their interior environment in the office workplace".

The industry professional takes a keen interest in the new devices in the market that are used outside the sphere of influence of local government policies (Anon 17_T, 2010). This attention to detail and assertion of technical know how can be used to transfer knowledge through integrated forums that could advocate for more stringent rules on the level of academic portfolio industry professional should hold.

The government's role as the body that enacts policies and laws to govern the implementation of new elements into society's interior environments can widen their scope of influence. Due the nature of the policy making, the representatives in government have high academic achievement. It is therefore within their scope to access technical knowledge that accompanies new sustainable devices and its presentation to the public (Anon 15_K, 2010).

b. Political factors (POL)

Definition: Factors relating to how informal power structures are formed

Description: Structures' responses to issues relating to energy efficient buildings

Outline: The occupants according to Anon 10_S (2010) see "the role of politics in terms of having direct influence on the return on investment of the sustainable devices that can be implemented in the office workplace". These influences are seen to be connected to the economic aspect of the sustainability pillars and can be directed by the political engagement between government's ability to be interdependent in the allowances made for introduction of new products to the market. This would create an amiable political environment to enhance engagement and increase implementation of sustainable devices to promote energy efficiency.

The industry can then interact with the client and the occupants within the same framework of samples but with the added dimension of the influence of political frameworks and the impacts they have on users' choices. The conceptualisation of sustainable devices that are driven by economic, social and ecology concerns can then be further coalesced into a collaborative and open interaction that allows all stakeholders to understand and appreciate their role.

The government's role can be seen as the arm that enhances and drives collaborative and awareness campaigns. This is because as a body they are able to reach more stakeholders and have more resources to use in such ventures (Anon 16_V, 2010). The sustainability principles which fall into different sectors of government can then be seen as an entity that can exist in its entirety as a body with the political framework concerned with society as a whole.

c. Collaborative initiatives (COL)

Definition: Specific interaction of different groups with common interests toward energy efficient buildings

Description: Examples stated of involvement of a group in communicating principles of an energy efficient building

Outline: The occupant relies on the recommendation of industry experts to point them in the right direction in order to provide with the most appropriate products in accordance with the project objectives (Anon 3_EG, 2010). This reliance can be seen as collaboration between two stakeholder groups. Thought it is initiated due to a client needs for products in their interior environment this collaboration can be enhanced by providing continued interaction that can provide information relevant to both parties.

The industry professional in understanding their client needs and adhering to them in the culmination of a project proves the need of other stakeholder's input in design and implementation of projects. To provide a higher level of interaction and collaboration these relationships can be converted into information hub that serve as a knowledge base for industry and a port of call for academics studying the area of interior environments.

The government in its capacity as a body of governance that represents the society as a whole can be fundamental to collaborative initiatives. This can be seen in the fact that the society is constructed through the coming together of various stakeholder groups in communities. These stakeholder groups can be create collaborative initiatives under common goals and outcomes that enhance equity.

d. Enacted laws and policies (ELP)

Definition: Factors to how formal power structures are formed

Description: Structures' response to issues relating to energy efficient buildings

Outline: The occupant has an understanding of the working of formal laws enacted by government structures to regulate the use of electricity by the society at large (Anon 4_ME, 2010). Though these laws are seen to affect the client more so than the occupant they should be higher level responsibility driven into the occupant to cause more energy conscious use of interior environmental systems in the office workplace.

The inability of industry professionals to relate the recommendations they make to their clients and current local government policies shows a lacking in the engagement between the law and its relevant industry representatives. This lack of relations is seen in the fact that the local industry professionals use international policies and laws to gauge their level of aptitude (Anon 17_T, 2010).

The government feels that by stating a general health and safety act, the responsibility of adhering to specific principles that govern definite devices in a building is the responsibility of industry researchers (Anon 15_K, 2010).

Social innovation through co-design

A methodology involving co-design can be used to derive information from pictograms in sustainability. The depiction of these images relate to resource saving devices/ processes. They allow a mental and non-verbal link between the occupant, industry and policy makers. The schematic in figure 4.17 depicts the connection between principles of sustainability and the influences they have on the various actors in the design process. The three fundamental aspects of sustainability which are; *economic, social* and *ecology* are seen to influence in varying degrees. Since the occupant is the one who engages with the sustainable products and devices in the

office environment, they have been placed in centre. This central point accords the occupant a place of high relevance in the design process as evaluators of their office environment. This centralisation also brings to the fore the fact that the other actors in the built environment do not involve the occupant at basic levels of design. The occupant exists in isolation and comes into contact with the design process at the implementation stage. This creates a gap in the built environment industry due to the minimal use of the intrinsic user knowledge of the occupant. This lose of knowledge can be minimised through co-design that would see the direct involvement of the occupant.

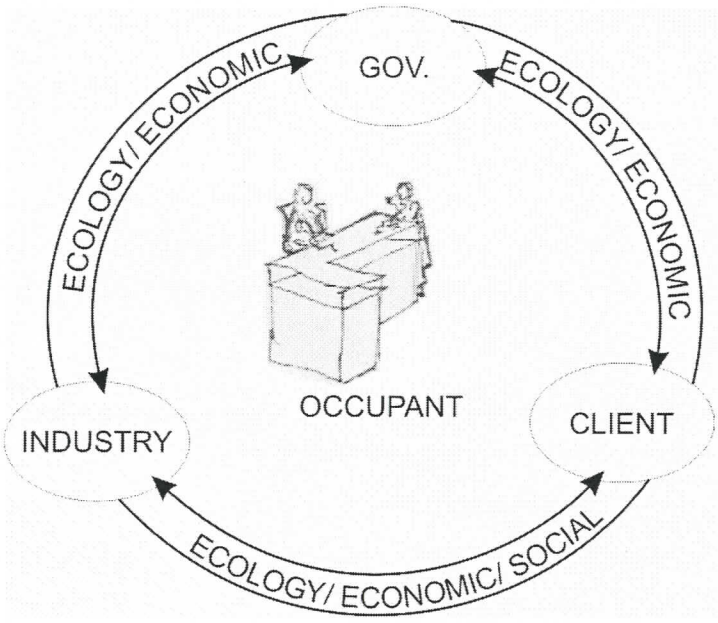


Figure 4.34: Mapping of mental and non-verbal links (author's construct)

To create a bridge in interdependent networks that exist in the built environment industry, there needs to be an advocacy for connectivity through knowledge hubs. Through these connections a sense of ownership can mean more transparency in the implementation of sustainability principles. If this transparency were to permeate the transfer of knowledge between the stakeholder groups, a greater sense of participation could be achieved.

The involvement of the occupants not only as the people who use the artefacts, but as inclusive actors who get affected by the presence of it is a move toward social innovation. The creation of collaborative communities where there can be an exchange of information is a basic foundation. In this light, 'the creation of innovative ways to solve problems and create cohesion and can be seen as a birth of social innovation' (Manzini, 2004; Chapman & Gant, 2007). These innovative methods can be viewed in light of collaborative networks that can be formed to evaluate sustainable products and their impact on economic, social and ecological aspects within the local environ.

Collaborative networks *(ubuntu)*

These networks would be inclusive of all stakeholders in the process so as to promote conviviality. This cohesion between actors can be advocated through the use of *ubuntu* as a driver toward interdependency within the stakeholder groups. As observed in the government sector, the application of *Batho Pele* is an indication of policy's recognition of the need to people first. To now integrate this as a main objective of how the built environment applies sustainability principles in the area of office design is the next step. As observed by the occupants the exclusion of their voice and the unavailability of information is an area that should be looked into. The occupant has a need to be an integrated part of the process and can provide essential information that could lead to greater innovation.

In the built environment industry in Cape Town from the onset of 2006 there has been an increase of interest in integrating sustainability principles in industry groups. As observed in the introduction of GBCSA in 2006, sustainability is gaining a foothold and causing conscious behavioural changes in the professional recommendations of interior office environments. These changes can therefore be seen as a catalyst for fundamental change in the actors involved in the design process. In order to continually perpetuate this relationship, the enacting of collaborative networks can be issued by all actors in the industry. These collaborative networks can work toward introducing and sustaining energy efficient behaviours in office workplace setting by sharing ownership of environmental change through design processes. This sharing between actors of the right to impart opinion can be seen as a basis of *ubuntu* whose ethos is built upon taking into consideration the whole in all individual endeavours. Thus by causing this interdependency between stakeholder groups can improve relations and cause more effective measures toward energy efficient buildings.

Section summary

Through the evaluation of what technical knowledge is known amongst the groups of *occupants, industry* and *government representatives* it can be said that more effort is needed in order to align group objectives. The creation of formal organisations driven by government brought about by internal and external forces to reinforce the policing of natural resources is prevalent. In addition to these are the non-profit organisations that include representatives from both industry and government. In all these there is insufficient representation of the occupants who use the environments that are undergoing sustainable driven change. Collaborative effort to involve the occupant is seen through their industry relationship with the client and industry professional. Through the enacting of laws and policies the government impacts the interior environment directly without having any contact with the occupant. The introduction of collaborative networks that work toward closing the technical and policy gap between these stakeholder groups can be seen as a positive move toward holistic sustainability in the built environment. In order to align these stakeholder groups there needs to be an understanding of how current inter-relationships occur. This evolution of social change in the built environment industry will be looked into in the next section using activity theory as a theoretical lens.

4.10 Chapter Summary

In this chapter the research, through the division of the data collected, attempted to articulate the nuances picked out during the fieldwork. As an overarching analysis tool the research questions were used to draw out each section that was created. Using these areas to bring to the fore; *occupant, industry and government.* The discussion in the following chapter uses Activity Theory's analysis of interrelation between these stakeholder groups and how the actors therein influence each others actions within the chosen of activity of attaining an efficient interior building environment.

CHAPTER FIVE

DISCUSSION OF FINDINGS

5.1 Introduction

This chapter looks in detail at the actors involved in conceptualising, designing and implementing sustainability principles in energy efficient buildings in Cape Town's central business district. The actors involved in this study include occupants, designers, lighting professionals, government representatives as well as experts in the field of energy efficient buildings. The data was collected from interviews performed with actors in their different stakeholder groups stipulated in the previous.

5.2 Identifying the sustainability paradigm

The criteria for identifying the sustainability paradigm was aligned with Bluyssen's framework for health and comfort illustrated in Figure 5.35. The indicators that are mentioned in the framework are outlined in Appendix B. They state the parameters, control and issues seen in thermal comfort, lighting, air quality and acoustical quality. The case study which is situated in Cape Town's central business district shows an indication of fulfilling the paradigm's goals through retro-fitting their lighting.

5.3 Roles of principal actors

As summarised below in Figure 5.35, the second generation activity theory model shows subjects at a three tier level. Within the first tier is the individual and mental state, the second tier is the action that signifies the goals set out to attain the third tier which is the activity, based on the object's motive. This research adopts the occupant as the keynote actors and identifies the objects as sustainable products or devices installed in the office workplace.

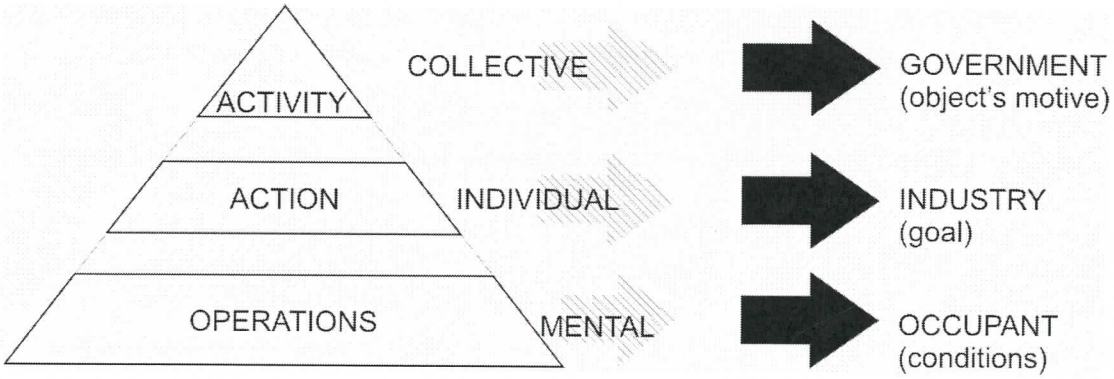


Figure 5.35: Levels indicated in the 2nd Generation Activity theory (adapted from Korpela & Soriyan, 2000)

In order to produce any socially relevant outcome there needs to be inputs from several individual actors acting on their respective parts of the joint task. This would coincide with there being a need to initiate collaborative networks within the industry to allow for synchronising of actions by the said individuals to gain a preferred working activity. Figurer 5.36 illustrates Leontiev's model of individual action and the consequent collective activity that would be ideal toward a joint outcome of work (Korpela & Soriyan 2000).

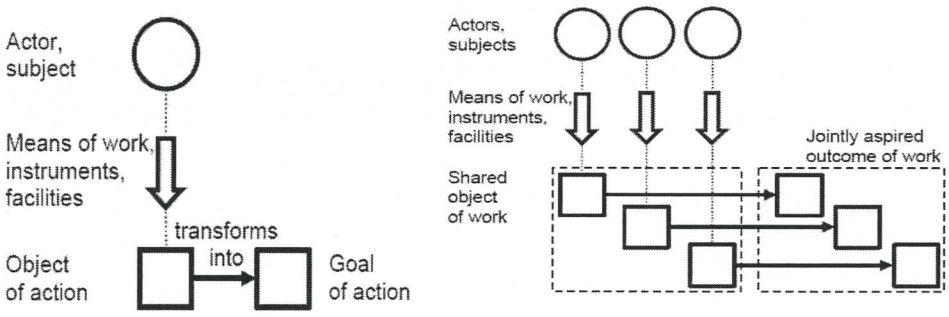


Figure 5.36: Individual action of work; individual actions merging into a joint activity (Korpela & Soriyan, 2000)

Leontiev emphasises that the motive of a collective activity is in its shared object – or more specifically, in what the object transforms into during the activity. For instance, in the case of energy efficient buildings the motive of a construction activity is to transform the raw materials into an office building. Individual actors engaged in the activity may or may not be conscious of the collective motive, but it is yet the shared object and its transformation into the jointly produced outcome which defines an activity (Korpela & Soriyan 2000).

5.4 Activity analysis: integrative levels of analysis of energy efficiency in the office workplace

Individual level

A case study into the interaction of occupants in a recently retro-fitted office building in Cape Town's central business district was performed. The case study was outlined to capture the conscious and unconscious levels of interaction between the occupant and the sustainable devices installed in the office setting to reduce energy use. The key actors within energy efficient building include the following (illustrated in Figure 5.37): occupants, industry professionals and government representatives.

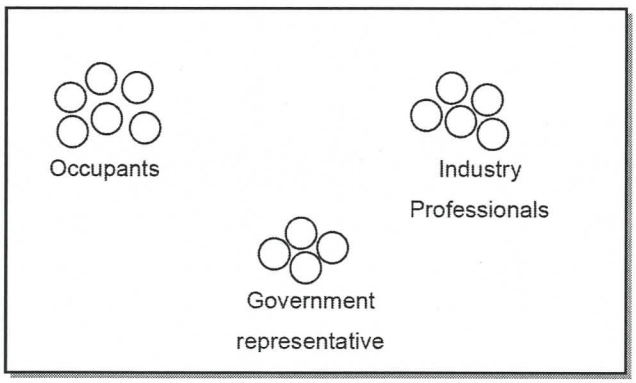


Figure 5.37: Actors within the Built Environment

The specific group level actions of the various actors were:

- Practice: utility of sustainability devices
- Industry: conceptualisation of products, implementation of interior environmental systems
- Policy: enacting of policies that govern the built environment, amending of current policies within the built environment

Group level

The occupants who occupy the practice group are the end users of the sustainable products and devices installed in the office environment. This means that they represent the area of utilisation and thereafter the assessment of the said products.

The industry professional in the industry group represent the actors who design, recommend and install the sustainable components in the office workplace. They are the gatekeepers to the information that allows for more efficient use of the interior environmental systems in the office environment.

The government representatives who are seen to be in the group of policy typically work within their own area with limited access for other stakeholders to get involved in policy making or amendments. In this case the government personnel that were chosen had a dual representation by being industry professional working both in policy and as an expert consultant.

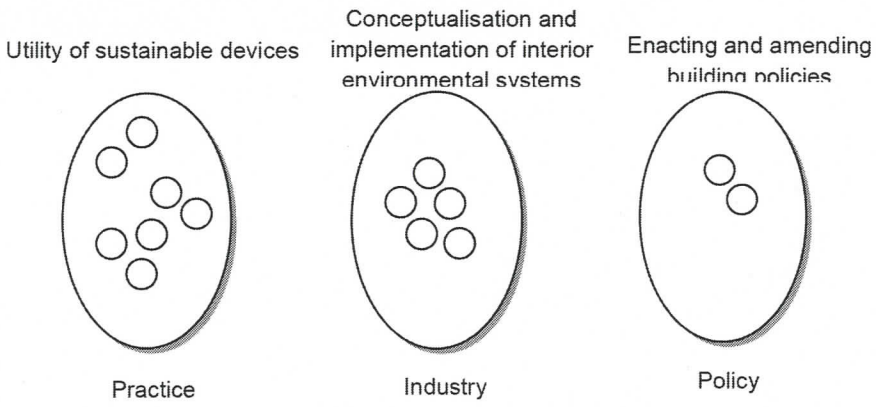


Figure 5.38: Group activities within the built environment

Organisational level

At the organisational level the interactions happens within the frame of the energy efficient buildings in Cape Town's central business district, at all three group levels and are mediated through hierarchy in the respective groups.

Each hierarchical setting is positioned by the amount of information the actors within it are privy to. The transfer of knowledge from one group to another will be the area of interest as it will set the platform for further mediatory means of communication.

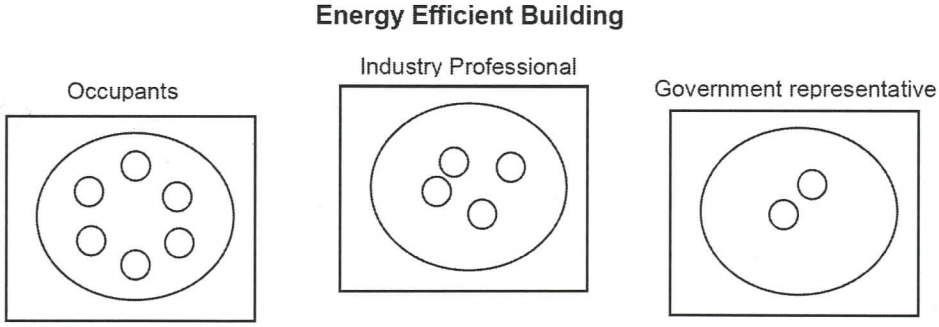


Figure 5.39: Organisational level activities within the built environment

Societal level

Similarly, the societal level activities are located in Cape Town. The various groups are illustrated below in Figure 5.40. The city of Cape Town at its societal level is observed as an external force alienated from the other groups, while the activities performed at this level have a direct impact on Cape Town as a society interacting with the built environment.

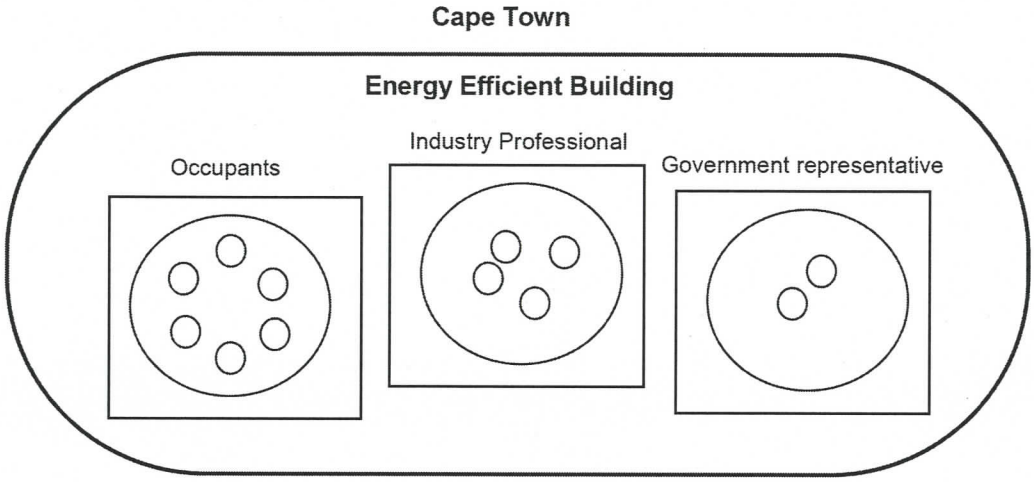


Figure 5.40: Societal level activities within the built environment

5.4.1 Collective work activity as systemic entity

Engeström's main addition to the above mentioned Leontievian model was to point out that when several subjects work on a shared object, there needs to be some form of coordination between them, and this coordination is also mediated by what he calls social infrastructure – rules and division of labour. In this case the actors were placed in group activities levels which allows for unit analysis of their goals toward the joint outcome. In the built environment the mediation that occurs is typically done through print media and IT platforms. A means of transparent and inclusive communication can enhance the social infrastructure and allow for integration of groups through representation. While individual actors act on the object of work through means of work, we can regard that the group taken together as a collective actor/ work community who applies these collective means or instruments so that the individual actions are directed to produce a joint outcome (Korpela & Soriyan, 2000).

Looking at the elements of the work activity, the framework starts from the elements of a *mediated action by an individual* (Figure 5.41, broken line); the subject or actor, the object of the action, the instruments or means (both mental and physical) needed for the action, as well as the goal all take place within a work process.

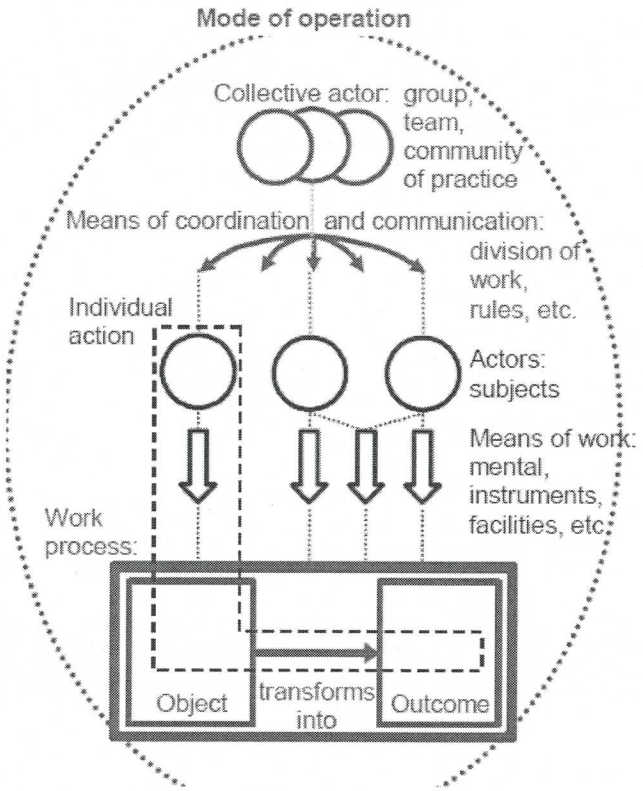


Figure 5.41: Elements of a work activity

(Mursu *et al.*, 2007)

Actors/subjects

An *actor* is described as a member of a working group, carrying out specific tasks individually or in a team, using different kinds of facilities and skills, independently or in cooperation (Korpela & Soriyan 2000). What is important is that the actor is part of an activity, doing their work and focusing on a shared goal, based on the motive of an *activity*. In the case study research from the previous chapter, the occupant was seen to be a part of the practice working group; while the industry expert fell under the practice group and the government representative the policy group.

In practice it almost always requires several actions by several individuals to produce a service or product. It is important to note that individual human actions can only be understood through the collective activity of which they are a part. Instead of groups of uncoordinated actions, work, in practice, consists of systemic activities subordinating the actions in a purposeful way (Korpela & Soriyan, 2000). For example in the built environment, it would be restrictive to analyse only the designer's work or the contractor's work in building construction. In addition to these, attention should be paid to multi-professional cooperative work, for example, the GBCSA which is involved in sustainable built environments and how this is organized and managed similarly the Cape Town Partnership that was involved in the retro-fitting of existing buildings in Cape Town's central business district during the period of 2006-2008. All these actors perform their individual tasks that ultimately come together to produce an activity that culminates in an energy efficient building.

Means of work

Actors work on their objects using specific means of work, i.e. different kinds of tools, facilities, artefacts and also mental skills, knowledge and so forth. As observed during the analysis of the data in the previous chapter various skills were applied to the interior environmental systems by actors in the groups. According to their awareness and skills acquired through technical and personal exposure, these aspects greatly influenced how they interacted with the interior environment. In all mediated work there is a need for information about how to use the means. It is important to consider where actors get the information needed in the work process, how they use that information and where they record or save new information. With the advent technologically advanced materials to reduce the levels of consumption in the built environment, dissemination of information is used as a tool for segmentation in the market. There are also many kinds of information, e.g., formal information and tacit information, as well as professional skills. The availability of this information is mainly based on where in the hierarchy within the group the actor belongs.

Object

An object is the target of the actors' actions. In this instance the object is the interior environmental systems in the office workplace. The object is part of the shared goal and actors should recognize the object of the work. The first experiences of the object are based on external features, which are transformed into deeper knowledge of the object as the work process continues. The external features would include the exterior environment which has a direct influence on the degree of use of the interior environmental systems. These aspects of the exterior environment can include: day-lighting, opacity of glazing and proximity to reflected day light. In the work process the actor (or collective actor) and the objects are in interaction, mediated by the means of work, which would include the artefacts installed to control the interior environment.

Work process

The work process includes an object of the activity, a transformation towards an outcome and the outcome. The object is where the actors aim to contribute, to create a transformation process to achieve an intended outcome. It is not simply changing something into something else, but more related to the motive of an activity it is purposeful.

It is crucial to create a collective understanding among information system designers and actors about how they are working, what kind of tasks are being carried out, what information tools are used and how, who are the other actors involved and so on. We take a group of professionals and analyse their relation to the information system in use, thus the interaction is between group and information system. We can view this level as the actors' perspective in work processes. An actor has a goal, tools, colleagues and rules when s/he is working on the goal and transforms it into the intended outcome.

Means of coordination and communication

In addition to the instruments or means of the individual actions, other kinds of mediating instruments – 'social infrastructure' – are also needed within an activity. The actions need to be oriented by means of coordination and communication

(Korpela & Soriyan, 2000). Among the means of coordination and communication we can include the division of work and rules and also physical artefacts such as information systems made available to the actors through the collective group websites.

Mode of operation and contradictions

Work activity as a real-world phenomenon is *systemic* by nature. That is, there must be a relative fit between the elements of a work activity, a *mode of operation*. When an activity evolves over time, it moves from one relative fit to another according to zones of proximal development, from one mode to another, in historical phases. *Contradictions*, imbalances within and between various elements and the mode, are the force driving the activity to change. It is the observation of such mentioned *contradictions* that are seen to arise in the built environment industry acting as catalysts for change in the mode of operations.

Contradictions can be divided into four levels: primary inner contradictions within each constituent component of the central activity, secondary contradictions between the constituents of the central activity, tertiary contradictions between the object and motive of the dominant form of the central activity and the object and motive of a culturally more advanced form of the central activity and quaternary contradictions between the central activity and its neighbouring activities (Korpela & Soriyan, 2000).

On the primary inner level, contradictions cause frictions, for example, in the built environment industry there may be contradictory objectives when it comes to the cost of production between sources of raw materials. In the manufacturing process there arose contradictions in the choice of materials due to price differentiation that was caused by ecological footprint of products.

On the secondary level, the elements develop differently in relation to each other. There are external pressures and requirements directed to the elements, or there will be new external factors such as rules or tools. These can be seen as new policies that have direct impact on the incentives offered by government when it comes to integrating passive energy into energy use in buildings' interior environmental systems. There is also the difference in technological advancement between the countries that produce the sustainable products and the local companies that sell and offer maintenance services.

On the tertiary level, contradictions emerge when work processes are reorganized and the old mode of operation is rebelling against the new mode of operation. This can currently be seen in the introduction of voluntary building codes that relate directly to the sustainability of a building and its overall energy use and carbon-footprint. The slow adaptation of sustainability principles into the built environment industry is seen to cause friction especially in terms of trade and shared building projects with actors from a mode of operation that has sustainability principles imbedded into the law.

On the quaternary level, the mode of operation is not in balance with its environment. The building environment has a direct link with the economic, social and ecological environments it exists within. If the mode of operation, which is in this case the

integration of sustainability principles into buildings, does not feature as a principle method of property development then other areas of environment will bear the brunt of unsustainable production and consumption levels. The maintenance of the building will rise as will the emissions into the atmosphere. This will subsequently affect the body if society through a rise in health issues.

Network of activities

Therefore, since activities do not stand alone. The elements of one activity are produced by other activities and the outcome of one activity is usually needed in one or more other activities. This can be seen in the production and consumption cycles observed in the built environment industry. In order to have lighting in a building there needs to be a number of activities performed by various groups to attain the light fixture in the recommended space. This outcome begins at its most basic for of an actor conceptualising and designing the product up until the contractor installs it in the room. Mediation is needed between the activities and this is achieved by *means of networking.*

The uppermost level of activities and the network of activities provide an understanding of the chain of activities, where the product or the outcome of the service chain is produced. Usually we need a network of activities, including different *supporting activities* for example awareness campaigns to increase a change from incandescent light fittings to low energy light fittings and *producing activities* like the abovementioned light fitting production, to finalize the outcome. We can view this level as the clients' perspective, because the goal is to provide an outcome to the next activity and finally there is a final outcome, e.g., a healthy and comfortable building.

Sometimes it is very useful to climb even higher, to see the landscape of the social construction of different service providers in built environment industry. We have to consider the legislation, national programs and policies, competitors and so forth. Sometimes it is useful to see the global picture as well, to identify the international factors involved. Even if these uppermost levels are not described in detail, they usually have to be considered in development solutions. The standardizations of lighting fixtures and policies that govern the energy efficiency of buildings in other foreign countries are impacting local industry. This can be seen in the product literature and fitting available from these markets comes with this standardization imbedded in the design. The local industry can have a governance program that evaluates the type of products that are installed in the local built environment through collaborative networks.

Means of networking

The relations between activities usually need some means for networking and information sharing, to manage knowledge transfer. This networking can take different forms. In the built environment industry knowledge transfer from one group unit to another is currently done through written literature for example, pamphlets, brochures and technical specification pamphlets. This written literature is also available electronically on individual websites of the actors. Similarly policy changes are shared through open forums which seek to involve representatives from the policy and industry groups, but have a negligible representation from the practice group. To

create a whole picture of an activity network, it is crucial to describe the means of networking. The group activities should be linked together so as to allow them to validate each other in their impact to the built environment industry.

An overview of the operations and actions of the various actors shows the links inherent in such network of activities (Figure. 5.44). The green dashed lines indicate where there are contradictions that need to be evaluated to improve future collaboration between the activity groups.

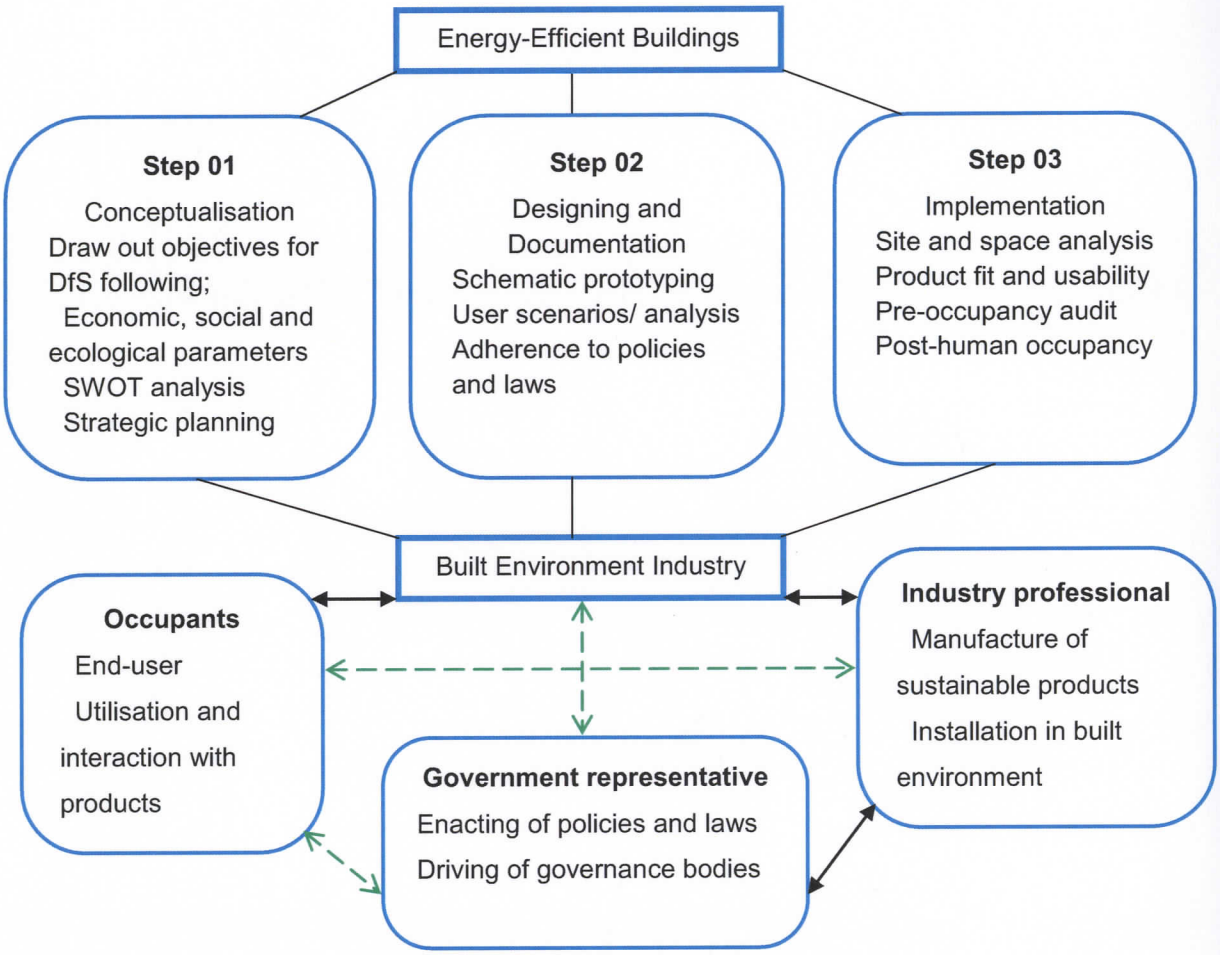


Figure 5.42: The built environment: An overview

The following activity analysis (Figure 5.43) elaborates on the above mentioned. The occupant and client rely on the industry professional to provide them with the relevant information pertaining to design and documentation of their office workplace. The contradictions seen to arise here are due to the failure on the part client to consult the written information availed to them by the industry expert. Similarly there is a failure on the part of the industry to take into consideration the lack of expertise knowledge when writing out informative literature. This lack of empathy from the industry's in high expectation of the actors in practice to understand industry jargon used frequently in these printed media. Further, the government representatives rely heavily on the voice of industry when enacting policies and laws in the built environment. This causes the government to act unfavourably toward the social aspect which impacts directly on the occupants in the office workplace.

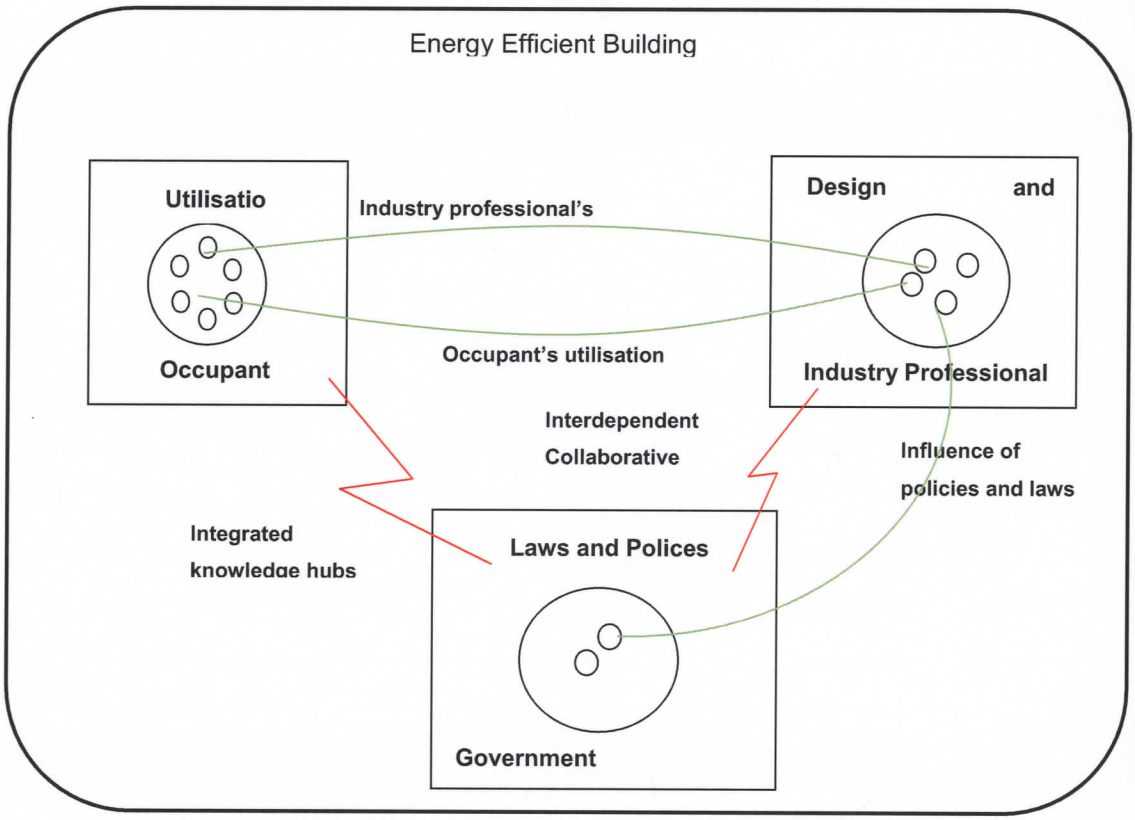


Figure 5.43: Activity analysis of the built environment

The activity analysis reveals the following implications to the built environment industry:

- The design of energy efficient products to be installed in office environments should take into consideration the occupant's perspectives as direct influence in sustainable product assessment.
- Industry professionals and groups should facilitate means of networking that incorporates basic informative written literature that can be used to raise awareness and improve utilisation of sustainable products and devices in the office workplace.

- Public forums both on the ground and electronic can be used by government bodies to drive governance and market integrated and interdependent approaches to policy creation.

5.5 Summary

Activity Theory has been used in this chapter to explain the inter-relations between the units of analysis that were used in the case study research. These groups share and transfer knowledge using various means of networking within the built environment thereby working toward energy-efficiency in buildings. But as extrapolated in the analysis these means of networking are not without their ineffectiveness. By aligning the ethos of *ubuntu* to influence the integration and interdependence of these means of networking collaborative networks can lead to improved relations through shared ownership. In the next chapter, a review of information gathered in the literature review shall be used to align the case study research ad resultant analysis. It is the intention of this research to recommend a guideline to alternative approach to means of networking.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The means of networking in the built environment as discussed in the previous chapter are directed to specific knowledge groups in the industry. The lack of transparency can be argued to exist in use of industry jargon to exclude actors from direct communication. In this chapter the main findings will be drawn together with results from previous chapters to give the study a coherent whole. Additionally, the results will be aligned so as to relate the conclusions to literature and theory found in the domain of design for sustainability in the built environment. Thereafter there shall be discussion of anomalies found during the case study research and place the study in industry where it has the most relevance to the actors within the network of the built environment industry. The chapter shall conclude with implications to policies that the research raises.

6.2 Revisiting the research objectives

The aim of the study was, to ascertain the role and importance of the occupant to the conceptualisation of the office workplace's interior environmental systems. The objectives of the case study research were as follows:

- Review the underlying factors in DfS that have seen to the radical change of design approach to introduce sustainability into the office workplace design.
- Investigate the influence of occupant awareness to PSS initiatives in the installation of the interior environmental systems in the office workplace design, currently in Cape Town.
- Extrapolate design characteristics in modern office designs that have been influenced by technological advancements: solution oriented partnerships.

6.3 Discussion of main findings obtained in study by drawing together results from previous chapters

In the introduction of this study, there is a drawn out conclusion that designers have became vehicles for change in the physical environment we inhabit. In conceptualising and designing interior spaces where an individual and groups perform activities, it is within the control of designers to cause direct influence in how actors in an interior space relate to each other and their exterior environment. This is done through the choice of physical boundaries created by the sub structure of a building and the envelop that contains it. Therefore, recommendations of light quality, acoustical quality, indoor air quality and thermal comfort are not subsequent results but predetermined results in the culmination of a design.

In determining the utilisation of these materials that are components for the manufacture of devices used for the development of interior spaces, the human aspect has to take greater priority. Due to high technological advancement there has been a high proliferation of 'new' materials in the building construction market. The economic and environmental advantages are seen to take precedence over social advantages. This is clearly seen in the linkages of respiratory diseases that are said to be caused by inhalation of carcinogenic fumes given off by especially fibreboards. The general public, due to lack of awareness of the technical aspects and specifications of these materials, are subjected to unhealthy environments.

As designers who recommend these materials for the client to put into office environments, where the occupant spends their working day in, it falls to this industry group expert to act as a catalyst for social change. This social change can be motivated through systems that encourage communication at different levels in organisations. This can lead to self organization and a process of learning, sharing and generation of social capital for management of complex adaptive systems (Folke *et al.*, 2005:448).

In understanding the different levels of the built environment as an organisation an exploratory study was performed at a small scale in Cape Town. At the most basic level the exploratory study investigated the stages followed by a client to engage deisgners when redesigning their office space. This was followed by obsevations and short informal interviews of a company dealing with office furniture and accessories. An alternative route of having your own office furniture lead to interviews with a local furniture deisgner and a propreiter of a furniture workshop. The basis of this expolratory research was to find out if and how the built environment industry relate to each other at their various organisational levels. The amount of information shared and the levels of interdependancy between the different technical knowledge apprent to the individual or group setting.

The information acquired from this study moved the research to set the literature review at assessing the industry's adaptability to the introduction of design for sustainability as a fundamental principle in interior design. Firstly, there was a need to understand what the built environment implemented as 'green' design. This was sectioned off as determining how the built environment takes into consideration the management of natural resources when conceptualising and designing an office building. Due to the fact that the office audit used currently in Cape Town is adapted from the Australia, the main office blocks reviewed were chosen from this geographical area. Interior design has adapted into its process technical recommendations that incorporate engineering and bio-mimicry. The office building is now considered as living organism that absorbs, metabolises and emits into its immediate surrounding. Thus sustainability is not just about the longevity of the building and its ability to perform after its (reason it was built). Technological advancement into the performance of the office building as seen in the local cases chosen is a high priority. This was especially observed in the use of energy by the building to create a healthy and comfortable interior environment. The advancements influenced the light quality in choice of orientation of the site and the envelope of the building, there was also consideration when assessing indoor air quality. The human aspect was asserted by allowing each individual in the building to have access to an exterior view.

These advancements are linked in theory to the creation of PSS which is directly connected to interior environmental systems. As summarised in the literature review where a PSS dealing with the provision of 'light' to its customers starts with a product assisted by a service provision to a complete service provision of renting out lumens. This has been integrated into sustainable buildings in the replacement of incandescent light fitting with energy efficient light fittings with automation control systems. In the PSS system this can be paced at the stage of use oriented PSS. This

then provides the occupant with direct control of their interior environmental system and thus their use of energy to provide a healthy and comfortable office workplace.

By allowing the occupant to be an active participant in the 'greening' of the office workplace there can be increase in the use of feedback to the construction industry. Though this is not seen as a used primarily as a source of data it can be a proactive measure to greater efficiencies in energy efficient office buildings. The information can then be made available to other actors within this network in the built environment industry.

These networks were reviewed under SOPs and are seen to be active in the generation of solutions within networks where the actors have a joint common outcome. The governance of these SOPs can be directed at government who could then use these networks to introduce, assess and promote governance involving stakeholder groups in the built environment industry. This can be integrated into the already existing ethos adapted by the Western Province Government, *Batho Pele*. *Batho Pele* is mainly about putting people first in the government provision of services. This can be perpetuated in the built environment by integrating principles of ubuntu which would promote collaboration between the stakeholder groups for the benefit of the society as large.

If by adopting the premise of putting people first is a proactive measure to adopting sustainability principles in the built environment industry, then co-design which advocates working with the end user can be adapted in the design process. By participating in peer-to-peer initiatives and as social actors facilitate the convergence of different actors toward shared ideas and potential solutions co-design can be promoted as a vehicle of more efficient office workplaces (Manzini, 2007).

According to Dees (2001:4) as a social entrepreneur the designer takes on the role of "an agent who adopt a mission to create and maintain social value, recognize and relentlessly pursue to serve that mission while engaging in process of continuous innovation, adaptation and learning". Using the platforms already existing in the governance organizations, the designer can contribute to the efficacy and efficiencies of the process by the including the occupant as an active actor in the design process.

To further the role that the occupants can play in the design process of an energy-efficient building, a qualitative case study of a recently retro-fitted office space within the central business district of Cape Town was performed. The case study followed in the guidelines stipulated by Yin (2009). This included; a case study protocol, case study database, sampling methods and sources of evidence to the inclusion of triangulation.

The case study was then analysed using thematic analysis and the data collected tabulated in matrixes. These matrixes were used to view what each stakeholder group assigned to the theme chosen. The themes were chosen according to the research questions stipulated in chapter one and guided the data collection and analysis process. The subsequent stakeholder analysis units emerged from the data collected during analysis, that is; practice, industry and policy. These analysis units were used in the following sections of analysis to promote continuity in the research.

These units are seen to exist in the built environment and are in constant flux as concerns their ability have knowledge transfer.

6.4 The relation of results and conclusions to the literature and theory in the domain of interior design in the built environment industry

The built environment as an industry and a physical environment exist in the same realm but seem to act as autonomous entities. As discussed in the literature when reviewing the buildings that have adopted sustainability principles into energy use of the building. The industry and by extension the government offers sustainability as a voluntary addition to the local built environment industry. Though physical environment is seen to have changed dramatically in direct relation to the unmitigated production and consumption cycles of property developments, policy remains the same. The industry sector as an organisation has fragmented groups that deem the relevance to one extreme as a fundamental objective to new developments, and at the other extreme as propaganda circulated to promote new taxes and financial gains through programs like CDM (control development mechanisms). The government by not engaging with practice and industry alike in the introduction of voluntary policy and law reduce the proactive role that policy could play in the reduction of use of natural resources.

The physical environment that encompasses the office building is currently less adaptable. This is due to the increase in carbon emissions and gases from other buildings and transport systems. The choice to open windows and doors to allow 'fresh' air into an office space is becoming evermore limited. The occupant then becomes a crucial actor in the network of actors in the design process. Being in direct contact with the impacts caused by activities performed by policy and industry they have a pivotal role to play in local implementation of sustainability principles. As discussed in the literature networks exist and depend on stakeholder groups that set it up. These network groups are divided by using differentiating language and forums. The occupants were then rightly seen to be unaware of the existence of these networks. This is because they are seen to be outside their relative concerns as end users. The networks in industry are seen as vehicles to govern and introduce innovation to the design process. The professional experts in the industry do not see these networks as a platform to exchange information and share knowledge. This causes knowledge gaps in the lack of collaboration between actors whose aim is seen to be a joint outcome by other stakeholder groups, that is the policy and practice stakeholder groups.

Therefore, in conclusion taking into consideration the abovementioned aspects arising in the built environment, a lack of transparency exists. The need to be the fore runner in innovation and introduction of seemingly new ideas into the industry is acting as deterrence for better communication. As products, devices and sustainability principles concerned with energy use in the market are observed to be imported from developed contexts. There is no reason for industry to refrain from creating and joining networks that would allow them to be more prudent in their choice of sustainable products and devices. This is important as some of the products as discussed in the literature are produced using elements that are harmful to the end user. These products can enter into the local market as most of the policies and laws governing the banning of these elements have not been adopted by the local

government. There can also be more effective methods of including the society in changing the production and consumption cycles. This is by taking into consideration the local context and ethos that are inherent to the environment. The principles of *ubuntu* can be used to allow for inclusiveness by allowing integrated and interdependent approaches to be adopted. These approaches could be seamlessly imbedded into the area of policy, where the local government already has a similar ethos under the banner of *Batho Pele*. These societal driven principles of approaching problems from a community based advantage as opposed to group or individual gain in the outcome can allow for all three aspects of sustainability to be taken into account, that is economic, social and ecology.

6.5 Discussion of anomalies and surprising results and whether results confirm/deviate from what was expected

The research in to governance of energy efficient buildings arose from the unexpected information gaps within industry concerning the underlying reasons behind the introduction of these products into the industry. The last climate change summit was held in Johannesburg, South Africa. It was interesting to discover that some of the actors within the industry stakeholder group did not take into consideration the conclusions reached in the summit. There are also the Marrakesh guidelines which impact directly on the built environment industry. The area of policy has held workshops that intend to introduce policies and knowledge sharing awareness initiatives. Since these initiatives would have to include the involvement of industry professionals it is in the best interest of all stakeholders involved to have inclusive forum so as to promote conviviality in the industry.

At the onset of the research, with the choice of case study it was expected that since the client was the company owner, sustainability principles installed into the space would be discussed with the client and the occupants of building. The lighting engineer recommended and installed the devices but neglected to give the end users appropriate information that would have been useful when altercations occurred with the system. As raised by the occupants the light sensors do not work at an optimum and it is only by closing the door does the system's sensitivity not cause the lights to switch on as a person passes by. This can be corrected by changing the beam angle of the light sensor inside the room to a smaller radius. By having open collaborative networks such ineffectiveness of systems can be addressed as the industry would have open networks to discuss utility and perpetuation of sustainability systems.

The association and guilds that are formed in industry have lost the influence of acting as vehicles of knowledge repositories. These repositories would act as means of knowledge transfer and think tanks where newly appointed actors to the industry can acquire information. Knowledge sharing and learning seem to happen in isolation and results implemented without the benefit of other input from other professional experts in the field.

Additionally, there was a propensity in the industry to use international products and retain international policy guidelines when installing sustainable devices. This shows a lack of support from both government and industry professionals in supporting local initiatives and in-context solutions to energy efficiency in office buildings. 'Local globalisation' (Manzini, 2007) which is a concept that endeavours to create solutions

locally that can be carried forward to the global market is a worthwhile route to take. This would mean the involvement of local actors working toward a joint outcome where *ubuntu* can be used to enhance equity and cohesion.

6.6 Ambiguities in the resultant data not explained in the theory of framework chosen

The role of technology in the design process

Technology features as a large influence in the advancement of elements in the design process. These elements range from tools used in conceptualisation to the ultimate installation of the products into the interior environment. Gauging the impact of technology on the innovations that are currently seen in the implementing of sustainability principles into the interior environmental systems is crucial. Activity Theory is best applied when observing networking systems that investigate means of networking between actors in an environment. It is therefore not feasible to use the theory to investigate the role of technology as an actor within the environment. As technology exists today it can be used to assess the effectiveness of interior environmental systems and calibrate the said systems to better suit the occupants' needs. This can be viewed as technology acting in an autonomous position without the direct influence of the occupant or client utilising the space.

The idea of artificial technology is a daily occurring phenomenon in interior environments. Lighting that uses daylight sensors to dim artificial lighting as the need occurs, uses some form of artificial intelligence. A theory that can allow for inanimate objects and systems to be categorised within its framework as separate entities would have added an interesting perspective to the research. This would also allow other actors in the network to adopt technology geared methodologies when sharing knowledge within networks. There was, as observed in the data collection stage, a use of websites to create awareness and share knowledge. This mainly did not reach the desired target because industry uses blogs, professional networks among other tools to share information. The companies that have an interest in building knowledge hubs would need to adopt a system that can be customised by actors so as to provide desired information. This aspect of *means of networking* was not followed as the theory did not cater for this type of investigation.

The role of ecology and economic aspects in the laying down of goals and objectives of an activity

Ecology in the design process plays an important function as all property developments are built in a physical environment that affects the exiting ecological system. The view that buildings should be designed using bio-mimicry is not without just cause. Having been constructed using materials and components that absorb from the atmosphere and consequently after performing its primary function emits back into the same atmosphere; local ecological systems adapt. It is within this frame that part of the activity should be based upon. As actors go through the work process defined in activity theory, the object also takes part indirectly performing actions that influence the outcome. The severities of these actions are controlled by the adherence of the construction, in both material selection and interior environmental system processes, to sustainability principles. This aspect of the design process is a fundamental part if one is to create a healthy and comfortable environment for the

occupant, but only allays the real health issues which can be found in the exterior environment.

Consequently with the renewed aspect of energy-efficient building that take into consideration the local exterior environment, is the economic aspect. Industry in its haste to adapt international standards so as to construct more sustainable buildings is importing, both intellectual property and building components. In the theory used to collect the data there was no avenue to follow through on the influence of competition to the desired joint outcome of the actors. This was because the information used by the industry that was influenced by international policy was not seen in the units of analysis. Consequently, the units did not further fragment to take into account the impacts of micro-networks within the stakeholder groups that influence goals of actors. It is therefore within the interest of the research to delve more into the impact of the choices made by industry on both the economic and ecological aspects in the local environment. The data collected from these areas would have illustrated the nuances in industry that have a direct impact on components and devices installed in energy-efficient buildings.

Vehicle for driving joint outcomes that are hinged on the same objectives drawn from DfS principles

As propositioned in the previous section there needs to a collective responsibility for sustainability principles implemented in the local environment. If this is to be done in a manner that involves all stakeholders within the built environment, a self-governing body can be the vehicle that drives it. The said vehicle should be advocated by the government and enacted under the building codes of South Africa to ensure the industry professionals within the self-governing body have aligned objectives that follow policy and law. The main aspects of DfS are that an initiative should take into consideration the economic, environmental/ecological and social aspects. When advocating for self-governance in the built environment industry in the adopting of sustainability principles into energy-efficient buildings, these aspects should ring clear in the goals of the object. The governance bodies that were part of the study and fitted into the industry stakeholder analysis unit were mainly concerned with the economic and ecological aspect. The social aspect which would include the occupant and client were not dealt with sufficiently. As these actors fall under the unit analysis of practice it was taken into consideration the impact they would have in context to unconscious societal behavioural changes. Behavioural changes at the societal level were not an aspect that fitted into the theory used but were considered as peripheral influences to the work process.

The process of design is one that pertains to the society in its need for healthy and comfortable shelter. The behavioural changes in society have a direct influence on what designers build in the environment and the interior spaces therein. Activity theory observes the work process from the principle of the actions done by actors working toward a jointly desired outcome. These actions are not considered to be driven by behavioural changes that have occurred due to technological advancements and integration of societies from varying communities. This incidental trait that was observed in the occupants, whom background varied from local to Eastern European, can be considered to be an operation which would progress to an

action in the activity. This inclusion of a societal aspect as an action would have provided a holistic approach to occupant influence on the design process.

6.7 Relevance and value of the study

In the construction industry as observed in Cape Town's Central Business District, energy efficiency is an aspect property developers are seeing integrated into projects with growing regularity. Though not so much for its social impacts but more so for the economical gains in facilities management and the positive ecological impacts the building would have. This falls in place with the research as it draws together the areas that are growing where sustainability principles are implemented. The built environment industry has come to the point where they are met with the influence occupants in a sustainable building have on its running costs. This aspect of sustainability that can bring to the light the social aspect of the built environment into the area of priority; social capital can impart great positive influence in the design process. As awareness grows at the societal level, sustainability has the ability to impart a greater influence in the way communities relate to each other and their physical environment.

In line with the above objective, this would impact on the assessment of energy levels used in office buildings. With the onset of trading in carbon emissions, cities with creative communities involved with commercial building that are committed to energy efficiency can have a positive input to the provincial government's economy. This can be seen in the introduction of CDM in the adaptation of sustainable buildings in the greater Cape Town area. One example of this is the retro-fitting initiative in Cape Town's Central Business District of chosen government buildings, with the collaboration of CORAID a Dutch aid organisation, taken up by the Cape Town Partnership. Created under the Kyoto Protocol, the CDM was designed to help developed nations meet domestic greenhouse gas (GHG) reduction commitments by investing in low-cost emission reduction projects in developing countries (Cheng *et al.,* 2008). Since this time South Africa and Cape Town in particular has taken up reducing carbon emissions as a fundamental objective in new commercial construction. In doing so, it is important for the industry to consider the influence occupancy awareness plays in EEB and the governance of these newly appointed features in the built environment industry.

South Africa has ratified the United Nations Framework Convention on Climate Change and its Kyoto Protocol and plays a proactive role in the climate negotiations (Milford, 2009). In so doing occupant awareness and utilisation of sustainability products in office buildings brings to the fore the objectives of these abovementioned areas in government. The increase of conscious behavioural changes in society can have a positive influence in the rapid change of EEB and their reduction of carbon emissions into the atmosphere. This can be seen in the decreasing of carbon emissions of buildings to the atmosphere. As recent publications will show Cooke (2010) states "the Public Transport Shared Services Centre (PTSSC) is a provincial government building in Cape Town. This is intended to demonstrate leadership in sustainable construction through shared resources; a response to the critical need for infrastructure essential to transport, and to make a confidence-building investment of the state in an area of socio-economic and functional need." In articulating the need o

build confidence and attune the building to be connected with the people it serves as opposed to the organisation it represents, the occupant is elevated in the list of design priorities. As illustrated in the figure below, the building takes into consideration ecological aspects in the orientation and design of the building. The interior accommodates the needs of the occupant in its four indoor elements; thermal comfort, lighting quality, acoustics and indoor air quality. This element of occupant awareness, intended to change the design thinking in the built environment industry from being product oriented to user oriented, was one of the main objectives of the research.

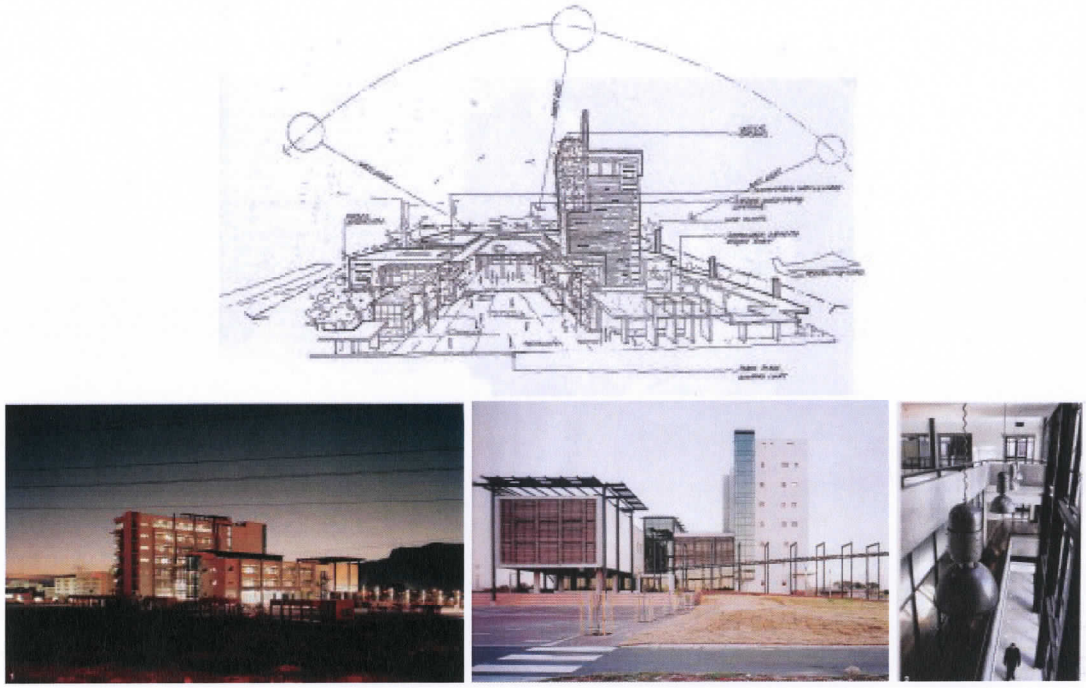
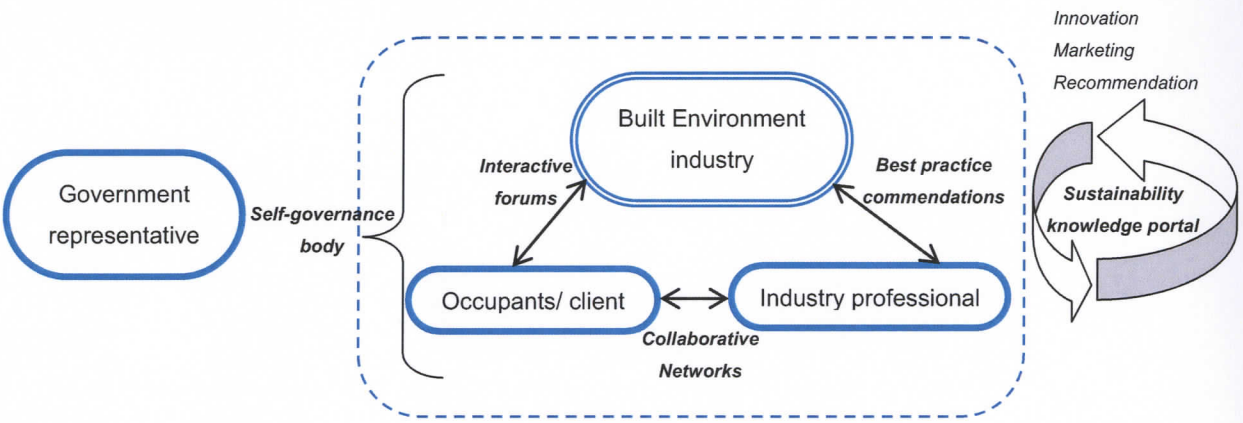


Figure 6.44: Implementation of sustainable building practices at the PTSCC in Bridgetown, Cape Town

(Cooke, 2010)

Sequentially, to the increase of adaptation of sustainability principles in the built environment industry, there is a growth in the market of a proliferation of consultants who have expertise in these areas leaving the designer and architects who conceptualise the buildings with a knowledge gap. As stated by Raman (2010) "architects (and designers) tend to rely on ...contractors' know how, manufactures recommendations and advice from engineers and other specialists." The creation of a collaborative network would provide a platform where the designer and architect can broaden their knowledge on construction and interior components that they recommend and use in buildings. This would reduce costs and improve the efficiencies of the design process and resultant design.

6.8 Recommendation regarding implementation of findings and possible policy implications



- Collaborative networks created to liaison between the actors of industry and practice can be used to disseminate information and create greater awareness.
- Interactive forums run by the industry groups can be formulated to provide access to actors in practice who want to deliberate with professionals on current innovations in industry.
- The built environment industry can through a series of best practice commendations can bring to the fore local technological advancements that can be adapted by other industry experts. These would serve as a means of giving industry innovators a sense of recognition and create a healthy competitive environment.

The government as a body that is seen to be outside the interaction that happens in the construction and running of energy efficient buildings in Cape Town can drive *self-governing bodies*. These self-governing bodies can act as vehicles to collect information relevant for policy creation and amendments for the government. As a societal body it would act as a forum for the actors in practice and industry to relate with government in a transparent and flat organisational structure.

The *sustainability knowledge portal* can work in conjunction with the self-governing body as a means of communication of the industry and the government bodies related to elements of sustainability in the built environment.

6.9 Gaps and uncertainties that might require further scholarship.

Consequently with the renewed aspect of energy-efficient building that take into consideration the local environment, is the economic aspect. Industry in its haste to adapt international standards so as to construct more sustainable buildings is importing, both intellectual property and building components. This lays a hardship on local industry whose innovation is unable to compete with these new in coming products and technological advancements. If the local industry is to have a firm hold in the market as concerns the advent of energy efficiency there needs to arise champions of energy efficient buildings geared towards "local globalisation" (Manzini, 2007).

There is a lot that can be seen to be moving toward bridging this gap in practice. Constructions in current work mode are "building according international green and sustainable standards" (Cornish, a2010). But as seen in the case study that was done in Cape Town's Central Business District in the research it stands also in other projects that, "most of the green elements such as skylight and ceilings are imported from overseas" (*ibid*). This importing of sustainable construction elements causes the local industry to lag behind and miss out on economic opportunities and technological advancements. The built environment is now categorising their projects as "green projects" (Cornish, a2010), which will be a continuing change in the industry.

The new Pick n Pay in Randburg is using, under VMB Consultants, a combination of a refrigeration plant with a thermal storage system. This new technology a first in South Africa and recommended and installed by a local company; this can be seen as a good start to 'local to global' improvisation in the construction industry. The innovation of these construction methods and implementing of sustainability principles that take the local climate into account should be hailed as 'good practice'. In terms of lighting manufacturers are gearing up to alleviate the growing imports of technologically advanced light fittings. As mentioned earlier in the research, dimmable LEDs are expensive as most of the fittings are imported from other sources. But according to Cornish (b2010), Radiant Lighting is now offering locally assembled dimmable LEDs.

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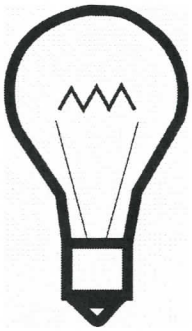
Appendix A: Introduction Pamphlet

PURPOSE OF MY STUDY



To create an understanding between the end-user and the interior designer through co-design systems approach. Furthermore, to integrate an environmental and economic aspect to the concept and final design intervention created. This would lead to a decrease in the compromise of natural resources.

The proposed case study will research the usage of space by employees and other stakeholders who inhabit the space. Efficient use of interior spaces in the office workplace can be drawn upon to improve work relations and interactions. This employee well-being touches on ergonomics and

To achieve the aforementioned objectives a qualitative approach will be used. This will include: interviews, observations and document analysis. To attain holistic results projective techniques which will see the use of story boards, story spots and interaction maps will be used. Through these techniques individual needs will then be grouped to form profiles/personas to assist in the next phase of the research.

Mary Wairimu Maina
Studying towards an Mtech in Design at CPUT
www.wairimumm@gmail.com

Appendix B: Framework for health and comfort

HUMAN MODEL

BUILDING RELATED INDICATORS

Labels

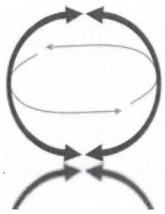
Labelling is a policy measure for stakeholders to include indoor environment in their daily business. It is a way of raising awareness and it helps to make choices. In Europe a standardization organ CENT C 351 is developing a harmonized testing scheme for emissions of construction products which could form the base for a construction product labelling system. Labels linked to sustainability as they exist today do not include the detailed information required to identify sources of exposures encountered in the indoor environment that influences the quality of life (health and comfort). Cautions must be adopted to avoid that improvement in sustainability may cause decrease in quality of life (health and comfort of the occupant or end-users). A label on product level, will at least ascertain that the total emissions of product are controlled or reduced and therefore the exposure is better controlled.

Measures

The control of the indoor environment factors has merely been focused on the prevention or curing of the different related observed physical effects in a mostly isolated way: thus trying to find solutions for thermal comfort, lighting quality, sound quality and air quality separately.

However, it should be noted that the traditional over-the-bench methodology for the design and construction of a building is not suitable for incorporating these measures efficiently. An interactive top-down approach is required, both for the communication process required facilitating the design, construction and maintenance and operation of an indoor environment and for the establishment of end-users wishes and demands (requirements and needs). This approach requires a clear framework that makes the links between the different phases of a building clear to all stakeholders.

1. How and why do people respond (physical, physiological and psychological) to combinations of positive and negative stress factors (air quality, thermal comfort, noise and lighting quality)
2. Which physiological, neurological and psychological mechanisms can be used to explain these responses?
3. Can we develop a subjective indicator for the negative effects (irritation, annoyance, fear...) and for the positive effects (pleasure, happiness, well-being...)?
4. How can we predict certain responses and/or other behaviour in certain situations?
5. What are our basic needs? Do we 'need' constant conditions during eight hours deskwork?



INDOOR ENVIRONMENT

	Thermal comfort	Lighting quality	Acoustical quality	Air quality
Parameters	Temperature (air and radiant) Relative humidity air velocity Turbulence intensity Activity and clothing	Luminance and illumination Reflectance, colour temperature and colour index o view and daylight frequencies	Sound levels frequencies duration absorption characteristics sound insulation reverberation time	Pollution sources and air concentrations. Types of pollutants (allergic, irritation, carcinogenic, etc.) ventilation rates and efficiency
Control	Heating and cooling air- conditioning systems Design of building and components	Luminance distribution integration artificial and natural lighting Daylight entrance	Acoustical control passive noise control active noise control	Source control ventilation systems. Maintenance Air cleaning activity control
Issues	Dynamic effects adaptation Integration systems with building (facade, floor and ceiling)energy use	Daylight entrance in relation with thermal comfort and energy use Health effects and control	Long term health effects vibrations and annoyance relation noise, type and annoyance	Interpretation and detection Secondary pollution (indoor chemistry and micro-organism) Fine dust Energy use

CONTROL

In the view of increasing smart control systems in our society, it is therefore important to investigate:

1. The relation between control, by yourself versus for you, and perception of well-being
2. What do people do and why they do it in relation the type of controls required?
3. What do people want versus what do people need?
4. Local personalised environments in relation to needs of individuals: what, when and where?
5. How do you provide people feedback, what do they expect to happen after they do something to adjust their environment? (e.g. adjust thermostat)

Focusing on retrofitting: The focus on energy-efficiency requirements (which then impact on emission reductions) is to date somewhat biased towards new buildings, whereas an increasing focus is required on the legacy of energy inefficient buildings that exists.

Specifically, policy options along the line of those required in the UK, Australia and others requiring selected retrofitting of commercial and residential buildings on the change of ownership should be investigated and developed. Furthermore, the development of a Green Star SA-rating tool for existing buildings that could be used as a basis or performance standard for existing buildings should be encouraged.

Appendix C: Consent letter

Study title Sustainable oriented partnerships toward a PSS in the office workplace

Investigator Mary Wairimu Maina, Master's Candidate

Ms. Maina is a master's candidate studying the aspects that influence the interior design of the office workplace from the end-users' perspectives. There will be reference to the integration of systemic approaches to the conceptualisation and design development process. Although the study might not benefit you directly, it will provide information that might enable designers and educators to incorporate design for sustainability features that might be beneficial to the widest possible range of potential users of product systems and the built environment.

The study supervisors and other appropriate authorities at the Cape Peninsula University of Technology (CPUT), in the Western Cape Province, have approved the study and its procedures. The study procedures involve no foreseeable risk or harm to you. This procedure includes:

1. Responding to questionnaires about your response to the needs met by the interior aspects in your workplace.

2. Taking part in projective technique studies to be done during interviews with willing participants in your office workplace.

3. Observation of the use and efficiencies of the interior spaces.

Please feel free to ask any questions about the study or about being a subject, you may call Ms. Maina at 0749707032 if you have any further questions. Additionally, you can contact her via email: wairimumm@gmail.com

Your participation in this study is voluntary; you are under no obligation to participate and you have the right to withdraw at any time should you choose to.

The study data will be coded so they will be no link to your name. your identity will not be revealed while the study is being conducted or when the study is reported or published unless you give explicit consent for the same. To ensure anonymity and confidentiality, all study data will be collected by Ms. Maina, stored in a secure place, and shall not be shared with any other person without your permission.

I have read this consent form and voluntarily consent to participate in the study

Signature of Participant Date

Signature of Witness Date

I have explained this study to the above subject and have sought his/her understanding for informed consent

Signature of Investigator Date

Appendix D: Matrix for observations

Interior dimension	Aspects in design		**Innovations in DfS**
Floor	MATERIAL	Porcelain tiles demarcating space by differentiation through using gloss and matt finishes.	What materials and methods are used to attain the gloss and matt finish on the tiles? Are these methods sustainable and do the materials enhance occupants' well-being?
	FUNCTION	Leads the occupant toward steps and signifies privacy	
	AESTHETICS	Decorative	
Wall	MATERIAL	Textured plaster fixed on a timber stud framework. Glass fitted to the gypsum plaster board.	What material is used to give off the sand paper effect that is extruded from the plaster? Do these materials have resins/ plastics that emit any VOCs? And if so how can the current interior systems decrease the effects?
	FUNCTION	Improve acoustics and demarcate public and private spaces	
	AESTHETICS	Give a line of continuity and the visual sense of an expansive space	
Ceiling	MATERIAL	Gypsum board in a smooth finish	What is behind the acoustic ceiling? There is a mixture of tungsten and LED white light, is there a functional or aesthetic reason for it? Do the luminaries emit anything into the atmosphere?
	FUNCTION	Cushion the noise and improve acoustics	
	AESTHETICS	The smooth finish allows for recessed lighting to act as a visual break	
Seating	MATERIAL	Brocade fabric sewn together and pinned to the framework	If the leg supports are made from veneer do the glues contain formaldehyde?
	FUNCTION	Soften transition from the external (lift) to the internal (offices)	
	AESTHETICS	A soft feel with an informal feel	
Window treatment	MATERIAL	Blackout lining with a velvet curtain fabric	
	FUNCTION	Add to the soft ambience created by the seating	
	AESTHETICS	Complements the seating and affirms the informal setting	
Accessories	MATERIAL	Grey tinted Perspex top with light steel coated supports Plant in a grey coated wrapped pot	
	FUNCTION	To add to the informal setting	
	AESTHETICS	Introduces a colour to the stark palette in the reception	

Appendix E: Interview schedule

CONTENT

INDICATORS
These include: indoor air quality, thermal comfort, acoustical quality and visual quality

HUMAN MODEL

Researchers' notes

QUESTIONNAIRE SCHEDULE

Informed consent to perform a **recorded interview** for the purpose of collecting information toward a **masters in Design** under the topic ' **A PSS for Solution oriented partnerships in the office workplace in Cape Town's CBD'.**

Participant _____

Researcher _____

Date _____

How and why do people respond (physical, physiological and psychological) to combinations of positive and negative environmental stress factors (air quality, thermal comfort, noise and lighting)?

Which physical, physiological, neurological and psychological mechanisms can be used to explain these responses?

How can we predict certain responses and/or behaviour in certain situations?

What are our basic needs? Do we 'need' constant conditions during and eight hours deskwork?

Appendix F: Journaling matrix

	CASE STUDY PROTOCOL TOPIC:	Design for sustainability in the office workplace	**DATE:**
	TOPIC:	Sustainability and how it attains meaning in the organisation	**REFERENCE:**
	RESEARCH INSTRUMENT:	Participant observation	**DATE PERFORMED:**
	CONTENT:	Data transmuted to information guiding the case study report	

Appendix G: Data collection activities

TIME ALLOCATED	ACTIVITY	DESCRIPTION
March 2010 - August 2010	**OBSERVATIONS**	Sporadic on-site observation over a period of six months
March 2010 - June 2010	**INTERVIEWS**	Occupant interview; industry professional interviews and government representative interviews
March 2010 - August 2010	**JOURNALING**	Researcher's reflective journal
March 2010 - June 2010	**FIELD NOTES**	Keep a record of any occurrences during interviews